THESES ABSTRACTS OF ANGRAU & PJ TSAU - 2013

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ABSTRACT

The study was conducted in Chittoor district of Andhra Pradesh with an overall objective of identifying and analyzing the optimality and sustainability of different farming systems. The relevant data were collected from both primary and secondary sources and were analyzed using tabular and functional analysis.

Major farming systems identified in the study area were FS-I (crop production and dairy enterprises), FS-II (crop production and poultry enterprises) and FS-III (crop production and sheep rearing enterprises). The gross returns in FS-I was `456151.45 while total cost was `282908.19 with net returns of `173,243.26 which was found to be most profitable one. Higher net returns were due to the rearing of dairy animals in the FS-I, followed by FS-II and FS-III with net returns of `171810.47 and `138500, respectively.

The functional analysis revealed that FYM, and phosphorous in kharif groundnut, seed, nitrogen, human labor and bullock labour in rabi groundnut, seed and human labour in kharif paddy, seed nitrogen bullock labour and phosphorous in rabi paddy, human labour in bajra, seed FYM, human labour and nitrogen in sugarcane and dry fodder and human labour in farming system - I significantly contributed to the increase in the crop yields and income from dairy. The MVP to MFC ratio was greater than unity for phosphourous in kharif groundnut, seed and bullock labour in rabi groundnut and rabi paddy, human labour in bajra, seed and nitrogen in sugarcane and human labour in dairy in the farming system -I indicating greater potentiality for further use.

In the case of farming system –II seed, nitrogen and human labour in kharif groundnut, seed, FYM and potash in rabi groundnut, FYM, phosphorous and bullock labour in kharif paddy, seed and phosphorous in rabi paddy, human labour in ragi, seed in fodder jowar and poultry feed and medicine in poultry rearing significantly contributed to the increase in the crop yields and income from poultry. The MVP to MFC ratio was greater than unity for seed and nitrogen in kharif groundnut, phosphorous and bullock
labour in *rabi* paddy, human labour in ragi, seed in jowar and medicine in poultry in the farming system -II indicating greater potentiality for further use.

In the case of farming system – III seed, FYM and human labour in *kharif* groundnut, nitrogen and phosphorous in *rabi* groundnut, seed, human labour and bullock labour in *kharif* paddy, bullock labour, FYM and phosphorous in *rabi* paddy, and green grass and human labour in sheep rearing significantly contributed to the increase in the crop yields and income from sheep rearing. The MVP to MFC ratio was greater than unity for seed, FYM and human labour in *kharif* groundnut, nitrogen in *rabi* groundnut, seed in paddy *kharif*, FYM in *rabi* paddy and green grass and human labour in sheep rearing in the farming system -III indicating greater potentiality for further use.
AGRICULTURAL ECONOMICS

Author : BHARATH KUMAR REDDY, L.
Title of the thesis : AN ECONOMIC ANALYSIS OF RAINFED FARMING IN CHITTOOR DISTRICT OF ANDHRA PRADESH
Major Advisor : M.S. MACHI RAJU
Degree : M.Sc. (Ag.)
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D 9628

ABSTRACT

The present study entitled "An Economic Analysis of Rainfed Farming in Chittoor District of Andhra Pradesh" was intended to examine costs and returns and resource use efficiency in the cultivation of rainfed crops. The study covered two mandals and four villages. A sample of 80 farmers was selected at random from the four villages. The primary data for the year 2011-2012 were collected through a pretested schedule by survey method. Conventional and functional analyses were used to analyze the data and to arrive at valid conclusions.

The cost of cultivation of groundnut, red gram, sunflower, bajra, jowar and ragi was estimated at Rs.32,540.96, Rs.21,550.50, Rs.22,372.04, Rs.19,360.84, Rs.19,111.46 and Rs.19,039.72 per hectare respectively. The cost of cultivation was highest in the case of groundnut followed by sunflower and redgram.

On an average, the selected farmers produced 10.5 quintals of groundnut, 9.50 quintals of redgram, 11.00 quintals of sunflower, 11 quintals of bajra, 16 quintals of jowar and 14 quintals of ragi.

The findings of the study indicated that sample farmers incurred Rs.3,099.13, Rs.2,268.47, Rs.2,033.82, Rs.1,760.07, Rs.1,194.46 and Rs.1,359.72 for producing a quintal of aforesaid crops. The cost of production was highest in groundnut followed by sunflower and redgram.
The gross and net returns per hectare of groundnut, redgram, sunflower, bajra, jowar and ragi were Rs.40,875.00 and Rs.8,334.04, Rs.28,500.00 and Rs.6,949.50, Rs.32,000.00 and Rs.8,627.96, Rs.27,250 and Rs.7,889.16, Rs.26,900 and Rs.7,788.54 and Rs.25,875 and Rs.6,835 respectively. It is interesting to note that the net income per rupee of expenditure was highest in the cultivation of bajra (Re.0.40) followed by sunflower (Re.0.38) and redgram (Re.0.32).

The functional analysis revealed that seeds and manures in groundnut and sunflower, human labour and cattle labour in redgram significantly contributed to the increase in the yields.

**AGRICULTURAL ECONOMICS**

Author : MANASA VEENA, G.

Title of the thesis : ECONOMICS OF PRODUCTION OF MANGO UNDER DRIP AND SURFACE IRRIGATION SYSTEMS IN CHITTOOR DISTRICT

Major Advisor : B. PRATAPA REDDY

Degree : M.Sc. (Ag.)

College : S.V. AGRICULTURAL COLLEGE, TIRUPATI

Accession Number : D 9626

**ABSTRACT**

The present study entitled “Economics of production of mango under drip and surface irrigation systems in Chittoor district” was intended to examine costs and returns, investment pattern and capital productivity in the production of mango under drip and surface irrigation systems. Incidentally, the study of value addition was also attempted as one of the objectives. It was carried out in Chittoor district of Andhra Pradesh. Two mandals that ranked first and second under mango area were purposively selected. Two villages from each selected mandal with surface and drip irrigation systems were selected at random. The list of all mango farmers from selected villages was prepared and the farmers were categorized into two groups viz., farmers with surface irrigation and farmers with drip irrigation. From each of the selected village, ten farmers in each group were selected at random. Thus forty farmers from each surface and drip irrigated systems constituted the sample for the study. The total sample was eighty. The primary data were collected by survey method through well structured schedule for the agricultural year 2011-2012. The data were analyzed by using conventional analysis and project evaluation techniques.
The total costs for entire life span of the mango orchard worked out to `22,85,671.42 on surface irrigated farms against `23,04,545.80 on drip irrigated farms. The operational and fixed costs accounted for 51.78 and 48.22 per cent on surface irrigated farms and 45.88 and 54.12 per cent on drip irrigated farms.

The total yield obtained from 5th year to 40th year was 682.68 tonnes on surface irrigated farms whereas on drip irrigated farms it was 734.31 tonnes per hectare. The total gross and net returns were `54,61,400, `32,97,855.20 and `58,74,480, `36,92,631.50 per hectare on the aforesaid farms respectively.

The project evaluation techniques revealed that mango production was economically more viable under drip irrigation than under conventional surface irrigation. The net present value and benefit-cost ratio were `32,499.71 and 1.54 on surface irrigated farms and `67,531.15 and 2.77 on drip irrigated farms at higher discount rate (24 per cent) reflecting higher productivity of capital on the latter. Internal rate of return was calculated at 34.85 and 61.35 per cent on these farms in the same order, which was higher than the borrowed rate of interest i.e., 10 per cent.

The processing cost for per tonne of mango pulp was `20,915.34 and it resulted in a net income of `1,584.66.
India is the largest producer of oilseeds in the world. In Andhra Pradesh, Anantpur district for groundnut, Kurnool district for sunflower and Adilabad district for soybean crop were purposively selected for studying three major oilseed crops.

The study is undertaken with following objectives:

1. to study the farm structure, cropping pattern and profitability of major edible oilseeds in Andhra Pradesh
2. to map the value chain of selected edible oilseed crops
3. to study the value addition and workout profit margins along the value chain
4. to examine the level of integration and assess constraints in the present value chain

The size of land holding pattern in the study area showed that about 57.5 per cent of the farmers are marginal and small farmers. The average value of investment made on implements (₹ 58678/farm) and average value of livestock and poultry per farm (₹ 75393/farm) was highest in sunflower farmers of Kurnool. The cost of cultivation of groundnut, sunflower and soybean are ₹ 35764.0/ha, ₹ 24965.8/ha, ₹ 22001.7/ha in the respective districts of study area. In Andhra Pradesh, Anantpur district groundnut is a major crop cultivated with an area of 6.61 lakh ha, which accounted to 49.63 per cent of groundnut area in the state. Kurnool district recorded an area of 1.74 lakh ha (39.04 per cent) of the total state’s sunflower area i.e, 4.46 lakh ha. Similarly, Adilabad district registered 81.9 per cent of soybean cultivated area in Andhra Pradesh. Therefore these three districts i.e, Anantpur for groundnut, Kurnool for sunflower crop and Adilabad for soybean crop were purposively selected.

Profitability of groundnut, sunflower and soybean in the study area can be concluded that the farmers in all three crops studied were earning profits. Mapping the groundnut value chain gave three value added first the groundnut Hand Picked Selected seed, groundnut refined oil and groundnut chikky. Sunflower value chain map revealed that almost all the produced sunflower seed goes for processing as sunflower refined oil. Soybean in Adilabad district identified soybean refined oil, soymilk, soy paneer, soynuts, Soy instant foods and soy papads.

The value addition and profit margins calculated for groundnut HPS seed, refined oil and chikky concluded that benefits are enjoyed by few farmers only just as in case of HPS seed. Such knowledge provided to him may help to decide about the quality production and link up with desired sub value chain. Sunflower value addition showed that when one quintal of sunflower seed is processed to crude, it gives a value addition of ₹48 per quintal over and above the value addition costs till crude oil is extracted, further the crude oil obtained is used to extract refined oil resulting in value addition of ₹ 217 per quintal, after meeting the expenses of value addition. The by product obtained along with crude oil is used extract solvent oil from which refined solvent oil is extracted. Cost of value addition was presented when one quintal of soybean is processed for various products.

Market co-integration was calculated for major groundnut markets Kurnool Anantpur and Adoni markets and for sunflower major markets identified are Kurnool and Adoni. Integration tests like correlation coefficient and Dicky Fuller test and AEG tests showed that they are cointegrated. The major constraints faced by groundnut farmers in Anantpur district, Kurnool sunflower farmers and Adilabad soybean farmers were ranked using garette scores. The major constraint they faced were lack of storage facilities for their produce, low price offered to them at the time of harvest, transportation and commission charges in the AMC’s. The constraints faced by the traders, processors of major edible oilseeds are power holidays and 5 per cent VAT on the sale value. The soy food processors like soy milk, nuts, paneer and soy instant foods manufacturers also
mentioned seven major constraints which ranked by the order of merit using Garette scores.

Conclusions and policy implications suggested for groundnut are good quality seed, timely seed subsidy and suitable seed storage structures for harvested produce. Contract farming is to be promoted for oilseeds cultivation by the processing industry. Traders of groundnut seed and oil opined that groundnut good seed is exported and edible oils are imported from other countries. If the same good grain is gone for oil extraction good healthy quality oil can be made available to the consumer. Sunflower farmers are troubled and incurred heavy losses due to downy mildew and necrosis which attacks the crop after flowering, low price for the harvested produce and they found chickpea and cotton and castor lucrative which can give good yield even in little rains and they even had good market. Due to this crop shift sunflower crushing and expelling units are affected. Soybean farmers despite the drought and monsoon vagaries were not happy with the price they received for soybean and the facilities of road transport facilities and market facilities are also a problem. It is also a crop worth a lot of value added products and little processing needed there is a scope of employment generation if government could provide efficient training to the rural youth and unemployed people.

AGRICULTURAL ECONOMICS

Author : SITARAMBABU, V.
Title of the thesis : IMPACT ASSESSMENT OF ANDHRA PRADESH RURAL EMPLOYMENT GUARANTEE SCHEME UNDER MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE ACT
Major Advisor : Dr. D.VISHNU SANKAR RAO
Degree : Ph. D.
ABSTRACT

The present study “Impact assessment of Andhra Pradesh Rural Employment Guarantee Scheme under Mahatma Gandhi National Rural Employment Guarantee Act” was undertaken with the following specific objectives.

- To study the impact of Andhra Pradesh Rural Employment Guarantee scheme on livelihood Security of people in rural areas.
- To study the impact of Andhra Pradesh Rural Employment Guarantee scheme on Eco-restoration and regeneration of natural resource base for sustainable rural livelihood.
- To study the impact of Andhra Pradesh Rural Employment Guarantee scheme on Creation of durable community, social and economic assets and infrastructure Development in rural Areas of Andhra Pradesh.
- To study the constraints in implementation of the scheme by different stakeholders.

Multistage sampling technique was adopted to select the sampling units. The Andhra Pradesh state stood top position in implementing the MGNREGS works on qualitative grounds at all India level. Anantapur district in Rayalaseema region, Mahabubnagar district in Telangana region and Srikakulam district in Coastal Andhra region were selected based on the criteria of highest expenditure incurred and total works completed. Three mandals and two villages from each district were selected based on the above criteria. From each village 10 beneficiaries were selected randomly. Thus the total sample for the study consists of 180 beneficiaries three districts, nine mandals and 18 villages. Primary data were collected through a well prepared questionnaire. Tabular analysis, percentage analysis paired ‘t’ test, real wages, investment, income, employment multiplier ratios MPC and Multiplier effect, Garrett’s ranking technique, regression analysis and discriminant analysis techniques were used to analyze the data.

The MGNREGS, since its inception (2005-06 to 2010-11) had provided wage employment to 9374078 lakhs households generating 18907041 lakhs of individuals in Andhra Pradesh. The percentage of employment provided to SCs was 23.05 per cent, STs was 13.07 per cent and physically challenged person was 0.74 per cent. The per cent of women got employment under MGNREGS was 53 per cent. During the study period (2010-2011) the average wage rate per day per person was Rs 97.22 and the average no. of days provided for household was 54.68 days, against a wage rate of 100 and 100 days employment guaranteed under the scheme. The net positive impact of MGNREGS regarding generation of employment opportunity was highest in Anantapur district (63 per cent) followed by Mahabubnagar district (54 per cent) and Srikakularm district (44
per cent). This highlights an important finding that, the impact of MGNREGS on generation of employment opportunities vary positively with the backwardness of the district i.e., Anantapur district being the most backward with reference to both agricultural and non-agricultural activities had benefited most followed by Mahabubnagar and Srikakulam districts. The MGNREGS programme had significant negative effect on agricultural (25.32 per cent) and non-agricultural works (14.19 per cent) as revealed by the ‘t’ test. Hence the hypothesis that the MGNREGS had negatively affected the availability of agricultural labour to agricultural and non-agricultural activities in the villages was accepted. The MGNREGS programme had significant negative effect on agricultural cultivation works (25.32 per cent) as well as nonagricultural works (14.19 per cent). Implementation of MGNREGS created 100 days of additional employment to every household per financial year. It resulted in competition of wage rate and works. In all the three districts, wage rate was more than doubled both for agriculture and non-agricultural works and also for both men and women.

After implementation of MGNREGS the minimum wages had positively increased compared to before MGNREGA as revealed by significant ‘t’ values, both for agricultural works and non-agricultural works. The real wages for agricultural and nonagricultural works also increased positively. The results on impact of MGNREGS on average income of the beneficiaries, revealed that the MGNREGS implementation increased the total income of the beneficiaries. The average increase in income was 18241.74 per annum and MGNREGS wage income contributed to increased wage income etc. The agricultural wage income (26.03 per cent), income from crops (13.63 per cent), dairy income (41.76 per cent), MGNREGS wage income and non-agricultural wage income (39.26 per cent) of the households increased after MGNREGS. The consumption expenditure of beneficiaries’ households had increased significantly after MGNREGS by 28.25 per cent. The MPC before MGNREGS varied from 3 per cent in Srikakulam district to 35 per cent in Anantapur district. The rise in income of the beneficiaries through the execution of MGNREGS programme had successfully mitigated the indebtedness in all the selected districts. In Srikakulam district the declined indebtedness was highest to the tune of 52.13 per cent followed by Mahabubnagar with 21.81 per cent and Anantapur with 19.20 per cent. The execution of the MGNREGS programme had benefited the beneficiaries in the following two ways. With the increase in income of the beneficiaries, their repayment capacity to clear the loans (crop loan and term loan) had increased significantly in all the selected districts. Besides enjoying repayment capacity, the beneficiaries are capable of saving a part of their income in various agencies like Post Office, banks, LIC and SHGs.

The MPC after MGNREGS increased from five percent in Srikakulam district to 47 per cent in Anantapur district. Overall the three districts the MPC increased from 15 per cent to 58 per cent. The dummy variable for pooled consumption function of before and after was also statistically significant indicating the effect of MGNREGS in increasing the MPS of beneficiaries due to increase in income.

In overall the districts the migration of number of households and number of family members for household declined to the extent of 54 per cent and 35 per cent respectively. The workers in the selected villages migrated to out of mandal and within
district declined to the extent of 52 per cent, out of district within state declined to the extent of 53 per cent and out of state declined to the extent of 59 per cent. The period of migration is up to a maximum of four months. The migration of number of households and number of family members per households declined to the extent of 54.17 per cent and 35.42 per cent respectively. Thus, it could be inferred that value of assets owned, days of employment and capacity to work as agricultural labour were the three major contributing factors to discriminate between the two groups of MGNREGS. It is to be noted that before the execution of MGNREGS programme, public assets created are not scientifically managed. After MGNREGS there is a significant impact regarding the assets creation both in terms of number and value in all the selected districts and this contributed to works creating more number of man working days of employment.

In overall 78.33 per cent of respondents expressed that there was overall increase in agriculture productivity while 52.78 while per cent of respondents perceived that there was no change in availability of irrigation / drinking facility. Majority of the respondents opined an increase in soil and water conservation (51.67 per cent), water table of the area (72.28 per cent), flood control and protection (57.78 per cent) and land development (72.22 per cent). About 72.22 per cent respondents agreed that due to MGNREGS there was overall development in their villages.

Investment income multiplier ratio and investment employment ratio had shown encouraging trends during the study period. The income elasticity of consumption expenditure with increased wage income under MGNREGS was positively significant and ranged from 15 to 58 per cent. The multiplier of 2.36 due to MGNREGS over all the three districts indicated that for every rupee increases in government expenditure the income increased by 2.36 due to consumption expenditure spending and secondary respending through multiplier effect. Delay in wage payment, delayed process in post office and non availability of regular works were the major problems experienced by the beneficiaries of MGNREGS in Andhra Pradesh.
ABSTRACT

The present study entitled “comparative economics of paddy and bajra seed production in kurnool district of Andhra Pradesh” was undertaken to examine costs, returns, resource productivity and constraints in the production of paddy and bajra. Multistage stratified purposive cum random sampling technique was used for the selection of mandals, villages and the farmers. A sample of 60 farmers was selected at random from 4 villages. The primary data for the year 2011-12 were collected through a pre-tested schedule by survey method. Both conventional and functional analysis was used to analyse the data and to arrive at valid conclusions.

The total human labour employment in the cultivation of paddy and bajra seed production was 95.67 and 31.76 mandays per hectare respectively.

On an average, the cost of cultivation of paddy and bajra seed was estimated at ₹57,782.30 and ₹27,790.35 per hectare respectively. The cost of cultivation of paddy was two times higher than that of bajra cultivation.

The gross and net returns per hectare of paddy and bajra seed farms were ₹1,06,500, ₹48,717.70 and ₹36,000, ₹6,209.65 per hectare respectively. Net returns per rupee of expenditure were ₹0.84 and ₹0.24 in the seed production of paddy and bajra.

The average yields obtained by the farmers in the case of seed growers of paddy and bajra were more than the break-even output reflecting their profitability.

The regression analysis indicated that tractor power and manures on bajra seed farms, manure on paddy seed farms were positively related and significant. However, human labour was negatively significant on paddy seed farms.
ABSTRACT

The present study entitled “An optimum production pattern for farmers in Kadapa district of Andhra Pradesh” intended to examine the possibilities and prospects of increasing net farm returns and employment by better resource allocation through optimum crop mix under varied capital and technological environments.

The study was carried out in Jammalamadugu revenue division of Kadapa district, Andhra Pradesh. From the selected revenue division, four mandals were selected at random. Two villages from each mandal were selected for the detailed study based on gross cropped area. Thus, the sample consists of eight villages. The farmers were stratified into two size groups i.e., small (less than two hectare of dry land) and large (more than two hectare of dry land). Altogether 128 farmers were selected for the detailed study taking 64 farmers from each size group. The required data were collected in the structured schedule developed for the purpose through personal interviews from the respondents. The data pertains to the agricultural year 2010-2011. Linear programming was used to develop optimum plans.

The optimization models designed at different capital and technological environments showed a tendency towards more capital and labour intensive as well as most profitable enterprises. A rational use of presently available resources at existing technology would enable to realize net farm returns of ` 86,750.80 and ` 1,72,247.00 for small and large farms respectively. This showed that there is scope for reorganizing the resources in order to increase the net farm returns to the extent of 63.48 and 70.51 per cent among the small and large farmers respectively.

Adequate borrowing at existing technology facilitated small and large farmers to realize ` 1,13,170.80 and ` 1,96,923.00 as net farm returns respectively. This was higher by 13.45 and 14.32 per cent over model 1 for the above said categories of farms. The
adoption of recommended technology with available funds increased the net farm returns to `89,998.45 on small farms and `2,17,823.00 on large farms.

Adoption of recommended technology with adequate borrowing helped to realize `1,31,426.60 and `2,77,976.60 for small and large farmers respectively. These returns were higher by 46.03 and 27.61 per cent over the returns realized by adopting recommended technology with available funds on small and large farms respectively.

The improved technology with adequate capital provided higher employment (Models S4 and L4). It indicated an additional employment of human labour and tractor to the extent of 20.28 mandays, 97.31 womandays and 10.41 hours respectively on small farms and 24.68 mandays, 182.30 womandays and 12.62 hours on large farms over the existing plan.
AGRICULTURAL ECONOMICS

Author : VENKATA RAMANAMMA, P.
Title of the thesis : STUDY ON THE VIABILITY OF TENANT FARMERS IN PRAKASAM DISTRICT OF ANDHRA PRADESH.
Major Advisor : Dr D. VISHNU SHANKAR RAO
Degree : M.Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPTLA
Accession Number : D 9580

ABSTRACT

As the growing proportion of landless tenants, owner cum tenants and small and marginal farmers households get affected due to various risks and problems associated with agriculture and their viability is debated over the years. The research study entitled “Study on the Viability of Tenant farmers in Prakasam district of Andhra Pradesh” was taken up with the following objectives.

- To study the magnitude of incidence of tenancy in Andhra Pradesh.
- To study socioeconomic conditions of sampled tenant farmers in Prakasam district of Andhra Pradesh.
- To analyse the investment pattern, productivity, profitability and viability of tenant farms.
- To identify and study different methods of tenancy relationships in input, credit and Output markets.
To identify and analyse the constraints of tenant farmers in management of farms. Prakasam district was purposively selected for the study as it has large number of tenant farmers i.e. approximately 1,02,240 and existence of small and marginal farmers and landless labour. The sample constitute of 120 tenant farmers categorized into pure tenants (71) and owner cum tenant farmers (49) were randomly selected from 12 villages in three mandals in the district based on the higher concentration of registered Land Licensed cultivators (LCC) provided by the Dept of Agriculture and Revenue departments. The data collected on various aspects of tenant holdings pertaining to 2012-13 agricultural year and collected through personal interview method. The secondary data on magnitude of tenancy at state level were collected from NSSO reports related Andhra Pradesh, Sarvekshna, Directorate of Economics and Statistics GOI.

The most prevalent terms of tenancy in study area was followed through fixed money (93.33 per cent) and very less number followed by fixed produce (6.7 per cent). The rental values in fixed cash payment terms of lease varied from A. 50,000/ha for Turmeric, A. 12500/ha for Redgram and A. 25,000 for Bengalgram and all other crops A. 37,500/ha. The kind payment terms of tenancy was followed only in case of Paddy i.e. 2812 kgs/ha.

The cost of cultivation/ha on Cost C3 basis in different crops was Paddy A. 88684/ha, Tobacco A. 92374/ha, Bengal gram A. 66536/ha, Redgram Rs27249/ha and Cotton A. 88172/ha. The productivity of different crops/ha in quintals was 54.75 in Paddy, 7.65 in Tobacco, 4.62 in Redgram, 9.67 in Bengal gram, 14.3 in Cotton and 22.87 in Chilies.

The Net income/ha of tenant operational holding was negative for Pure tenants, owner cum tenants as well as overall the sample i.e. A. -8478, A. -24164/ha and A. -14883/ha. However the owned farm business income (i.e. Gross returns over Cost A2) was positive in all the categories i.e. A. 2853/ha, A. 10219/ha and A. 5861/ha for pure tenant, owner cum tenants and overall the sample respectively.

The household expenditure ranged from A. 55989/annum in Pure tenant families to A. 59616/annum in Owner cum tenant households with an average household expenditure of A. 57470/annum over all the households. The per capita daily expenditure on tenant households works out to A. 39.25 which is 53 per cent less than the World Bank poverty norms of $ 1.25 per day per capita expenditure. It can be concluded that all the tenant farm families are living below the poverty norm. The debts outstanding per household ranged from A. 14514 for Pure tenants to A. 37020 for Owner cum tenants with an average debt outstanding of A. 23704/annum overall the sample.

The average annual net family income for all the house households was on the negative. It ranged from A. -44122 for Pure tenants to A. -66146 for Owner cum tenant and overall the sampled households it was A. -53115. The family income from wages and dairy was more compared to crop income.

The results revealed that, the level of net farm income of the sample farmers was
negative hence we can concluded that tenant farming is not an profitable enterprise and not viable in the long run if the trend of negative net returns continue though the farm business income (income over Cost A2) are positive but very meagre income to sustain the farming in the long run.

The results also revealed that the unviable nature of tenant farm households who are living below poverty line with family living expenditure 53 per cent below the World Bank norms of $ 1.25/day per capita ultimately resulting in agrarian and social crisis leading to suicide deaths of tenants and small and marginal farmers. Among the 40 suicide deaths reported in Prakasam district since 2006, 13 are tenants, 19 are owner cum tenants and 8 are small farmers.

It was suggested for expansion of secondary agriculture activities to generate reasonable income and employment opportunities to tenant farm households and nonfarm income and employment to avoid further agrarian social distress.

AGRICULTURAL ECONOMICS

Author : VINITA KANWAL
Title of the thesis : IMPACT OF FOREST DEVELOPMENT PROGRAMMES ON LIVELIHOOD OF RURAL PEOPLE IN NAINITAL DISTRICT OF UTTARAKHAND
Major Advisor : Dr. N. VASUDEV
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9524

ABSTRACT

The present study entitled “Impact of Forest Development Programmes on livelihood of rural people in Nainital district of Uttarakhand” was undertaken to overview the effects of FDPs in terms of income generation, employment generation and marketing constraints faced by the rural people.

The study was undertaken in Nainital district of Uttarakhand, which was purposively selected for the study as this was the first district of implementation of
Participatory Forest Management Programme and witnessed its successful implementation.

Three villages were selected randomly from Bhimtal block of Nainital district of Uttarakhand. Twenty beneficiaries from each village were selected thus making the total sample size of 60. Investigation was done for two separate years i.e. one immediately after the implementation of FDPs (for agriculture year 2008-09) and other for the latest year of implementation of FDPs (for agriculture year 2013-14).

Majority of the FDP beneficiaries in the study area were found to be marginal farmers of middle age group with a very less education i.e. till the high school only. Maximum beneficiaries were found to have access to KCC and more orientation towards Cooperative banks and societies for their credit requirements with medium level of credit worthiness. Major source of income was found to be agriculture (farming) before the implementation of FDPs but after the implementation forest produce as well as labor generated by the FDPs became major source of income in the study area.

FDPs were found to have a positive effect on both income generation and income distribution. Majority of the beneficiaries were found to be falling under low income category before FDPs implementation but after the FDPs were implemented, income level of beneficiaries was raised and majority of the beneficiaries were found to be falling under medium income group followed by high and low income group.

Extent of employment generation analysis concluded that prior to FDPs employment sources for women were meager but after FDPs implementation employment level of both men and women were found to be raised both in terms of absolute employment and man equivalent days.

Marketing constraint analysis concluded that major channel of marketing of forest produce was producer to middlemen, middleman to ultimate consumer. The Gini coefficient for pre FDPs period was found to be 0.65 and post FDPs was 0.59. Robin Hood index value prior to FDPs implementation was found to be 22.2 which decreased to 19.2 after FDPs implementation. Herfindahl index before FDPs was 0.020 which decreased in post implementation period and became 0.018. All the indices values indicate that inequality decreased after implementation of FDPs.

Ex-ante and ex-post Values of Lorenz Asymmetric Coefficient for FDPs were found to be 0.68 and 0.89 respectively.

Constraints as seen by the beneficiaries were found to be seasonality of work, unequal wage distribution among man and women, back breaking work, underpayment, presence of middleman for salary distribution and thus less salary, frequent casualties etc.

Constraints as observed by Sarpanch of Van Panchayat Samities were found to be huge loads of paper works, records, maintenance, large amount of calculations, lack of efficient staff with good skills and technical knowledge; lack of honesty, prevailing laziness in people etc.
Constraints as reported by NGO persons were reluctance of people to attend training been organized, lack of education level that leads to the wastage of time in teaching the beneficiaries and lack of cooperation of beneficiaries.

AGRICULTURAL  ECONOMICS AND AGRIBUSINESS MANAGEMENT

Author : DEVA KUMAR, G.
Title of the thesis : AN ECONOMIC EVALUATION OF SEED BUSINESS OF PULSES IN KURNOOL DISTRICT OF ANDHRA PRADESH
Major Advisor : Dr. T.V. NEELAKANTA SASTRY
Degree : M.Sc. (Ag.)
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D 9631

ABSTRACT

The present study entitled “An Economic evaluation of seed business of pulses in Kurnool district of Andhra Pradesh” was intended to examine costs and returns and to estimate break-even output in the seed production of bengalgram and blackgram. Multi-stage purposive cum random sampling technique was adopted for the selection of district, mandals, villages and the farmers. The sample of 60 farmers consisting of bengalgram and blackgram seed growers was selected at random from four villages. The primary data for the year 2011-2012 were collected through a pretested schedule by survey method.

The total human labour employment on bengalgram seed farms was 40.82 man days per hectare as against 47.75 man days on blackgram seed farms.

On an average, the per hectare cost of cultivation in the seed production of blackgram (₹ 68,503.60) was higher than that of bengalgram seed production (₹ 64,551.15).

Manures and fertilizers followed by rental value of owned land, human labour, seed and plant protection were the major items of expenditure on both the categories of farms.
The net returns per hectare of bengalgram and blackgram seed farms were `44,823.85 and `17,121.40 respectively. The returns per rupee of expenditure was higher on bengalgram seed farms (` 0.69) compared to blackgram seed farms (` 0.25).

The break-even output on bengalgram and blackgram seed farms was 7.11 and 11.20 quintals per hectare respectively.
AGRICULTURAL EXTENSION

Author : AYYAPUSETTY JEEVAN KUMAR
Title of the thesis : A STUDY ON THE AGRICULTURAL EXPERIENTIAL LEARNING PROGRAMME (AELP) AT AGRICULTURAL COLLEGE, BAPTLA
Major Advisor : Dr. T. GOPI KRISHNA
Degree : M.Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPTLA
Accession Number : D 9577

ABSTRACT

Indian Council of Agricultural Research has recommended a new initiative called “AGRICULTURAL EXPERIENTIAL LEARNING PROGRAMME” in the recently revised curriculum for the B.Sc. (Ag.) degree programme following the recommendations of IV deans committee. The ANGRAU has also implemented AELP with a load of 20 credits in the VIII semester of B. Sc. (Ag) with its emphasis on moulding graduates from “job seekers to job providers” in all the constituent colleges from the year 2010-2011. The primary aim of this initiative is to remove the weaknesses in the earlier higher agricultural education system and to develop a cadre of skilled professionals who can create their own enterprises. It is expected that the experiential learning programme will bring professionalism and practical work experience in real life situations to students.

Considering attitude and entrepreneurial skills as dependent variables, two scales were developed by using Likert method of summed rating technique viz., attitude of students and teachers towards AELP and extent of entrepreneurial skills acquired by the students of AELP. The attitude scale was comprised of 40 statements and entrepreneurial skills scale had 57 statements. Data was collected through a well structured questionnaire which was developed keeping in view of the objectives of the study.

Descriptive research design was used in the present study. ANGRAU in Andhra Pradesh was selected purposively. Out of eight Agricultural Colleges in ANGRAU, Agricultural College, Bapatla has been selected by purposive sampling. A total of 120 students from the academic years 2010-11 and 2011-12 were selected by proportionate random sampling and the total number of teachers nominated during the above period as Managing Director, Chief Executive Officer, Directors, Financial and Marketing Advisors for various AELP units was selected to constitute the sample.
The detailed analysis of profile of students indicated that majority of the students belong to urban background, their parents had service as the occupation and low income, the students had medium innovativeness, medium risk orientation, medium scientific orientation, medium management orientation, medium decision making ability, medium self-confidence, medium achievement motivation, medium marketing orientation. Regarding extent of entrepreneurial skills, students fully acquired and had moderately favourable attitude towards AELP. The teachers had moderately favourable attitude towards AELP.

The correlation analysis revealed that innovativeness, risk orientation and scientific orientation were positively significant, parental income, management orientation and self-confidence is negatively significant at 0.01 per cent level of probability with extent of entrepreneurial skills acquired by the students of AELP. Parental occupation is found to be negatively significant at 0.05 level of probability. Whereas, place of residence, decision making ability, achievement motivation were negatively non-significant and marketing orientation is found to be positively nonsignificant.

The computed correlation coefficient (r) values of risk orientation, scientific orientation, management orientation, decision making ability and Self-confidence were positively significant and innovativeness is negatively significant at 0.01 per cent level of probability with attitude of the students of AELP. Whereas, place of residence, parental occupation, parental income, achievement motivation and marketing orientation were negatively non-significant.

Strengths of AELP as expressed by the AELP students are: Availability of implements and tools for agricultural operations, Availability of adequate land resources, Availability of farm machinery, Availability of transportation facilities, Availability of input supply services, Availability of adequate water resources, etc.

Weaknesses of AELP as expressed by the AELP students are: Dependence on outdated technology, Lack of training, Inadequate availability of trained man power, Increased cost of cultivation, etc.

Opportunities of AELP as expressed by the AELP students are: Consumer preferences to buy the fresh produce, Image of the organization, Availability of media support, Availability of adequate indigenous technology, etc.

Threats of AELP as expressed by the AELP students are: Shortage of power, Lack of support price, Changed consumer preferences for quality, Shortage of quality water for irrigation, Stringent financial rules and regulations, etc.

Constraints expressed by the AELP students are: Lack of prior knowledge on AELP enterprises, Lack of prior training on AELP enterprises, Non availability of approved technologies, Non availability of productive labour, etc.
Suggestions expressed by the AELP students are: Giving preference to students interest while choosing an enterprise, Giving scope for preparation for competitive exams/ entrance test for higher studies, Last semester should be with course work, Removal of non-viable units, Uniform division of work to each and every student, etc.

Constraints expressed by the teachers are: Low key participation by AELP students, Low key importance given for post harvest management, Inadequate duration of the programme, Much dependence on rain-fed agriculture, etc.

Suggestions expressed by the teachers are: Giving preference to students interest while choosing the AELP enterprises, Enhancing day to day involvement of students, Arrangement of proper marketing facilities, Regular monitoring of the students, Arranging weekly meeting of CEO and Directors rather than fortnightly meetings, etc.
AGRICULTURAL EXTENSION

Author : HRUDAY RANJAN, C.
Title of the thesis : AN EXPLORATORY STUDY ON SCOPE AND IMPORTANCE OF FARM MECHANIZATION IN GROUNDNUT IN CHITTOOR DISTRICT OF ANDHRA PRADESH
Major Advisor : Dr. P.V.SATYAGOPAL
Degree : M.Sc. (Ag.)
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D 9636

ABSTRACT

The study was conducted to find out extent of awareness, knowledge and adoption of different farm machinery in groundnut by the farmers, to analyze the perceived attributes of different farm machinery in groundnut by the respondents, to explore the scope of farm machinery in different practices of groundnut crop and to develop a strategy for innovation and promotion of effective farm machinery in groundnut.

Ex-post-facto and Exploratory research designs were followed for the study. The investigation was carried out in 12 villages of Andhra Pradesh covering four mandals from Chittoor district of Rayalaseema region. From each village, 10 groundnut farmers
were selected randomly, thus making a total sample of 120 groundnut farmers as the respondents for the study. The data were collected by personal interview method through structured interview schedule and analyzed by employing suitable statistical methods.

Majority of the groundnut farmers were middle aged with middle to high school education, had medium farming experience, had small farm size, had medium material possession, had medium extension contact, had medium mass media consumption, had medium social contact, had medium risk orientation. Majority of the respondents had medium achievement motivation, scientific orientation, and management orientation.

Majority of the groundnut farmers had medium extent of awareness, extent of knowledge and extent of adoption. Among all the thirty three recommended implements Mould Board Plough, Cultivator, Disc Plough, Rotovator, Sprinkler, Drip, Plank, Knapsack Sprayer, Motorized Knapsack Sprayer, Power Sprayer stood first in position in terms of awareness.

With regard to knowledge sprinkler method was ranked first followed by Cultivator, Plank, Leveler, Drip Method, Seed Cum Ferti Drill, Seed Treatment Drum, Disc Plough, Knapsack Sprayer, Rotovator, Motorized Knapsack Sprayer, Star Weeder, Mould Board Plough, Power Operated Groundnut Decorticator, 4 Row Bullock Drawn Groundnut Planter, Bullock Drawn Intercultivation Implement, Tractor Drawn Groundnut Planter etc. in their respective rank order.

With reference to adoption Cultivator stood first followed by power sprayer, plank, rotoverator, Motorized Knapsack Sprayer, Seed Treatment Drum, Knapsack Sprayer, Leveler, Tractor Drawn Groundnut Planter, Seed Cum Ferti Drill, Power Operated Groundnut Decorticator, Disc Plough, Dry Pod Thresher, Sprinkler Method, 4 Row Bullock Drawn Groundnut Planter, Bullock Drawn Intercultivation implement, Hand Operated Groundnut Decorticator etc. in their respective rank order.

The variables viz., Education, land holding, material possession, extension contact, mass media consumption, social contact, risk orientation, achievement motivation, scientific orientation and management orientation had shown positive and significant relationship with the extent of awareness and knowledge at 1 per cent level of significance. Concerning extent of adoption variables like education, extension contact, mass media consumption, social contact, risk orientation, achievement motivation, scientific orientation and management orientation had shown positive and significant relationship at 1 per cent level of significance, whereas material possession had shown positive and significant relationship at 5 per cent level of significance and farming experience had shown negative and significant relationship with the extent of adoption at 5 per cent level of significance.

The regression analysis revealed that, the Age, Farming Experience, Land Holding, Social Contact, Achievement Motivation, Scientific Orientation, Extension Contact, Risk Orientation were the major variables to explain the extent of awareness up to 86.40 percent. Social contact, Land holding, Achievement motivation, Scientific orientation, Extension Contact, Risk Orientation were the major variables to explain the
extent of knowledge up to 88.20 percent. Education, Achievement motivation, Land holding, Farming experience and Material possession were the major variables to explain the extent of adoption up to 80.70.

All the thirty three implements were studied in terms of their perceived attributes viz., Relative advantage, Compatibility, Complexity, Trialability and Observability by the groundnut farmers and also their perception towards advantages, disadvantages, suggested refinements and needed support.

Based on the results obtained through the present research, the scope of farm mechanization was explored and a strategy was designed for innovation and promotion of effective farm machinery in groundnut.

AGRICULTURAL EXTENSION

Author : KARTHIK, D.
Title of the thesis : A STUDY ON THE EFFECTIVENESS OF COTTON FARMER GROUPS IN WARANGAL DISTRICT OF ANDHRA PRADESH
Major Advisor : Dr. A.SAILAJA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9526

ABSTRACT
The present study entitled ‘A study on the effectiveness of cotton farmer groups in Warangal district of Andhra Pradesh’ was undertaken to assess effectiveness in terms of group performance and crop performance in the study area.

An *Ex-post* facto research design was followed for the study. The State of Andhra Pradesh was selected purposively for the study. Warangal district of Andhra Pradesh was selected randomly. Two mandals in the district and two villages in each mandal were selected randomly. Thus, a total of four villages were selected. From each village, three farmer groups were selected namely rythu mitra groups depicted by G₁, farmer groups of NGO depicted by G₂ and commodity interest group depicted by G₃. Respondents were selected through stratified quota sampling. Ten farmers from each group were selected in a village, hence 30 farmers from three groups were selected from the village. Thus, 20 respondents of each group were selected from each mandal and 40 respondents from each group are selected from district making a sample of 120 respondents.

The analysis of personal characteristics of G₁ indicated that majority were marginal farmers with middle age, high school education, with medium farming experience, low annual income and received medium training. Majority of respondents of G₁ with respect to situational characteristics had high institutional support and medium market facilities. Majority of respondents of G₁ with respect to group related characteristics had working age of their group more than four years with group size 10-20 members, medium communication, perceived their group leader with high group leadership, medium group cohesiveness and effective decision making pattern in the group.

The analysis of personal characteristics of G₂ revealed that majority were marginal farmers with middle age, had high school education with medium farming experience, low annual income and medium training received. Majority of respondents of G₂ with respect to situational characteristics had high institutional support and medium market facilities. Half of respondents of G₂ with respect to group related characteristics had working age of group as one to two years and other half of the respondents had more than four years, with group size 30-40 members, medium communication, perceived their leader with high group leadership, high group cohesiveness and effective decision making pattern in the group.

Equal majority of respondents of G₃ with respect to personal characteristics were small and marginal farmers, had middle age with primary education, medium farming experience, low annual income and low training received. With respect to situational characteristics, majority received medium institutional support and had medium marketing facilities. With respect to group related characteristics, majority were members of group of working age one to two years, half of respondents with group size 10-20 members and other half with group size 30-40 members, with low communication, perceived their leader with low group leadership, low group cohesiveness and ineffective decision making pattern in the group.

Majority of respondents of G₁ had medium effectiveness where as majority of G₂ had high effectiveness and in case of G₃, majority were low in effectiveness category.
Majority of respondents of $G_1$ had medium cooperation, competition, conflict, accommodation and assimilation.

Majority of respondents of $G_2$ had high cooperation, medium competition, high conflict, accommodation and assimilation.

Majority of respondents of $G_3$ had low cooperation, competition, conflict, accommodation and assimilation.

Majority of respondents of $G_1$ had medium group performance, whereas, majority of respondents of $G_2$ had high group performance and in case of $G_3$, majority had low group performance.

Majority of respondents of $G_1$ had medium crop performance, whereas, majority of respondents of $G_2$ had high crop performance and majority of respondents of $G_3$ had low crop performance.

Majority of respondents of $G_1$ had medium cotton crop intensity, medium crop yield index and medium extent of adoption.

Majority of respondents of $G_2$ had medium cotton crop intensity, high crop yield index and high extent of adoption

Majority of respondents of $G_3$ had high cotton crop intensity, low crop yield index and low extent of adoption.

The mean values of group performance of three groups were non-significant for cooperation, conflict, and accommodation.

The mean values for crop performance of three groups were non-significant with cotton crop intensity and significant with cotton crop yield index and extent of adoption.

There was no significant difference in mean values of $G_1$ and $G_2$ with respect to components of group performance (group processes) cooperation, conflict, and accommodation.

There was significant difference in mean values of $G_1$ and $G_3$ and $G_2$ and $G_3$ with respect to components of group performance (group processes) cooperation, conflict and accommodation.

There was significant difference in mean values of $G_1$ and $G_2$, $G_2$ and $G_3$ and $G_1$ and $G_3$ with respect to components of crop performance.

For $G_1$, the variables age, training received, institutional support, communication, group leadership and the effectiveness were positive and significantly correlated at 0.05 level of probability. In case of $G_2$, the variables age, education, farming experience, training received, communication, group leadership, group cohesiveness and the effectiveness were positive and significantly correlated at 0.05 level of probability and variable institutional support and the effectiveness were positive and significantly
correlated at 0.01 level of probability. In case of G3, the variables age, education, farm size, training received and the effectiveness were correlated at 0.05 level of probability.

Majority (85.00%) of respondents of G1 expressed lack of village level worker to assist in group management activities for which 67.50 per cent of respondents suggested appointment of village level worker to assist in group activities and in adoption of practices.

Majority (75.00%) of respondents of G2 expressed that few members deviate from group adoption practices as prescribed by NGO for which 72.50 per cent of respondents suggested members who deviate must be imposed with penalty.

Majority (77.50%) of respondents of G3 expressed uncontiguous land distribution for which 82.50 per cent of respondents expressed members should hail from contiguous land area.

Strategy was developed based on findings of the study for State Department of Agriculture and NGOs for three groups.
ABSTRACT

The output and productivity of any land could be increased by following recommended package of practices, and chilli is no exception. Chilli output could be increased if the farmers adopt the recommended package of practices. For increasing the level of adoption farmers need to be convinced about recent production technologies. In this regard, it is imperative to examine the factors which higher the process of their adoption.

To study the adoption behavior of chilli farmers in Guntur district of Andhra Pradesh an ex-post facto research design was followed. The study was conducted in Andhra Pradesh state during the year 2013.

Guntur district of Andhra Pradesh was purposively selected, since this three mandals were selected randomly out of fifty six mandals and six villages were selected from each mandal for the study. Ten respondents were selected from each village by following simple random sampling method thus, making 120 farmers consisting of 60 owner farmers and 60 tenant farmers constituted the sample of the study. Data was collected by pre-testing followed by personal interview method.

For the purpose of statistical analysis of the coded data various statistical tools were used viz., frequency and percentage analysis, Z – test, correlation analysis, multiple regression analysis, ranking and class interval.

The detailed analysis of profile of farmers indicated that majority of the farmers were middle age group, had high school level education and small land holdings with medium level of farming experience, nuclear family type, medium family size, medium level of training received and coupled with medium level of scientific orientation, medium level of risk orientation and medium level of market orientation. ‘Z’ value indicated that there was significant difference between owners and tenants in respect of almost all the variables except – age, education, farming experience, family type, scientific orientation and attitude.
In case of owner farmers, the correlation analysis revealed that age, education, farming experience, family type, annual income, extension contact, mass media exposure, scientific orientation, risk orientation and market orientation were positively and significantly correlated with adoption.

In case of tenant farmers, the correlation analysis revealed that age, education, land holding, farming experience, family type, annual income, training exposure, source of credit, extension contact, mass media exposure, scientific orientation, risk orientation and market orientation were positively and significantly correlated with adoption.

In case of owner farmers, the correlation analysis revealed that education, family type, annual income, extension contact, mass media exposure, scientific orientation, risk orientation and market orientation were positively and significantly correlated with attitude.

In case of tenant farmers, the correlation analysis revealed that age, education, land holding, annual income, training exposure, source of credit, extension contact, mass media exposure, scientific orientation, risk orientation and market orientation were positively and significantly correlated with attitude.

Among the different modes of rent paid by the tenant farmer for the leased land, highest per cent was recorded in case of the pooled data of cash & kind (55.00%), followed by cash (41.67%) and kind (3.33%).

The most important problems reported by the tenant farmers in tenant farming were more land lease rents, most of the land owners demand land leased rent before the commencement of the cropping season, lack of financial support from banks, it is difficult to pay the entire land lease rent in the form of cash, short term tenancy tenures, developmental departments do not offer agricultural trainings for tenant farmers, borrowed from money lenders at higher interests leading into debts, no fixed land lease rents, no vouchers are given for payment of lease rents for the land, ineligibility to get input subsidy, crop insurance and weather insurance, etc.

Suggestions given by the farmers to overcome the problems were banks should extend crop loans for tenant farmers, tenancy tenures should be at least for 3 to 5 years, developmental departments should extend agricultural trainings for tenant farmers on regular, season and time specific basis, tenancy contracts need to be monitored by the government, lease contracts are verbal and no written agreements, all farmers should only go for written land lease agreements, Government should monitor the land lease rents, input subsidy, crop insurance and weather insurance should be extended for tenant farmers.
ABSTRACT

Feedback is an integral part of effective agricultural communication. Feedback gives an opportunity to the technology developers to transfer the technology and rethink on the issues raised by the clientele the farmer through extension personnel. The possible refinement and modifications could be done by the research scientist which in turn will lead to higher adoption and faster diffusion of the technologies. Thus the feedback through effective feedback mechanism increases the functional linkage between the clientele, technologies and the development agencies. With this back drop the present study “A study on feedback mechanism in Agricultural Technology Management” was taken up.

Ex-post facto research design was followed. Out of nine agro climatic zones of Andhra Pradesh, Krishna zone was selected randomly for the study comprising of three districts namely Krishna, Guntur and Prakasam. A total of 120 respondents comprising of 40 research scientists, 40 extension personnel were selected who are working in Krishna zone (three districts) and 40 farmers from one district i.e. Guntur for selection of farmers for the study randomly. Interview schedule was used for data collection and the statistical measures like mean, frequency, percentage, correlation coefficient were used.
The findings with regard to awareness of the respondents indicated that majority of the research scientists, extension personnel and farmers had high awareness about feedback mechanism. The findings with regard to perception of the respondents indicated medium perception for research scientists and extension personnel and high perception for farmers. The findings with regard to extent of participation in feedback mechanism by the respondents indicated medium participation by research scientists, extension personnel and low participation by farmers. The findings with regard to extent of utilization of feedback mechanism by the respondents indicated that research scientists had medium utilization whereas extension personnel and farmers had low utilization of feedback mechanism.

The present feedback mechanism was documented by contacting the research scientists, extension personnel and also from secondary sources. Various extension activities are being conducted by the state agriculture university and state department of agriculture under collaboration of ATMA in which research scientists, extension personnel and farmers are the stake holders for getting/ giving feedback.

The findings with regard to the selected characteristics of the respondents indicated that research scientists were middle aged, possessed doctoral degree, very low experience, very low training received, low extension contact, medium socio political participation, low time, high access to get/give feedback, medium feedback during crisis, medium reporting, low transport facilities, medium job commitment, medium role awareness, low achievement motivation, ambivert personality type, medium extension service orientation, low participation behavior in group, low use of extension teaching methods, medium communication media used, high ability to give feedback and low level of interaction.

The findings with regard to the selected characteristics of the respondents indicated that extension personnel were young aged, were graduates, very low experience, very low training received, low extension contact, low socio political participation, low time, high access to get/give feedback, low feedback during crisis, medium reporting, low transport facilities, medium job commitment, high role awareness, medium achievement motivation, introvert personality type, high extension service orientation, low participation behavior in group, medium use of extension teaching methods, medium communication media used, medium ability to give feedback and medium level of interaction.

The findings with regard to the selected characteristics of the respondents indicated that farmers were middle aged, possessed secondary education, medium farming experience, medium training received, low extension contact, small farmers, low socio political participation, low time, high access to get/give feedback, low feedback during crisis, medium reporting, low transport facilities, high job commitment, low role awareness, low achievement motivation, extrovert personality type, high extension service orientation, low participation behavior in group, low use of extension teaching methods, low communication media used, high ability and medium level of interaction.

The correlation analysis revealed that the variables like education is negatively and significantly associated and extension teaching methods, communication media used, level of interaction, socio-political participation, reporting, extension service orientation were positively and significantly associated with extent of participation in feedback.
mechanism by research scientists. Whereas for extension personnel the analysis revealed that the variables like extension teaching methods, reporting were positively significant with extent of participation feedback mechanism. While for farmers the variables like education, experience, training received, reporting, participation behaviour in group, extension teaching methods, communication media used, farm size, ability to give feedback, level of interaction were positively significant with extent of participation in feedback mechanism.

The correlation revealed that the variables like access to get / give feedback, reporting, participation behaviour in group, extension teaching methods, communication media used, level of interaction, extension contact, job commitment, role awareness, extension service orientation, ability to give feedback and feedback during crisis were positively significant with utilisation of feedback mechanism by research scientist. In case of extension personnel the variables like extension teaching methods, feedback during crisis, extension contact, reporting, participation behaviour in group and level of interaction were positively significant with utilisation of feedback mechanism. In case of farmers the variables like education, experience, transport facilities, extension teaching methods, communication media used, training received, farm size, socio political participation, feedback during crisis and level of interaction were having positive significant correlation and the variable age was negatively significant with the utilisation of feedback mechanism.

During the study the major problems expressed by research scientists were inadequate feedback regarding the minikits is given by the farmers/ extension personnel during the ZREACs and other meetings, less importance given to feedback after conducting meeting/ programmes whereas in case of extension personnel major problems were allotment of duties to the extension personnel other than works related to Agricultural Technology Management, contacts between the extension personnel and the research scientists were inadequate while in case of farmers the problems were lack of knowledge to identify the correct source of information for getting /giving feedback, lack of technical know –how and how to get/give feedback to the extension personnel/ researchers.

The major suggestions offered by research scientists, extension personnel and farmers were training of farmers and extension personnel in recording and updating the minikit results and filling up of vacant post and use of ICT for quick and large scale reach, reduce the allotment of other department duties for extension personnel or schedule the time without overlapping the timings of duties, develop good rapport between the extension & research scientists by conducting collaborative training session, educate the farmers about getting/giving feedback from/to the officials/ scientists and whom to contact.

Documenting the feedback given at various level by staff as well as other stakeholders, improve the extension contacts by utilizing the existing ICTs like mobile telephony(SMS), networking of farmers groups and specific need based trainings for
effective getting/giving feedback, conduct ZREAC, SLTP meetings, rythu chaitanya yatra twice a year before commencement of the season and farmers organisations/groups may be initiated and strengthened which would act as a platform for effective feedback at farmers/village level are the strategies suggested to improve the effective utilization of feedback mechanism in Agricultural Technology Management.

AGRICULTURAL EXTENSION

Author : MADAN MOHAN REDDY, K.
Title of the thesis : SWOT ANALYSIS ON SOYBEAN PRODUCTION
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Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9528
ABSTRACT

The present study entitled ‘SWOT ANALYSIS ON SOYBEAN PRODUCTION’ had been initiated focusing on the Strengths, Weaknesses, Opportunities and Threats of Soybean production.

Descriptive research design was adopted in the present investigation. Adilabad, Nizamabad and Karimnagar districts of Northern Telangana zone of Telangana region of Andhra Pradesh state were purposively selected for the study. The study was conducted in 24 villages selected randomly from 12 mandals (selected randomly) of 3 districts of Northern Telangana Zone of Andhra Pradesh state, which included 5 respondents from each of the selected village were selected randomly, thus a sample of 120 respondents were selected for the study.

The analysis of profile characteristics of Soybean growing respondents indicate that majority of them had upper primary level of education (6th to 7th) and fell under medium category in terms of Age, farming experience, information management behavior, R-E-F linkage and had low extension contact, marketing intelligence and marketing facilities where as majority of them had small farm size and majority had high resource mobilization pattern.

The major strengths on practicing soybean production technologies are- less number of irrigations required during the crop period, JS335 is high yielding variety and fixation of the atmospheric nitrogen in to the soil by the soybean crop due to its leguminous nature. The major weaknesses are- JS335 is a semi dwarf variety and low seed viability, lack of suitable high yielding varieties to the zone other than JS335. Low incidence of pest and diseases in line sowing followed by low cost of plant protection, harvest indices are easy to understand and practice are top three opportunities in practicing soybean production technologies. The major threats are- yield reduction in rabi season followed by more soil erosion in red soils due to heavy rains, lack of varieties suitable for rabi season.

The major strengths on existing agro-eco system for soybean production are- the existing range of temperature is highly congenial for crop growth during kharif season followed by the zone receives high amount of rainfall compared to other zones, existing topography is highly suitable for crop cultivation. The major weaknesses- are excess rainfall during the months of August and September may affect flowering and pod filling followed by lack of knowledge on soil and water conservation techniques. The major opportunities are- leaf fall at maturity stage can be added to the soil to enhance the soil and moisture conservation followed by fair distribution of rainfall during the months of June and July is congenial for seed germination and crop establishment. The major threats are- excess saturated soil conditions for more than two days causes significant yield reduction followed by heavy and continuous rains immediately after sowing will affect seed germination.

The major strengths on soybean crop against the major crops (cotton, sugarcane, maize) of the zone are- requires less number of irrigations followed by cost of cultivation is low, less drudgery in crop cultivation. Low seed viability and germination followed by
picking (harvesting) of soybean pods is difficult, low marketing intelligence are three major weaknesses. The major opportunities are- subsidy on seed cost followed by spreading of pest and diseases is low in line sowing, drought tolerant (rain fed) crop, no role of middlemen in marketing. The major threats- are non availability of soya seed in time followed by price fluctuations, seed looses viability with minimum impact.

The major strengths on production, processing and marketing of soybean crop are- low water requirement followed by low cost of cultivation, low risk, higher net returns and high demand for the value added soya products in the market. The major weaknesses are- seed viability and germination percentage is low followed by low labour availability, picking (harvesting) of soybean pods is difficult, non availability of National and International market information, use of high speed threshers reduce the seed germination percentage. The major opportunities- are chances for production of value added products of soybean like soya flour, oil, milk, chunks…etc. followed by protects soil fertility from erosion due to its dense foliage, subsidy on seed cost, weed smoother crop. The major threats are- lack of infrastructure to process the soya produce followed by fluctuation in market prices, non availability of seed in time, weak management information system in soybean production, predominance of a single variety in cultivation, intensive competition from other states to market the soya produce.

A strategy has been developed keeping in view of the results obtained in the study and discussions held with the stakeholders of the study.
The study was conducted to assess the knowledge of cotton farmers on health hazards of pesticide usage, to study the selected profile characteristics of cotton farmers, to study the relationship between the profile characteristics and the knowledge of cotton farmers on health hazards of pesticide usage, to elicit the problems perceived by the farmers during pesticide usage and the suggestions to overcome the problems as perceived by cotton farmers.

Ex-post-facto research design was followed for the study. The investigation was carried out in 6 villages of Andhra Pradesh covering three mandals from Kurnool district of Rayalaseema region. From each village 20 cotton farmers were selected randomly, thus making a total sample of 120 cotton farmers as the respondents for the study. The data were collected by personal interview method through structured interview schedule and analyzed by employing suitable statistical methods.

Majority of the cotton farmers were middle aged with high school education, had small farm size. Majority of the respondents had medium farming experience, extension contact, social participation, economic motivation, innovativeness, mass media exposure, risk orientation and scientific orientation.

More than half of the cotton farmers reported their knowledge on health hazards of pesticide usage as medium followed by high and low knowledge levels.

Correlation analysis revealed that there was a positive and significant relationship between knowledge and independent variables i.e. education, farming experience, social participation, economic motivation, innovativeness, mass media exposure, risk orientation and scientific orientation. Whereas age was found negatively and significantly related and farm size had non-significant relationship with the Knowledge of cotton farmers on health hazards of pesticides.

Regression analysis revealed that all the 11 selected independent variables put together explained 69.39 per cent variation in knowledge levels of cotton farmers on health hazards of pesticide. Further, it also revealed that education, economic motivation,
innovativeness, mass media exposure and scientific orientation were found positively and significantly contributed to the variation.

Unawareness about hazards of excess use of pesticides, illiteracy and lack of technical guidance were the major problems faced by the farmers ranked first, second and third respectively. Majority of the cotton farmers suggested provision of unadulterated chemicals, provision of chemicals and pesticides in mixed forms in different combinations and less concentrations, provision of plant protection equipment, training on plant protection technologies, increasing the radio broadcasts and telecasts on pesticide usage and health hazards due to indiscriminate use of pesticides, educating the farmers to identify adulterations, conducting different programmes and demonstrations regarding integrated pest management, timely availability of plant protection chemicals, improving the accessibility of source of getting eco-friendly technologies to overcome the problems.

A strategy was also been formulated to reduce the health hazards of cotton farmers due to pesticides by involving organizations like research stations, extension centers and department of agriculture.

Technical strategies like following biological control methods, integrated pest management practices, introducing safe storage, handling, mixing and cleaning procedures and prohibition of aerial spraying. Administrative strategies like mandatory certification of pesticide retailers and distributors, Alternative policies such as taxation and limiting the levels of pesticides, alternatives to pesticides can be subsidized, mandatory periodic inspection of spray equipment and dose rate reduction programme. Awareness raising campaigns, independent demonstration programmes, training distributors, advisors, farmers, and promoting research activities to reduce the risks in use of pesticides were given under extension strategies.
AGRICULTURAL EXTENSION

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ABSTRACT

The present study entitled ‘A Study on SWOT Analysis of Bt Cotton Cultivation in Karimnagar District of Andhra Pradesh’ had been initiated focusing on the Strengths, Weakness, Opportunities and Threats of Bt cotton cultivation.

Exploratory research design was adopted in the present investigation. Karimnagar district of Telangana region of Andhra Pradesh state was purposively selected for the study as it has highest area under Bt cotton cultivation. The study was conducted in 12 villages selected from 3 mandals of Karimnagar district, which included 10 farmers from each of the selected village. Thus, a sample of 120 Bt cotton farmers were selected for the study.

The analysis of profile characteristics of Bt cotton growing farmers indicated that majority of the respondents were middle aged, had primary school education, medium farming experience in both cotton and Bt cotton cultivation, small farm size, cultivating Bt cotton in red soils, medium level of social contacts, high marketing behaviour, frequently utilised friends/neighbours as personal localite sources of information, had medium economic motivation, medium scientific orientation, no training under gone and medium risk orientation. Majority of the respondents were using open well/bore well/drip irrigation for Bt cotton cultivation. Majority of the respondents had good FYM availability whereas 45 per cent of the respondents had good availability of seeds and 61.67 per cent of the respondents had poor availability of bio-fertilizers.
Majority of the respondents perceived that Bt cotton is relatively advantageous over non Bt cotton in terms of saving of time and net profitability. Majority of the respondents perceived that Bt cotton is compatible over non Bt cotton in terms of physical compatibility. Majority of the respondents perceived that Bt cotton is not complex compared to non Bt cotton in terms of difficulty in understanding and application in the field. Majority of the respondents perceived that Bt cotton is practicable in terms of trailability.

Majority of the respondents borrowed credit from rural banks ranging from Rs.20,000 to Rs.1,00,000. Majority of the respondents borrowed credit by paying interest between 1-3 per cent to private money lenders.

Majority of the respondents used their credit for cotton cultivation compared to other crops like maize, pulses and leafy vegetables. Remaining 20 per cent of the respondents used their credit for non agricultural purposes like marriages and other functions in their homes.

Majority of the respondents expressed changes due to Bt cotton cultivation as higher net returns, increase in yields and increased area under cultivation. Fifty five per cent of respondents expressed that due to Bt cotton cultivation there was occurrence of new pests and diseases like mealy bugs, tobacco streak virus, cucumber mosaic virus, grey mildew and wilt. Majority of respondents indicated that there was no change in pest population and there was a decrease in cost of cultivation.

The major strengths of Bt cotton cultivation as expressed by the Bt cotton growers were significant yield increase, reduced pesticide sprays for bollworm and higher net income. Major weaknesses perceived by the Bt cotton growers were poor performance in rainfed conditions, emergence of new pests and diseases like mealy bugs, Tobacco streak virus, cucumber mosaic virus, grey mildew and wilt. Availability of seed in time in sufficient quantities and savings on labours were the top three opportunities of Bt cotton cultivation as perceived by the farmers. In threats of Bt cotton cultivation farmers had given first rank for high cost of Bt cotton seed.

Positive consequences of Bt cotton cultivation as perceived by Officials of Department of Agriculture were reduced debts due to Bt cotton cultivation (50%) and negative consequences such as fall in cotton price due to more production under Bt cotton (90%), incidence of sucking pests, grey mildew and wilt incidence (70%) were also perceived by them.

Positive consequences of Bt cotton cultivation as perceived by the Agricultural scientists were increase in cropping intensity (90%) and increased yields due to high net returns (80%). Negative consequences perceived were fall in cotton price due to more production under Bt cotton (80%), reduction in area under food crops like maize, jowar etc., (80%), incidence of sucking pests, grey mildew and wilt (70%).
The consequences of cultivation of Bt cotton as perceived by majority of doctors was the problem of skin allergies (100%).

The consequences of consumption of Bt cotton stubbles by cattle, sheep and goat as perceived by veterinary doctors were mild cough and sneezing in cattle (100%), followed by nasal bleeding in sheep and goat (90%) and reduction in rumination (80%).

The positive consequences of Bt cotton cultivation as perceived by personnel of voluntary agencies were Bt cotton cultivation reduced pesticide sprays for bollworm (30%) and negative consequences were incidence of grey mildew and wilt (90%), increased mirid bug attack (90%) and incidence of sucking pests (80%).

Consequences of Bt cotton cultivation as perceived by officials of Bt cotton company were increased yields (100%) and reduced pesticide sprays for bollworm (90%), whereas increased incidence of sucking pests (40%), increased grey mildew and wilt incidence (40%) were the negative consequences perceived by Bt cotton officials.

Suitable strategies developed for benefiting Bt cotton farmer were: Utilization of television and cell phones for transfer of cultivation practices and other important messages to the farmers on Bt cotton. More number of trainings to be given on adoption gaps such as cultivation of refugee rows, selection of soil types etc. Promotion of farmer led extension, refinement of Bt cotton package of practices should be conducted according to farming situation through the participatory technology development mode. As India is a party of Cartagena Protocol on biosafety under the Convention on Biological Diversity (CBD), there is a need to develop effective and low cost GMO detection kits for testing purity of seed. Increased research on human and cattle health hazards caused by Bt hybrids of crops like Maize, brinjal, cabbage, cauliflower, groundnut, mustard, okra, pigeon pea, rice, and tomato where the Bt trails are in various stages of testing. Development of specific packages for management of newly emerging pest and diseases like tobacco streak virus, cucumber mosaic virus, mealy bugs, grey mildew and wilt. Increasing inspection and attacks on the private companies well in advance before sale of the seeds and fertilizers instead of taking action after the inputs are sold. Stringent measures on the dealers and companies and cancelation of licences and imprisonments should be done on those selling spurious seed or high cost seed were some of the suggested strategies for further promotion of Bt cotton.
AGRICULTURAL EXTENSION

Author : PRAVEEN, N.

Title of the thesis : **A STUDY ON INDIGENOUS TECHNICAL KNOWLEDGE OF TRIBAL FARMERS IN TELANGANA REGION OF ANDHRA PRADESH**

Major Advisor : **Dr. I.SREENIVASA RAO**

Degree : **Ph. D.**

College : **COLLEGE OF AGRICULTURE, RAJENDRANAGAR**

Accession Number : **D 9487**

ABSTRACT

Interest in Indigenous Technical Knowledge (ITK) has been fuelled by the recent world wise crisis and realization that it causes partly in over exploitation of natural resources based on inappropriate attitude and technologies. Scientists now recognize that indigenous people have managed the environments in which they have lived for generations, often without significantly damaging the local ecologies. Many feel that Indigenous knowledge can thus provide a powerful basis from which alternative ways of managing resources can be developed.
A study was conducted aiming to document and categorize the existing ITKs of tribal areas in Telangana region of Andhra Pradesh, their rationality and validity, perceived attributes, attitude, extent of adoption, relationship and conclude with different strategies for disseminating scientifically rationale and valid indigenous agricultural practices.

A total of 297 ITKs were documented from 216 tribal farmers across the study areas. Of the 297 ITKs could be observed that 6.06 per cent related to rice cultivation, sorghum accounted 5.72 per cent, cotton accounted 4.71 per cent, tribal food and medicines were 9.76 and 3.36 per cent respectively. Whereas mize and bajra accounted 3.70 and 3.36 per cent respectively. The ITKs related to redgram, blackgram & greengram accounted for 4.71 and 2.35 per cent respectively. The ITKs related to groundnut, sessamum and korra accounted 3.70, 2.02 and 1.68 per cent and 3.03 and 2.69 per cent belonged to turmeric and coriander respectively.

Majority 21.21 per cent of ITKs were related to general agriculture and 16.49 per cent were related to plant protection.

A sample of 80 agricultural scientists viz. 40 from crop production (Agronomy, Plant breeding and soil science) 40 from plant protection (Entomology and Plant Pathology), 5 scientists from Foods & Nutrition and 5 Ayurvedic doctors were selected for assessing the rationality and validity.

Among the 297 ITKs, 208 (70.03%) ITKs were judged as rational by the scientists and among them 89 ITKs (29.97%) were judged as valid ITKs.

Majority of the rational ITKs were belonged to indigenous varieties (17.79%), pest & disease management (13.94%), Tribal foods (13.94%) and crop rotation (10.10%).

Majority of the tribal farmers perceived the ITKs as better than the modern technology, with regard to relative advantage of ITKs, majority (67.1 %) of them perceived as high relative advantage over modern technologies and 30.1 and 2.8 per cent of them were perceived as medium and low relative advantage, respectively.

Majority (78.8 %) of the tribal farmers perceived the ITKs as highly compatible, followed by 18.9 and 2.3 per cent were perceived as medium and low compatible respectively.

Majority (80.5%) of tribal farmers perceived as low complexity of ITKs and 19.5 per cent of tribal farmers perceived ITKs as highly complex.

With regard to trialability attribute of ITKs, majority (75.5%) of the respondents were perceived the ITKs as high and 24.5 per cent as low trialability.
Nearly half of ITKs (46.7%) having high observable results, 29.2 and 24.1 per cent of them having medium and low observability respectively.

Majority of the respondents 50.92 per cent had favorable attitude toward ITKs followed by highly favorable attitude 24.53 per cent, neutral 11.57 per cent, unfavorable attitude 6.94 per cent and highly unfavorable attitude 6.01 per cent.

With regard to adoption of ITKs, 66.67 per cent of ITKs related to general agriculture were completely adopted by more than 50 per cent of the tribal farmers. Whereas complete adoption was observed in podu cultivation (75%), paddy (66.67%), maize (72.73%), sorghum (62.5%), cotton (64.29%), bajra (50%), foxtail millet (60%), chillies (75%), blackgram & greengram(57.14%), sesamum (83.33%), redgram (71.43%), groundnut (63.64%), turmeric (55.56%), Tomato (50%), brinjal (60%), coriander (50%), plant protection and post harvest technology (65.87%), tribal foods (65.52%) and tribal medicines (70%).

But partial adoption was included by more than 50 per cent of the respondents in 28.57 per cent of ITKs related to general agriculture. Where as partial adoption in podu cultivation(16.67%), paddy (27.78%), maize (27.27%), sorghum (31.25%), cotton (21.42%), bajra (40%), foxtail millet (20%), chillies (25%), blackgram & greengram(42.86%), sesamum (16.67%), redgram (28.5%), groundnut (36.36%), turmeric (33.33%), Tomato (50%), brinjal (40%), coriander (50%), plant protection and post harvest technology (31.71%), tribal foods (24.14%) and tribal medicines (20%).

The ITK not adopted by more than 50 per cent of the respondents were in general agriculture (4.76%), podu cultivation(8.3%), paddy (5.55%), sorghum (6.25%), cotton (14.29%), bajra (10%), foxtail millet (20%), turmeric (11.11%), plant protection and post harvest technology (2.43%), tribal foods (10.34%) and tribal medicines (10%).

Correlation value ‘r’ of the four attributes i.e. relative advantage, compatibility, trialability and observability selected for the study were influencing extent of adoption significantly and positively whereas the complexity was negatively significant at 1 per cent level of probability. The overall perceived attributes score was also positively significant at 1 per cent level with adoption of ITKs by the tribal farmers.

Strategy for scientifically rational and identified ITKs include validation of rational ITKs, Documentation of valid ITK, Establishment of separate cell & fund for protection of ITKs IPR / GI issues, Market intelligence cells and incubators for commercialization of ITKs, Networking of tribal potential farmer leader and potential farmers are potential disseminators of Indigenous Technical Knowledge.
ABSTRACT

Agricultural Extension is an educational service or system which assists farmers through educational procedures in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living and lifting the social and educational standards of rural life. Agricultural extension services include transferring knowledge to farmers, advising and educating farmers in their decision making, enabling farmers to clarify their own goals and possibilities, and stimulating desirable agricultural developments. Traditional public-sector extension services use a variety of extension programmes to overcome barriers to technological adoption without much success. Agricultural extension, which depends to a large extent on information exchange between and among farmers on one hand, and a broad range of other actors on the other, has been identified as one area in which ICTs can have a particularly significant impact. There is growing recognition that farmers and members of rural communities have needs for information and appropriate learning methods that are not being met.

A descriptive research design and exploratory study were adopted for the present investigation. The study was conducted in Ranga Reddy district of Andhra Pradesh purposively as it is the one of the major states where a number of ICTs projects are being implemented. A proportionate number of respondents were selected both from public and private sectors. For representation from public organizations, respondents were taken from State Department of Agriculture, Ministry of Agriculture-National Institute of Agricultural Extension Management (MANAGE) GOI, State Agricultural University-Acharya N G Ranga Agricultural University (ANGRAU) and ICAR institutes. For private sector, respondents were taken from Nagarjuna fertilizers, ETV, TV5, e-choupal (ITC) etc. were purposively selected for the study. A proportionate sample of 60 respondents each was selected randomly from State Department, Research and development (R&D) sector and Private Organizations for the study. Thus a total of 180 respondents were selected for the study. For R&D sector respondents from SAU (ANGRAU)-KVKs, DAATTCs and ICAR institutes were selected. The data was collected with the help of questionnaire.
In R&D sector, majority of the respondents were old, male, doctorates, hailing from both rural and urban areas, have less experience in job and extension was their major job responsibility. In case of SDA, majority of the respondents were young, male and graduate, hailing from rural areas and belongs to the low category of number of years of service. Extension was the major job responsibility. A majority of the private sector respondents were young, male and post graduate, hailing from urban areas. They have less years of service and extension was their major job responsibility. Majority (82.22%) of the respondents have personal computer/laptop. About 69 per cent of the respondents have personal computer/laptop with internet connection. Cent percent respondents have the mobile phone while a little less than half of the respondents (45.56%) have smartphone. With regard to SDA sector respondents, majority (53.33%) were hailing from low category followed by medium (33.33%) and high (13.33%) whereas about 47 per cent private sector respondents were belonging to high category followed by medium (40.00%) and low (13.33%). About 94 per cent respondents have awareness about ICTs through interpersonal communication channels like family members, friends and colleagues followed by mass media channels (84.44%) like newspaper/magazines/books etc., trainings (81.67%) and internet (57.78%). It could be seen from the table that slightly more than half of the respondents (57.78%) had undergone trainings on ICTs. R&D and SDA sector respondents learned ICTs skills majorly as guidance from colleagues/friends whereas private sector respondents majorly learned ICTs skills from trainings. Trainings to learn ICTs skills are a major method in private sector in comparison to R&D sector and SDA Sector. Thus, trainings on ICTs is a major area where both R&D and SDA sector are lagging behind and it should be a focus point for higher authority or policy makers to update knowledge and skills of respondents on ICTs. Besides, trainings, guidance from colleagues/friends is also a major contributing factor in method of learning ICTs skills.

Majority of the training by the R & D sector respondents were of one week to one month duration followed by the up to one week (23.33%) and more than one month (08.33%). SDA sector respondents received training on ICTs maximum of up to one week (20.00%) and about 07 per cent trainings were of one week to one month. Not a single respondent was trained on ICTs for more than one month. Majority of the private sector trainings on ICTs were of one week to one month (53.33%) followed by up to one week (36.67%) and more than one month (26.67%). On an average, majority of the trainings were of one week to one month duration (29.44%) followed by up to one week (26.67%) and more than one month (11.67%).

A majority (40.00%) of the R & D sector respondents have favourable attitude towards use of ICTs in agricultural extension followed by highly favourable (33.33 %) and neutral (20.00 %). With respect to SDA respondents, 45 per cent respondents have favourable attitude towards use of ICTs in agricultural extension followed by highly favourable (11.67%), neutral (25.00 %) and unfavourable attitude (18.33%). About 42 per cent private sector respondents have more favourable attitude towards use of ICTs in extension followed by favourable attitude (33.33 %). Not a single respondent from all three respondents’ categories having the highly unfavourable attitude. In total, it can be summed up from the table that majorly respondents have favourable (39.44%) and highly
favourable (28.89%) attitude towards the use of ICTs in agricultural extension. At individual level, majority of the respondents (60.00%) have experience in Mobile SMS from more than five years followed by telecommunication facilities (58.89%), computer hardware (55.00%), audio visual systems (52.78%), LCD (53.33%), VCD/DVD players (51.67%) and others. About 39 per cent respondents were having experience in use of video conferencing from one to five years followed by audio visual systems (37.22%), computer software (32.78%), computer hardware (33.89%) and others. There is very less percentage of the respondents who were using ICTs tools from less than one year like computer software (26.67%), video conferencing (26.11%), telecommunication facilities (12.22%), VCD/DVD Players (24.44%), LCD (27.22%), computer electronic communication (20.56%) and others. Organization has a cent per cent experience in use of technologies like computer hardware (100.00%), audio visual systems (100.00%), telecommunication facilities (100.00%), computer networks (100.00%), VCD/DVD players (100.00%), LCD (100.00%) etc. from more than five years but when it comes to the use of latest ICTs tools, like kiosks, mobile telephony, online social networking etc., not a single organization has experience from more than five years. Majority of the (51.67%) R&D sector respondents have medium e-readiness following by high (25.00%) and low (23.33%). About 64 per cent SDA sector respondents belong to medium e-readiness followed by low (28.33%) and high (08.33%) whereas about 84 per cent private sector respondents were falling in high category of e-readiness followed by medium (13.33%) and low (03.33%). In total majority of the respondents (42.78%) belong to medium category of e-readiness followed by high (38.89%) and low (30.56%). Power supply is one of the major problems identified by the respondents in all stages of effective use of ICTs followed by content development, expert availability, trainings and working conditions of ICTs. As these all problems are connected to each other so these problems should handle with care and in integrated mode instead of isolation mode.

Suggestions provided by the respondents with respect to use of ICTs in Agricultural extension systems are for effectiveness of the technology. There is a need to focus on the regular and frequent update of the information which is to be provided to its end users as information is the first and foremost requirement of not only the farming community but also the other stakeholders in the agricultural extension system. The updation of information should be supported by the frequent updation of the software or the hardware of the technology as both are complementary to each other. Besides, regular updation of information and software, there is also a need to see the compatibility of technology with the technology components itself, with other methods used and definitely with the end users etc.

For the effectiveness of ICTs, strategy should be planned in an integrated manner covering the important aspects like polices, institutions, stakeholders, human resources development, ICT knowledge centre, ICT infrastructures, content development, blending, identification of ICT experts and innovative leaders, ICTs upgradation, refinement and innovation and monitoring and evaluation.
AGRICULTURAL EXTENSION

Author : SAMPATH KUMAR, M.
Title of the thesis : A STUDY ON THE AGRICULTURAL MECHANIZATION IN KARIMNAGAR DISTRICT OF ANDHRA PRADESH
Major Advisor : Dr. R. VASANATHA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9529

ABSTRACT

The present study entitled ‘A Study on the Agricultural Mechanization in Karimnagar District of Andhra Pradesh’ had been initiated focusing on the knowledge, extent of use, attitude and documentation of farmers innovations in agricultural implements and machinery.

Ex post facto research design was adopted in the present investigation. Karimnagar district of Telangana region of Andhra Pradesh state was purposively selected for the study as maximum budget is allotted by the Department of Agriculture, Government of Andhra Pradesh for this district among the other Telangana districts under farm mechanization.

The study was conducted in 4 villages selected from 2 mandals of Karimnagar district, which included 30 farmers from each of the selected village, thus a sample of 120 farmers were selected for the study.
The analysis of profile characteristics of farmers indicated that majority of them were middle aged group (47.00%), had primary school education (37.5%), had low farming experience (59.00%), had medium socio economic status (41.00%), had medium source of procurement of agricultural implements and machinery (60.0%), had medium level of socio political participation (48.5%), had more than one crop (71.00%), had more than one source of irrigation (52.5%), had one time participation in extension activities related to agricultural implements and machinery (47.5%), had low labour availability (57.5%), had medium level of scientific orientation (52.5%) and had high repair centers availability (62.5%).

Majority of the large farmers had high knowledge (57.5%) regarding agriculture implements and machinery followed by medium and small farmers (45%) had low and medium knowledge

Majority of the large farmers (62.5%) and medium farmers (50%) had medium extent of use of agriculture implements and machinery and small farmers (40%) had low extent of use.

Majority of small farmers (50%) had unfavorable attitude, followed by medium (52.5%) having partially favorable and large (37.5%) having partially favorable and large (37.5%) having partially favorable attitude.

Gaps in knowledge and extent of use in Farm implements and machinery indicated that knowledge gap is 65.4 per cent among overall small farmers, (57.3%) among medium farmers, (53.9%) among large farmers. Knowledge gap is found to increase from large to medium, medium to small farmers in that order.

In case of gaps in extent of use, overall small farmers were found to possess (53.5%) of gap in extent of use, medium farmers had (44%) of gap in extent of use and large farmers had (17.1%) of gap in extent of use. The gaps in extent of use were found to increase from large to medium to small farmers in that order.

The results of correlation between the independent variables and knowledge indicated that the independent variables socio political participation, labour availability, mode of procurement of agricultural Implements and machinery, participation in extension activities related to Agricultural Implements and machinery and types of crops cultivated were found to be positive and significant correlated with knowledge.

Independent variables namely socio-economic status, participation in extension activities related to Agricultural Implements and machinery, availability of Repair centers and types of crops cultivated were found to be positive and significantly correlated with extent of use.

Independent variables namely education, farm size, mode of procurement agricultural Implements and machinery and participation in extension activities related to Agricultural Implements and machinery were found to be positive and significantly correlated with attitude. Rest of independent variables was not significant.

Majority of paddy farmers expressed the problem of wheel breakage (83.3%) in power tiller followed by wear and tear of blades in puddler (66.6%). In case of irrigated
dry crop growers, majority (75%) expressed the problem of loosening of bolts and nuts in MB plough followed by plough shear wear out (63.3%).

NGOs and officials of department of Agriculture should take steps to organise training programmes and field demonstrations for creating awareness and usage of implements and machinery especially for this group. Custom hiring centres should be established within very much accessible distance to farmers. Government should take steps to provide hassle free soft loans to farmers for purchase of farm machinery. Service units should be encouraged and mobile service units should be started. Government should encourage private entrepreneurs to set up hi tech machinery hubs for high value crops like cotton, sugarcane, vegetables, flowers etc.

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### ABSTRACT
The present study entitled ‘A Study on entrepreneurial behaviour and attitude of rural youth towards agri entrepreneurship’ had been initiated focusing on the agri entrepreneurship.

Ex-post facto research design was adopted for carrying out the study. The state of Andhra Pradesh and Telangana region were selected purposively. Nizamabad and Karimnagar districts of the region were selected randomly. Six villages from each district, ten respondents from each villages were selected randomly, thus a total of 120 respondents constituted the sample for the study. Interview schedule was used for data collection and the statistical measures like mean, S.D, frequency, percentage, correlation coefficient were used.

Most of the respondents were late young aged (38.33%), had college and above level education (65.84%), had not undergone any training (78.33%), within training undergone majority (65.38%) of them had only knowledge based training, low entrepreneurial experience (41.67%), manufacturing entrepreneurial activity (52.50%), micro scale of operation (67.50%), solo proprietorship ownership status (55.83%), low extension contact (41.67%), non official position (40.83%) and official position (40.00%) in one or more organizations, medium information seeking behaviour (50.83%), high economic motivation (43.33%), low family support (42.50%), medium financial support (37.50%), seasonal raw material supply (77.50%), whole sale market for their product (85.83%) and outside the village market (85.83%).

Most of the respondents had medium achievement motivation (36.67%), management orientation (39.17%), technology orientation (26.66%) and overall entrepreneurial behaviour (29.17%), high innovativeness (33.33%), risk orientation (41.67%) and self-confidence (35.83%), very high leadership ability (33.33%) and decision making ability (43.33%).

Most of the respondents (30.00%) had neutral attitude towards agri entrepreneurship followed by favourable (24.17%), most unfavourable (18.33%), unfavourable (15.00%) and most favourable (12.50%) attitude towards agri entrepreneurship.

Relationship of profile characteristics of the respondents with their entrepreneurial behaviour and attitude:

The independent variables like age was positively and significantly related with leadership ability, self-confidence, management orientation, overall entrepreneurial behavior and negatively and significantly related with the innovativeness, risk orientation and technology orientation. The variable education was positively and significantly related with innovativeness, risk orientation, self-confidence, technology orientation and overall entrepreneurial behavior. The variable training undergone was positively and significantly related with risk orientation, achievement motivation, management orientation and overall entrepreneurial behavior. The variable entrepreneurial experience was positively and significantly related with self confidence, management orientation and overall entrepreneurial behavior and negatively and significantly related with risk orientation and
technology orientation. The variable type of enterprise was negatively and significantly related with self confidence. The variable extension contact was positively and significantly related with innovativeness and self confidence. The variable socio political participation was positively and significantly related with leadership ability. The variable information seeking behaviour was positively and significantly related with innovativeness. The variable economic motivation was positively and significantly related with innovativeness, leadership ability, self confidence and overall entrepreneurial behaviour. The variable marketing facilities was positively and significantly related with self confidence.

The variables age, education, training undergone, entrepreneurial experience, economic motivation were found to be positively and significantly related with attitude of rural youth towards agri entrepreneurship.

The major problems elicited by the respondents were ‘Shortage of labour’ (52.50%), ‘Procurement of raw material is difficult’ (45.83%), ‘Lack of skill oriented training programmes’ (40.83%), ‘Lack of working capital for running the enterprise’ (30.00%), ‘Seasonal supply of raw material’ (27.50%), ‘Interruption in power supply’ (27.50%).

The major suggestions offered by the respondents were ‘Provide skill oriented training programmes’ (40.83%), ‘Improve technical knowhow knowledge’ (35.83%), ‘Regular supply of electricity and water’ (35.00%), ‘Simplify the loan sanctioning procedure’ (35.00%) , ‘Formation of organization or association to get help from all sources’ (32.50%).

AGRICULTURAL EXTENSION
ABSTRACT

The present study was conducted with broad objective of studying the entrepreneurial behaviour of members of Kudumbashree Neighbourhood Groups (NHGs) in Palakkad district of Kerala. The study was framed in such a manner to explore the selected profile characteristics of members of Kudumbashree NHGs and to identify the relative importance of different components of entrepreneurial behaviour of its members. The problems faced by the NHG members and their suggestions to formulate a strategy for effective functioning of NHGs for better entrepreneurship was also elicited.

Ex-post- facto research design was followed in the present investigation.

Alathur, Ottappalam and Palakkad taluks of Palakkad district of Kerala were purposively selected for investigation on the basis of presence of variety of Kudumbashree micro enterprises. Two villages were selected from each taluk thus constituting a total of six villages. A total of 120 NHG members, 20 from each group of five NHGs from each village were selected randomly. Eleven independent variables and the entrepreneurial behaviour as the dependant variable were identified for the study.

Majority of the NHG members were middle aged, educated up to the secondary level with medium income level, social participation, mass media exposure, training undergone, extension contact, marketing facilities, management orientation, value orientation and credit orientation. Majority of the NHG group members had medium level of entrepreneurial behaviour.

The study also revealed that among the ten different components of entrepreneurial behaviour selected for the study, respondents gave first preference to ability to coordinate the enterprise followed by decision making ability and innovativeness which were given the second and third preference respectively. Cosmopolitaness, managerial assistance, risk taking ability, knowledge of the selected enterprise, achievement motivation, information seeking and leadership ability were given 4th, 5th, 6th, 7th, 8th, 9th and 10th preferences by the respondents. Hence it is clearly evident that the NHG members are conceiving coordinated group efforts as the most
important factor for the success of an enterprise. All the components should be given adequate attention while framing the training programmes for the development of entrepreneurs by the concerned agency.

Correlation analysis revealed that age and credit orientation had non significant relationship with entrepreneurial behaviour. Education, income, social participation, mass media exposure, training undergone, extension contact, marketing facilities, management orientation and value orientation had positive and significant relationship with the entrepreneurial behaviour of Kudumbashree Neighbourhood Group women.

Regression analysis revealed that out of the 11 selected independent variables, mass media exposure, extension contact, marketing facilities and management orientation are positively and significantly contributed to the most of the variation in entrepreneurial behaviour of Kudumbashree NHG women.

Problems due to delayed payment for their produce is the major restraint followed by varying nature of the demand for the products, prejudices among the consumers about quality of the product, lack of proper marketing place, competition from other enterprises, less remunerative nature of the work, dearth of whole sale markets in the nearby areas for purchasing the inputs in large quantities, unavailability of inputs at right time, high cost / less quality of inputs, lack of money for purchasing the inputs, non cooperation among the NHG members unavailability of loan at lower interest rates, difficulty in getting the loans and unsatisfactory working conditions are cited as the major constraints faced by the Kudumbashree NHG members.

Timely payment of the money for the products purchased, demand for active role of Kudumbashree Zilla mission in making the market competition fair among the various units, need for improved machineries and skill oriented training programmes, NHG – Bank Linkage for all approved micro enterprises, sourcing of inputs in wholesale by the District Mission and its distribution to enterprises, provision of inputs at subsidized rates for Kudumbashree microenterprise, demand for active role to be played by the CDS chair person to settle the disputes within the enterprises and compulsory attendance and thrift collection by the members in the weekly meetings were the major suggestions given by the members of Kudumbashree NHGs.
ABSTRACT

Rice has shaped the cultures, diets and economies of thousands of millions of people in the world. India occupies first position in the area (44.6 m ha) which is the highest area occupied by a single crop in the million-hectares. It contributes 21.5 per cent of global rice production and a share of 15 per cent in global rice export. In Andhra Pradesh rice is the Principal food crop cultivated throughout the state providing food for its growing population, fodder to the cattle and employment to the rural masses.

In Andhra Pradesh, area under rice mostly depends on the monsoon pattern and availability of water in reservoirs. Area under rice was high during 2008-09 (43.87 l ha) and lowest is in 2002-03 (28.22 l ha). There is no scope for increasing area under rice and rice area is replaced by some profitable dry crops due to insufficient water. Rice is grown in 28% of gross cropped area and 50% of area under food crops round the year in all the districts. Though there is a rise and fall of area and production of rice based on water availability, but there is a constant increase in productivity. In the context of food security such decline in area and production is not good to meet the future rice requirement. In the coastal districts the area under rice is declining because of aquaculture activities.

Hence the study to analyze the constraints faced by the farmers in rice production was undertaken. The investigation was carried out in four mandals of Nellore district of Andhra Pradesh which were purposively selected, where rice were intensively grown. Ex-post-facto research design was adopted for the study. A sample of 120 farmers were randomly selected from the eight selected villages. The data were collected by personal interview method and analyzed by employing suitable statistical methods. Fourteen
independent variables were subjected to statistical analysis for the purpose of
categorization of the respondents and for studying their relationship with the dependent
variable i.e. constraints faced by the rice farmers.

Majority of the rice farmers engaged in rice farming were middle aged, medium
farmers with medium farming experience, training undergone, credit orientation, social
participation, mass media exposure, extension contact, economic motivation, scientific
orientation, management orientation and innovativeness and with high risk orientation.

Correlation analysis revealed that there was a negative and significant relationship
between education, training undergone, credit orientation, social participation, mass
media exposure, extension contact and scientific orientation of rice farmers. While risk
orientation had positively and significant relationship with the dependent variable. However, age, farming
experience, farm size, economic motivation, management
orientation and innovativeness had non significant relationship with the dependent
variable i.e. constraints faced by the rice farmers.

Regarding constraints expressed by rice farmers in rice production, inadequate
family labour was ranked first by all the rice farmers followed by unskilled labour / inadquate availability of skilled labour, younger generation not interested in rice
farming, lack of cooperation among the farmers, scarcity of labour due to MGNREGS,
increasing processing costs, lack of awareness on various departmental subsidy schemes,
high cost of farm machinery, Lack of processing facilities at local level, lack of proper
storage facilities, high cost of FYM / chemical fertilizer, high cost of labour, low labour
productivity, lack of skill in using machinery, high rental charges of certain farm
machinery during peak season, weed infestation and epidemics of pest and diseases.

Among the suggestions proposed by the respondents to overcome the constraints,
availing better market prize was ranked first to overcome the constraints in rice
production followed by giving priority to rice farming in NREGP programme, adopting
full mechanization in rice farming, formation of procurement centre at panchayat level,
implementation of interest free loan scheme to all the farmers through co-operative
societies, establishment of rice mills at local level, increasing of subsidy and support for
rice farming, increasing the efficiency of the extension staff , adoption of group farming
approach in rice farming, implementation of schemes to provide green manure to farmers
under different projects, prevention of illegal clay mining in rice farming, creating
awareness among the people about the ecological importance of paddy lands were the
suggestions made by the rice farmers.

To overcome the constraints faced by the rice farmers and to fulfill their
suggestions some of the strategies were made like contract labour schemes can be
implemented with the support of panchayat and local bodies; arranging contractors who
will organize a group of labourers and train them to be more skillful and efficient to work
as a team; encouraging the younger generations by the extension personnel making them
to know the potential of agriculture at present; making the farmers aware that agriculture
can be more profitable if they join in groups to take up large scale cultivation;
prioritization of agricultural works related to rice farming should be routed through
NREGP helping the farmers and as well as agricultural labourers; creation of proper storage facilities at panchayat or mandal levels; provision of storage facilities where ever possible by the market yards to the farmers at lower rents; and fertilizer dealers involved in black marketing, stocking of fertilizers and selling at higher prices at peak requirement should be blacklisted and denied of their license.

AGRICULTURAL EXTENSION

Author : VINOD SINGH

Title of the thesis : INDIGENOUS TECHNOLOGICAL KNOWLEDGE AND COMMUNICATION PATTERN OF TRIBAL FARMERS IN SIDHI DISTRICT OF MADHYA PRADESH

Major Advisor : Dr. G. SIVANARAYANA

Degree : M.Sc. (Ag.)

College : AGRICULTURAL COLLEGE, BAPATLA

Accession Number : D 9576

ABSTRACT

Indigenous knowledge is systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture. Indigenous knowledge systems are dynamic, changing through indigenous mechanisms of creativity and innovativeness as well as through contact with other local and international knowledge systems. Indian rural society has its own complicated structure, belief systems and functional mechanisms.

Traditional beliefs are abundant particularly among the rural community. Traditional agriculture is nothing but indigenous knowledge that can only serve as an alternative to modern agriculture.
Sidhi district of Madhya Pradesh is a treasure land of indigenous knowledge on agriculture and allied areas.

Scientists throughout the world have started identifying, documenting and analyzing indigenous technologies that are available plenty on various aspects like agricultural practices, animal husbandry, human health, communication pattern and weather prediction etc.

Keeping these in mind a study was conducted in Sidhi District of Madhya Pradesh.

The oral history method was followed for data collection. Three villages selected from each Kusmi and Majhauli talukas purposively to identify and document the indigenous technological knowledge.

A total number of 90 tribal farmers were randomly selected and interviewed by using pre-tested interview guide.

The main findings of the study were as follows:

The indigenous practices of agricultural resources in different fields are documented such as soil fertility management, water conservation, storage of grains and plant protection etc. Out of total documented practices 49 selected practices send for scientific rationality to the scientists, in which 48 practices comes under rational which got score 3 or more than 3 on five point continuum.

The indigenous practices of livestock resources in different fields are also documented such as selection of milch animal, breeding practices, feeding practices and treatment against different animal diseases (i.e. fever, dysentery, urinary problems, intestinal worms, tail necrosis, FMD, diarrhea and wound healing etc.). Out of total documented practices 33 selected practices send for scientific rationality to the scientist in which 30 practices comes under rational which got score 3 or more than 3 on five point continuum.

For indigenous practices of human health in different fields are documented such as fever, pain, jaundice, diabetes, wound healing, snake bite, cough and cold etc. Out of total documented practices 39 selected practices send for scientific rationality to the scientists in which 31 practices comes under rational which got score 3 or more than 3 on five point continuum.

The results indicated that the correct predictions of rainfall (rainy days) in Panchang are very high i.e. 16.6 to 100, 75.58 to 91.95 and 80.77 % in Month wise, Year wise and Overall mean of five years (i.e. from 2007-2011) respectively.

The study revealed that most of the tribal farmers are preferred Bhauji bazaar (91.11%), for source of information followed by Baithaki/Mukhiya/ Neighbor/Friends (86.66%), wise farmers (72.22%), Radio (66.66%), Ramlila (63.33%), Folk Songs (57.77%), Folk Dance (54.44%) and Folk Tale (53.33%).

Most of the tribal farmers are make worship of Baradev (Gond tribes) and worship of Thakurdev (Baiga tribes) before sowing and harvesting of every crop season.
Most of the farmers are having problems of resource poorness (90%) followed by Illiteracy (77.77%), lack of training facilities (72.22%), Lack of technical guidance (67.77%), Poor economic status of the farmers (64.44%), Lack of transport facility (61.11%), Farmers are not willing to take risk (56.66%), Afraid of work with outsiders (54.44%), Failure of crops due to delay/no rain (50%), Lack of market facilities (46.66%), Poor contact of extension worker with farmers (43.33%) and Lack of cooperation from fellow farmers (42.22%).

Suggestions cum strategies for proper utilisation of ITKs are “Educational facilities should be provided for the tribal people (83.33%)” followed by “Provide training facilities to the farmers on proven indigenous technologies(78.88%)”, “Farm equipment made available to the farmers which are cheaper, easily available and easy to handle based on traditional wisdom (72.22%)”, “Enhancing farmers experimental capacity and farmer to farmer training through participatory approach (68.88%)”, Provide market facility in tribal areas (61.11%)”, “Good, reliable transport and communication facility should be provided in tribal villages (56.66%)”, “Tribal villages should be connected to a regular supply of electricity (53.33%)” and “Strengthening local farmer organisation and also inter villages cooperation (46.66%)”. 
ABSTRACT

India is the largest rice growing country while China is the largest producer of rice. Annually rice is grown on 44.6 million ha land producing about 93.86 million tonnes. The annual production of rice has to be increased to 120 million tonnes by 2020 AD in order to meet the food requirement of the increasing population of the country. Since the demand for rice would continue to grow, there is an adverse to develop new and suitable technologies, evaluate their performance and strengthen the extension front.

The manual method of rice transplanting gives the optimum yield but that involves enormous drudgery, more human stress and also high labour requirement combined with labour intensive operations like nursery raising, uprooting of seedlings, transporting and transplanting them in the main field. The mechanical rice transplanting has been considered as the most promising option because it reduces the labour requirement, saving in time and cost of transplanting, removes human drudgery and can give uniform and desired plant density with better crop stand contributing to higher productivity.

Hence, an experiment was conducted on Development and Evaluation of Yanji 8 row paddy transplanter to suit SRI cultivation over conventional method of transplanting and to study the performance parameters and economics of Yanji 8 row paddy transplanter comparing with manual SRI and conventional transplanting.

The work was conducted at Agricultural College Farm and College of Agricultural Engineering, Bapatla during Rabi season. A field was selected in the Agricultural farm, which was divided in to four plots of areas 2000 m² for existing machine transplanting, 1000 m² for modified machine transplanting, 1000 m² each for manual SRI and Conventional methods. The mechanical planter (Existing and Modified
Yanji 8 row transplanter), manual SRI and conventional methods of transplanting were evaluated in the respective plots.

Tray type nursery was used to plant paddy seedling with existing machine and mat type nursery, for manual SRI and conventional methods. Instead of changing the finger mechanism in Yanji 8 row transplanter, a template with equally spaced perforations and punch consisting of equally spaced spikes were used to make holes in the prepared tray. Templated tray type nursery was used to plant paddy seedlings with modified Yanji transplanter. It was observed that 1 to 2 numbers of seedlings were picked by the finger with modified machine.

To obtain plant to plant spacing of 23 x 23 cm, the existing Yanji 8 row transplanter was modified by changing the gear box, which is connected to the ground wheel. By replacing a new set of gears which are having more number of teeth with the existing less number of teeth, the speed ratio changed from 0.774 for existing to 1.394 for modified. The speed ratio was increased by 0.62 then the plant to plant spacing was changed from 12 cm to 23 cm.

The theoretical field capacity of existing Yanji 8 row paddy transplanter and modified Yanji 8 row paddy transplanter was calculated as 0.1218 ha h$^{-1}$ and 0.1575 ha h$^{-1}$. The actual field capacity of both existing and modified transplanter were found to be 0.1030 ha h$^{-1}$ and 0.1169 ha h$^{-1}$ with field efficiency of 84.46 per cent and 74.28 per cent respectively. The average working speed of existing and modified transplanter was calculated as 0.643 km h$^{-1}$ and 0.810 km h$^{-1}$ respectively.

The average hill spacing, number of seedlings per hill and depth of planting for modified Yanji transplanter were found to be 23, 2 and 2.2 cm, whereas for existing transplanter those were found to as 12, 4 and 2.2 cm respectively. It was observed that the percentage of missing hills for both modified and existing 8 row transplanter were calculated as 6 per cent. The floating hills for modified and existing transplanter were calculated as 6 and 12 per cent respectively.

The early establishment and subsequent growth of transplanted seedlings by modified Yanji transplanter was faster, as reflected in terms of taller plants and more number of tillers per hill than the manual SRI and conventional methods. The net income was 17 per cent, 6 per cent and 14 per cent more in modified transplanter when compared with existing transplanter, manual SRI and conventional transplanting respectively.

A net profit obtained for existing Yanji transplanter, modified Yanji transplanter, manual SRI and conventional transplanting was Rs. 56,318.00, 68,600.00, 63,400.00, and 57,430.00 ha$^{-1}$ respectively.
ABSTRACT

Physical properties of ten varieties of maize (both conventional and hybrid) were determined at different moisture content levels varying from 12 to 20% w.b. It was observed that three axial dimensions, sphericity, surface area, volume, thousand grain weight, true density and porosity were increased with increase in moisture content from 12 to 20% w.b., whereas, the bulk density of all the ten varieties were decreased with increase in moisture content. It was also observed that angle of repose and coefficient of static friction increased on all surfaces (mild steel, plywood and glass) with increase in moisture content. The modifications were carried out to the ANGRAU hand operated maize sheller i.e., the diameter of the cylinder was increased from 13 cm to 21 cm, the adjustable peg tooths were made in peg tooth cylinder, provision was made to change the clearance between cylinder and concave and power transmission system is provided with belt and pulley instead of gears for easy cranking. The existing and modified ANGRAU hand operated maize sheller were tested with variety (NANIYA) at six levels of moisture contents ranging from 10 to 12% w.b. at feed rate of 65 kg/h. It was found that, the shelling efficiency (99.31%, 80.06%) of modified ANGRAU hand operated maize sheller found higher at moisture content of 10% w.b. as compared to the existing ANGRAU maize sheller, unshelled (0.69%, 19.94%) and visible damage (1.21%, 2.05%) percentage of modified ANGRAU maize sheller are found to be significantly lower at moisture
content of 12% w.b, as compared to existing ANGRAU maize sheller respectively. The modified ANGRAU hand operated maize sheller was tested with variety (RUDHIRA 145) at six levels moisture contents ranging from 12 to 20% w.b and feed rates of 120, 130 and 140 kg/h. These three feed rates corresponded to 300, 330 and 350 rpm of the cylinder speed, respectively. It was observed that the shelling efficiency (99.96%) was higher as compared to other combination treatments, whereas the unshelled grain percentage (0.04%) and visible damage percentage (0.77%) was lower when at moisture content of 12 % w.b and at feed rate of 130 kg/h. The popular tubular hand maize sheller was modified to suit different diameters of maize cobs and tested for its performance. The capacity of modified tubular maize sheller was found to be 22-24 kg/h and visible grain damage of percentage of 1.2%.

AGRICULTURAL PROCESS AND FOOD ENGINEERING

Author : VENKATESH, M.V.
Title of the thesis : OPTIMIZATION OF PROCESS PARAMETERS FOR SHELF LIFE EXTENSION OF SWEET ORANGE
Major Advisor : Er. S. VISHNUVARDHAN
Degree : M.Tech. (Ag. Engg)
College : AGRICULTURAL COLLEGE, BAPTLA
Accession Number : D 9479

ABSTRACT

Freshly harvested sweet oranges were stored at ambient condition (Temp = 26-29oC; R.H = 72-83%) without any treatment and different Physico-chemical and microbial attributes were studied on alternate day interval until quality deterioration was observed. PLW (physiological loss of weight) increased gradually during the storage period. Juice content of the fruit has been decreased from 45.28 to 34.38%. Firmness has been found declining initially up to 17 days, later it was increased slightly due to desiccation resulting in drying or toughening of peel. TSS and reducing sugars were found increasing; TSS has been increased from 7.57 to 9.04% and reducing sugars increased from 1.22 to 2.32 %. Ascorbic acid content has been decreased from 38.55 to 27.42 mg/100g. Phenol content in juice has been decreased from 16.49 to 17.43 mg/100g. Acidity has been decreased from 0.91 to 0.53%. The surface microbial load also showed a gradual raise in number of colonies during the storage period. Findings indicated that sweet oranges can be stored at ambient condition without any treatment up to 3 weeks with a minor loss of quality. Some physical properties of grade I (large), grade II
and grade III (small) oranges were investigated. The mean length, breadth and width of grade I (large) oranges were found to be 75.97, 84.32 and 84.00 mm; grade II (medium) oranges were 61.08, 66.99 and 66.75 mm; grade III oranges were 53.71, 58.41 and 58.02 mm respectively. Volume and mass of the grade I oranges were 285.55 cc and 248.77 g; grade II oranges were 143.69 cc and 152.62 g; grade III oranges were 88.73 cc and 96.80 g respectively. The bulk density and fruit density of grade I oranges were 0.50 and 0.88 g cm\(^{-3}\); grade II oranges were 0.58 and 1.06 g cm\(^{-3}\); grade III oranges were 0.52 and 1.09 g cm\(^{-3}\). Porosity of grade I, grade II and grade III oranges were 49.00, 51.04 and 49.04\% with their sphericity being 0.92, 0.93 and 0.93, respectively. The coefficient of static friction for grade I orange on mild steel, glass and plywood surfaces were 0.20, 0.22 and 0.23 respectively; for grade II orange on mild steel, glass and plywood surfaces were found to be 0.16, 0.21 and 0.18 respectively; for grade III orange on mild steel, glass and plywood surfaces were found to be 0.19, 0.22 and 0.21 respectively.

Effect of different chemicals and heat treatments as pre-storage treatments on shelf life of sweet orange stored under ambient and refrigerated condition were investigated. The various treatments include Only Carbendazim treated (1000 ppm), Only Boric acid treated (3\%), Carbendazim treated and hot air cured (53°C, 90% RH for 2 h), Carbendazim treated and hot air cured (53°C, 90% RH for 1 h), Carbendazim treated and hot water dipped (53°C, 6 min), Carbendazim treated and hot water dipped (53°C, 6 min), Carbendazim treated and hot water dipped (48°C, 12 min), Boric acid treated and hot air cured (53°C, 90% RH for 2 h), Boric acid treated and hot air cured (53°C, 90% RH for 1 h), Boric acid treated and hot water dipped (53°C, 6 min), Boric acid treated and hot water dipped (48°C, 12 min). Carbendazim treated and hot water dipped (53°C, 6 min) fruits retained higher values of physico chemical parameters studied and was rated best under both ambient storage and refrigerated storage conditions. Carbendazim treated and hot water dipped (53°C, 6 min) fruits were further investigated by application of various packaging treatments for further improvement of storage life. The various packaging treatments applied were Edible Oil Coating, Shrink wrapping of individual fruits, Tray wrapping. Polyolefin shrink wrapped fruits retained higher values of physico chemical parameters studied and was rated best followed by PVC tray wrapped fruits under both the storage conditions.
ABSTRACT

Cereals and legumes are important food and cash crops, mainly grown in India. They provide cheap sources of energy and protein, and hence, are good substitutes or supplements to major food staples. Grains need to be hydrated first to facilitate
processing operations such as milling, cooking or preparing value added products from it. Adding water is a pre-treatment for the flour milling process (tempering). Tempering is a kernel moistening process that enhances milling efficiency. Soaking is an important operation during the processing of some foods. Soaking of paddy is one of the important activities in the processing line for parboiled rice, puffed rice and flaked rice. From engineering point of view, one is interested not only in knowing how fast the absorption of water can be accomplished, but how it will be affected by processing variables such as temperature and also how to predict the soaking time under given conditions. Thus, the quantitative data on the effect of processing variables are necessary for application to optimize and characterize the soaking conditions, design food processing equipment and predict water absorption as a function of time and temperature.

The hydration kinetics of BPT 5204 paddy, NLR 92 paddy, BPT 5204 rice, NLR 92 rice and black gram was studied by soaking in water up to 180 min at temperatures of 30, 40, 50, 60 and 70°C in water bath by recording moisture content (% d.b). Hydration data was modeled using Peleg’s model, Arrhenius equation and Fick’s second law of diffusion model to develop guidelines for soaking operation.

Peleg’s equation adequately described the hydration behavior of the entire sample under the experimental condition. Peleg’s rate constant and capacity constant (k_1 & k_2) found to be function of soaking temperature. The value of k_1 for BPT paddy, NLR paddy, BPT rice, NLR rice and black gram decreased from 2.45 x 10^{-2} to 1.15x 10^{-2}, 2.46 x10^{-2} to 1.18 x 10^{-2}, 4.12 x 10^{-2} to 1.15 x 10^{-2}, 4.71 x 10^{-2} to 1.07 x 10^{-2} and 4.80 x 10^{-2} to 1.17 x 10^{-2} h % d.b^{-1} respectively as temperature increased from 30 to 70°C. The value of k_2 for BPT paddy, NLR paddy, BPT rice and NLR rice was decreased from 3.93 x 10^{-2} to 2.60 x 10^{-2}, 3.96 x 10^{-2} to 2.27 x 10^{-2}, 3.98 x 10^{-2} to 2.34 x 10^{-2} and 4.13 x 10^{-2} to 2.47 x 10^{-2} % d.b.^{-1} as temperature increased from 30 to 70°C while for black gram, k_2 was decreased from 1.32 x 10^{-2} to 0.393 x 10^{-2} % d.b.^{-1} for temperature from 30 to 50°C and then increased up to 0.476 x 10^{-2} for 70°C. The decrease in k_1 & k_2 demonstrating that the water absorption rate and water absorption capacity increased with time and temperature. Both the Peleg’s constants were expressed by a polynomial function for relating to the soaking temperature.

The Arrhenius equation adequately described interpreting effect of temperature on Peleg’s rate constant (k_1) with activation energy values of 16.56, 14.14, 26.33, 31.17 and 20.78 kJ/mol for BPT 5204 paddy, NLR 92 paddy, BPT 5204 rice, NLR 92 rice and black gram respectively indicating sensitivity of samples to temperature. The effective diffusivity was calculated from hydration data using Fick’s second law of diffusion equation varied from 2.63 x 10^{-11} to 3.75 x 10^{-11}, 1.99 x 10^{-11} to 3.33 x 10^{-11}, 3.21 x 10^{-11} to 4.84 x 10^{-11}, 3.2 x 10^{-11} to 4.57 x 10^{-11} and 1.16 x 10^{-11} to 1.0 x 10^{-10} m^2/s from the soaking temperature 30 to 70°C for BPT 5204 paddy, NLR 92 paddy, BPT 5204 rice, NLR 92 rice and black gram respectively. It was observed that effective diffusivity was increased as temperature increased from 30 to 70°C for all the samples studied.

Leaching loss was also studied for BPT 5204 rice, NLR 92 rice and black gram under experimental condition and found to be linearly related to soaking time and temperature. Bulk density, true density and porosity of all the samples after 1, 2 and 3 hour of soaking also evaluated as a function of soaking temperature in the range of 30 -
Data presented in this study on water absorption, leaching loss, activation energy, effective diffusivity and physical properties of the different samples can help in better design of sorption process and equipment.
ABSTRACT

Experiment on “Response of soybean (Glycine max L.) to sulphur levels with inorganic and organic sources of nitrogen” was conducted during Kharif, 2013 at College farm, Rajendranagar, Hyderabad to find out the optimum dose of sulphur with combination of nitrogen in soybean. The soil of the experimental site was sandy loam in texture, neutral in reaction, medium in available nitrogen, phosphorus and high in available potassium. The experiment was laid out in randomized block design with ten treatment combinations with different ratios of organic (FYM) and inorganic fertilizers (urea) with sulphur levels (0, 20, 30, 40 kg S ha\(^{-1}\)).

With graded levels of sulphur with inorganic and organic sources of nitrogen, more plant height, leaf area and dry matter production per plant, were noticed in T7 (75% Recommended dose of nitrogen (RDN) through urea, 25% nitrogen through FYM and 40 kg S ha\(^{-1}\)) which was on par with T4 (RDN 100% through urea with 40 kg S ha\(^{-1}\)). However these treatments were significantly superior over rest of the treatments. The treatment T1 (RDN 100%) recorded the lowest values of all treatments. The number of days taken to attain flowering was less with increase in levels of sculpture application.

Marked differences were noticed among the treatments with regard to yield and yield attributes like number of pods plant\(^{-1}\), number of seeds pod\(^{-1}\), seed yield and stover yield. The soybean crop applied with the treatment 75% RDN through urea, 25% nitrogen through FYM and 40 kg S ha\(^{-1}\) which was on par with T4 is RDN 100% through urea with 40 kg S ha\(^{-1}\) and T3 is RDN 100% through urea with 30 kg S ha\(^{-1}\) but was significantly higher over rest of the treatments. The treatment T1 is RDN 100% recorded the lowest values of all treatments.

Significantly higher N and S uptake per plant was observed with the treatment T7 but it was on par with T4 both were significantly higher over rest of the treatments. The lowest N and S uptake was observed with the treatment T1.
Significantly highest B:C ratio of 2.7 was obtained with T7. The treatment next in order to increase B:C ratio was observed with T3 followed by T4. From the above study it was concluded that the application of different sulphur levels with recommended dose of nitrogen through urea and FYM enhanced the yield and yield attributes such as number of pods per plant, number of seeds per pod and highest seed yield and stalk yield was recorded in the treatment 75 per cent recommended N applied through urea + 25 per cent N applied through FYM along with 40 kg of sulphur.
Investigations entitled “Studies on nutrient management in aerobic rice-based cropping systems” were carried out for two consecutive years (2011-2012 and 2012-2013) at S.V.Agricultural College farm (ANGRAU), Tirupati (Southern Agro-Climatic Zone of Andhra Pradesh). In these investigations, sunhemp was raised as a preceding crop to aerobic rice during summer, aerobic rice during kharif and groundnut, maize and sunflower were raised during rabi.

The first season (summer) study was laid out in randomized block design without consisting of any treatments, comprising of sunhemp uniformly for green manuring as preceding crop to aerobic rice. At 45 days after sowing, sunhemp was incorporated in-situ. In the second season (kharif), aerobic rice crop was raised in the same undisturbed layout, replicated four times with five graded nutrient levels (N1 - 75% recommended dose of nutrients, N2 - 100% recommended dose of nutrients, N3 - 125% recommended dose of nutrients, N4 - 150% recommended dose of nutrients and N5 - 175% recommended dose of nutrients). In the third season (rabi), each of the kharif treatments were subdivided into three plots in the same undisturbed layout to accommodate groundnut, maize and sunflower. The graded nutrient levels to kharif rice were considered as main plot treatments and rabi crops as sub-plot treatments. Recommended dose of nutrients for the respective crops was applied during rabi.
The results indicated that graded nutrient levels noticeably altered the growth parameters, yield attributes, yield, nutrient uptake and economic returns of aerobic rice as well as the post harvest fertility status of soil, with similar trend during both the years of study.

The growth attributes (plant height, total tillers m$^{-2}$ and dry matter production), yield attributes (panicles m$^{-2}$, number of grains panicle$^{-1}$, filled grains panicle$^{-1}$ and 1000 grain weight), yield, nutrient uptake, economic returns of rice and post harvest fertility status of soil were found to be the highest with N$_5$ (175% recommended dose of nutrients), which were however, comparable with those under N$_4$ (150% recommended dose of nutrients) and all of them were at their lowest with N$_1$ (75% recommended dose of nutrients).

Graded nutrient levels to preceding aerobic rice exerted significant influence on nutrient uptake, economic yield (in terms of rice equivalent yield) and economic returns of rabi crops as well as post harvest fertility status of soil, with similar trend during both the years of study.

As regards the graded nutrient levels to preceding rice, N$_5$ (175% recommended dose of nutrients to kharif aerobic rice) has resulted in the highest nutrient uptake, rice equivalent yield, economic returns of all the three rabi crops and better post harvest fertility status of soil, which was comparable with N$_4$ (150% recommended dose of nutrients to kharif aerobic rice), and all of them were at their lowest with N$_1$ (75% recommended dose of nutrients to kharif aerobic rice). Among all the rabi crops, groundnut crop recorded the highest rice equivalent yield, economic returns and post harvest soil available nitrogen, phosphorus and potassium. Nutrient uptake was significantly higher with maize crop than the other two rabi crops, while all of them at their lowest with sunflower.

Among all the cropping systems, sunhemp-rice-groundnut produced the highest rice equivalent economic yield as well as the highest gross returns, net returns and benefit cost ratio under the influence of N$_5$ (175% recommended dose of nutrients) applied to kharif rice. Post harvest soil status of available nitrogen, phosphorus and potassium was also found to be highest with the same nutrient level in the same cropping system, which were comparable with N$_4$ (150% recommended dose of nutrients to kharif aerobic rice) in the above mentioned cropping system.

In conclusion, the investigation has revealed that sunhemp green manuring-aerobic rice-groundnut cropping system with 150% recommended dose of nutrients (120-60-60 N, P$_2$O$_5$ and K$_2$O) to aerobic rice has resulted in higher productivity and economic returns with improved soil fertility status, thus satisfying all the criteria of sustainability.
Experiment on “Effect of plant growth regulators and chemicals on panicle emergence and yield of late sown rice” was carried out during Kharif 2013 at Agricultural Research Institute, Rajendranagar, Hyderabad, under the Southern Telangana agro-climatic zone of Andhra Pradesh. The soil of the experimental site was sandy loam in texture, alkaline in reaction. The experiment was laid out in randomized block design with ten treatments (T1- Foliar spray of GA3 @ 90 g ha\(^{-1}\) + Boron 0.1% ; T2- Foliar spray GA3 @ 135 g ha\(^{-1}\) + Boron 0.1% ; T3- Foliar spray KH\(_2\)PO\(_4\) 0.2% + Boron 0.1% ; T4- Foliar spray GA3 @ 90 g ha\(^{-1}\) + KH\(_2\)PO\(_4\) 0.2% + Boron 0.1% ; T5- Foliar spray NAA @ 100 g ha\(^{-1}\) + Boron 0.1% ; T6- Foliar spray NAA @ 200 g ha\(^{-1}\) + Boron 0.1% ; T7- Foliar spray BIOBRASS @ 0.3 l ha\(^{-1}\); T8- Foliar spray BIOBRASS @
Higher plant height recorded with application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% which was on par with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1% and \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% at 90 DAP and at harvest. At 90 DAP and at harvest more number of tillers m\(^{-2} \) was produced with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% this was on par with application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% and \( \text{BIOBRASS} \) 0.6 l ha\(^{-1} \). At 90 DAP, application of \( \text{NAA} \) @ 200 g ha\(^{-1} \) + Boron 0.1% and \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1% and application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1% was also on par with these treatments.

At 90 DAP, highest dry matter m\(^{-2} \) was observed with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% and which was on par with \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% and at harvest, application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% recorded more dry matter production.

Days to 5% panicle emergence has not differed in all the treatments, as the treatments are imposed at 5% panicle emergence stage. The crop has come to 5% panicle emergence at 104 days after planting and Days to 50% flowering observed earlier with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1%, \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1%, \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \) and \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% which were on par with each other.

Panicle exertion percentage was maximum with application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% and this was on par with \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% , highest flag leaf angle was observed with application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% . Panicles m\(^{-2} \) was maximum with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% and which was on par with \( \text{NAA} \) @ 200 g ha\(^{-1} \) + Boron 0.1%, \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1%, \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \), \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1 %, \( \text{NAA} \) @ 100 g ha\(^{-1} \) + Boron 0.1% and \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1%.

Highest panicle length was observed with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% which was on par with \( \text{GA}_3 \) @135 g ha\(^{-1} \) + Boron 0.1%, \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1%, \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \) and \( \text{NAA} \) @ 100 g ha\(^{-1} \) + Boron 0.1% and \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1%. Maximum filled grains panicle\(^{-1} \) was observed with application of \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \) and maximum ill filled grains panicle\(^{-1} \) noticed in control.

Highest seed set percentage was observed with application of \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \) and highest test weight was recorded with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + Boron 0.1%. Maximum grain yield was observed with application of \( \text{BIOBRASS} \) @ 0.6 l ha\(^{-1} \) which was on par with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1%. More straw yield noticed with application of \( \text{GA}_3 \) @ 90 g ha\(^{-1} \) + \( \text{KH}_2\text{PO}_4 \) 0.2% + Boron 0.1% and which was on par with application of \( \text{GA}_3 \) @ 135 g ha\(^{-1} \) + Boron 0.1% and \( \text{GA}_3 \)
@ 90 g ha\(^{-1}\) + Boron 0.1\%, the maximum harvest index was recorded with application of BIOBRASS @ 0.6 l ha\(^{-1}\).

Highest gross returns was observed with application of BIOBRASS @ 0.6 l ha\(^{-1}\) and this was on par with application of GA\(_3\) @ 90 g ha\(^{-1}\) + KH\(_2\)PO\(_4\) 0.2\% +Boron 0.1\%, more net returns and highest B:C ratio was observed with application of BIOBRASS @ 0.6 l ha\(^{-1}\).

**AGRONOMY**

**Author** : BHANU PRAKASH, B.

**Title of the Thesis** : RESPONSE OF LOW LAND RICE (*Oryza sativa* L.) TO NITROGEN AND PHOSPHORUS LEVELS IN ALFISOLS

**Major Advisor** : Dr. M. SRINIVASA REDDY

**Degree** : M. Sc. (Ag.)

**College** : AGRICULTURAL COLLEGE, MAHANANDI

**Accession Number** : D 9472

**ABSTRACT**
A field experiment was conducted during kharif, 2011-12 on sandy loam soils of College farm, Mahanandi, Acharya N.G. Ranga Agricultural University, Andhra Pradesh to study the “Response of low land rice (Oryza sativa L.) to nitrogen and phosphorus levels in alfisols” The experiment was laid out in a factorial randomized block design, replicated thrice. The treatments consisted of three nitrogen levels viz., N₁ (160 kg N ha⁻¹), N₂ (200 kg N ha⁻¹), N₃ (240 kg N ha⁻¹), and five phosphorus levels, viz., P₀ (control), P₁ (20 kg P₂O₅ ha⁻¹), P₂ (40 kg P₂O₅ ha⁻¹), P₃ (60 kg P₂O₅ ha⁻¹), P₄ (80 kg P₂O₅ ha⁻¹). Samba Mashuri (BPT-5204) was test variety of rice. An uniform dose of 80 kg K₂O ha⁻¹ was applied to all the plots.

The soil was sandy loam and it was slightly alkaline in reaction with a pH of 7.9; E C of 0.15 dSm⁻¹. The soil was low in organic carbon and low available nitrogen, medium in available phosphorus and high in potassium.

Nitrogen and phosphorus had profound influence on growth parameters, yield parameters, yield, and nutrient uptake of rice as well as post harvest soil fertility status.

At all the stages of observation, the highest plant height, LAI and dry matter production were observed with the highest level of nitrogen viz., 240 kg N ha⁻¹ (N₃) and it was on par with 200 kg N ha⁻¹ (N₂), while the application of 160 kg N ha⁻¹ (N₁) produced short statured plants with the lowest LAI and dry matter production at all the stages. With regard to phosphorus, application of 80 kg P₂O₅ ha⁻¹ (P₄) resulted in tallest plants. Highest LAI was recorded with application of 80 kg P₂O₅ ha⁻¹ and it was on par with application of 60 kg P₂O₅ ha⁻¹, while the shortest plants with the lowest LAI and dry matter production was recorded without phosphorus fertilizer application (control).

Application of 240 kg N ha⁻¹ recorded enhanced levels of yield attributes of productive tillers m⁻², filled, total no. of grains panicle⁻¹ and 1000 grain weight, grain and straw yields and it was on par with application of 200 kg N ha⁻¹ and lowest was with application of 160 kg N ha⁻¹. Regarding to phosphorus application highest no. of productive tillers m⁻², filled, total no of grains panicle⁻¹ and 1000 grain weight, grain yield and straw yield. Productive tillers m⁻², grain yield and straw yield was on par with application of 60 kg P₂O₅ ha⁻¹ and lowest was with control.

The highest nutrient uptake (nitrogen, phosphorus) by the crop in grain and straw was with application of 240 kg N ha⁻¹ and 80 kg P₂O₅ ha⁻¹.

The highest gross returns was recorded with application of 240 kg N ha⁻¹ and highest net returns, Benefit: Cost ratio was observed with application of 200 kg N ha⁻¹ while the lowest gross and net returns as well as benefit-cost ratio were obtained with 160 kg N ha⁻¹ (N₁). Regarding to phosphorus application highest gross returns was obtained with application of 80 kg P₂O₅ ha⁻¹ and highest net return was with 60 kg P₂O₅ ha⁻¹. Benefit-cost ratio were the highest with application 20 kg P₂O₅ ha⁻¹, while the lowest gross returns, net returns as well as benefit-cost ratio were obtained with control and it was statistically non significant.

Highest post harvest available nitrogen was recorded with application of 240 kg N ha⁻¹ and lowest was with application of 160 kg N ha⁻¹. Regarding to phosphorus
application highest post harvest available phosphorus application 80 kg P$_2$O$_5$ ha$^{-1}$ and lowest was with control.

Nitrogen and phosphorus balance due to nitrogen and phosphorus levels, the highest positive balance was obtained with application of 240 kg N ha$^{-1}$ and lowest was with application of 160 kg N ha$^{-1}$. Among phosphorus levels negative balance was obtained with control and 20 kg P$_2$O$_5$ ha$^{-1}$. Positive balance was recorded with application of 40, 60, 80 kg P$_2$O$_5$ ha$^{-1}$.

Among all nitrogen levels tried, application of 200 kg N ha$^{-1}$ had resulted in significantly higher growth parameters, yield attributes and economic returns. Among the phosphorus levels 60 kg P$_2$O$_5$ ha$^{-1}$ had resulted in significantly higher yield, net returns and maintained positive balance of P in soil.

AGRONOMY

Author : CHANDRASEKHAR PYDIMARRI

Title of the Thesis : SEED PRODUCTION OF SUNNHEMP (Crotalaria juncea L.) AS INFLUENCED BY SOWING TIME.
ABSTRACT

A field experiment entitled “Seed production of sunnhemp (Crotalaria juncea L.) as influenced by sowing time” was conducted during rabi, 2011 on clay loam soils of Agricultural College Farm, Bapatla. The experiment was laid out in a randomized block design with ten treatments comprising of T1-October 1st; T2-October 15th; T3-November 1st; T4-November 15th; T5-December 1st; T6-December 15th; T7-January 1st; T8-January 15th; T9-February 1st; T10-February 15th were replicated three times.

The findings of the experiment revealed that the growth parameters viz., plant height, dry matter accumulation, at all stages of crop growth, days to 50 per cent flowering and days to maturity were significantly influenced by the time of sowing.

Among different dates of sowings, early sowing in October 1st resulted taller plants and gave the maximum plant height at 30, 60, 90 DAS and at the time of harvest. The maximum amount of dry matter was also recorded with October 1st sowing at all the growth stages.

The yield attributes viz., number of branches; number of pods, test weight, seed yield, straw yield and harvest index were significantly influenced by the dates of sowing. The crop sown on October 1st produced more number of branches, more number of pods and test weight, when compared to other sowing dates. The highest seed yield (1068 kg ha-1), straw yield (4299 kg ha-1) and harvest index (19.90) were obtained with October 1st sowing which was on a par with October 15th sowing. Yield and yield attributes subsequently decreased with delay in sowings.

Temperature and photoperiod markedly influenced on seed production of sunnhemp. The accumulated agro climatic indices viz., growing degree days ranged from 1666 to 2097 0C day, heliothermal units 11538 to 15431 0C day hour and photo thermal units 18869 to 25533 0C day hour during the crop growth period. The October 1st sowing was accumulated 2066 0C day growing degree days, 14900 0C day hour heliothermal units and photo thermal units 23289 0C day hour, which caused to produce higher dry matter and seed yield.

Among the dates of sowing, the highest heat use efficiency was recorded with October 1st, October 15th sowings, and lowest heat use efficiency was with February 1st and February 15th sowings at maturity.
The significant linear relationships were observed for seed yield and agroclimatic indices *viz.*, growing degree days (GDD), heliothermal units (HTU), photothermal units (PTU). Similarly linear relationship derived between drymatter accumulation and agroclimatic indices.

From the constructed multiple linear regression model for drymatter accumulation and agroclimatic indices, it was observed that the multiple linear regression model-I were significantly adequate and their goodness of fit was 64.2 per cent and multiple linear regression model-II between seed yield and agroclimatic indices, the goodness of fit was 76.7 per cent. The simple linear regression between seed yield, drymatter accumulation and heat use efficiency (HUE) was prepared and the goodness of fit was 97.5 per cent and 65.2 per cent. Based on results of present investigation it could be concluded that The sunnhemp crop sown during the month of October is congenial for realizing higher seed yield and stalk yield than late sowings.

Temperature and photoperiod markedly influenced on drymatter production, yield attributes and seed yield of sunnhemp. Delayed sowings with low temperatures at early stages of crop growth decreased the plant height and biomass production which decreased the seed yield of sunnhemp. High temperatures and longer photo period coupled with reproductive and seed filling phases resulted in poor seed development and seed yield.

Maximum gross returns, net returns and return per rupee invested were also recorded with (October 1st) early sowings of sunnhemp crop.
ABSTRACT

A field experiment entitled “In-situ green manure incorporation effects on nutrient dynamics of kharif maize (Zea mays L.)” was conducted during kharif, 2012 on clay soil of the Agricultural College Farm, Bapatla, under rainfed condition. The treatments consisted of 3 different green manures (dhaincha, sunnhemp and pillipesara) and 3 different ages of their incorporation (60, 45 and 30 days) with an additional control (where no green manuring was done). The experiment was conducted in a randomized block design (RBD) with factorial concept and replicated thrice.

Age of incorporation of green manures only had a significant influence in increasing plant height and drymatter production at 30 DAS of maize. Similar trends were also observed for plant height and drymatter production in maize at remaining stages.

Quantity of green manure biomass production was maximum (13.8 t ha⁻¹) in dhaincha followed by sunnhemp and pillipesara and all these were found to be significantly superior to one and another. Age of incorporation of green manures also had a significant effect on biomass production. The 60 days aged green manure recorded maximum biomass (18.1 t ha⁻¹) which was found to be significantly superior to 45 and 30 days aged green manures. A similar trend was also observed in respect of drymatter production with regard to these greenmanures.

Days to 50% tasseling & silking of maize was significantly reduced due to age of incorporation of green manures whereas, no significant difference was observed due to incorporation of different green manures. Number of cobs per plant due to in-situ incorporation of green manures was also not significant.

No significant difference in respect of cob length, number of grains per cob, cob weight, test weight and shelling percentage was observed due to in-situ incorporation of different green manures but significant increase was observed due to age of incorporation.
of green manures. However, the interaction was found to be non significant. All green manure treated plots recorded a significant increase over control.

Age of incorporation had a significant influence on grain yield of maize. Maximum grain yield (7871 kg ha⁻¹) was recorded when incorporated at 60 days which was significantly superior to 45 and 30 days incorporation of green manures. However, grain yield obtained from 45 and 30 days aged incorporated green manure plots did not attain the level of significance with each other. The minimum grain yield (5761 kg ha⁻¹) was observed in control where no green manuring was done. All the green manure treated plots recorded significantly higher grain yield of maize over control. The percentage increase in grain yield due to 60, 45 and 30 days age of incorporation over control was 36.6 %, 22.0 % and 14.8 %, respectively. All the three green manure crops remained at a par with one and another. However, the interaction between green manures and their age of incorporation was remained statistically at a par. Similar results were observed for stover yield.

Nitrogen content and uptake at harvest were found to be higher in dhaincha incorporated plot which was significantly superior to sunn hemp and pillipesara incorporated plots, however, no significant difference was observed between sunnhemp and pillipesara incorporated plots. Age of incorporation of green manures also had a significant effect on nitrogen content and uptake of maize at harvest. It was found maximum where green manures were incorporated at 60 days which was significantly superior to 45 and 30 days incorporated green manures. Whereas, N content and uptake at 45 and 30 days incorporated green manures remained on a par with each other. All the green manure treated plots recorded a higher N content and uptake in maize at harvest and found significantly superior to control. Nitrogen use efficiency (NUE) of different green manures was highest in dhaincha followed by sunnhemp and pillipesara. Age of incorporation of green manures also had an effect on the NUE. The maximum (18 kg/kg N) NUE was observed with 60 days age of incorporation followed by 45 and 30 days age of incorporation. Overall, there was an increase in microbial population due to incorporation of different green manures and their ages of incorporation. But, the increase in microbial population was more or less was affected due to their ages of incorporation. The pH of the soil 30 DAS as well as at harvest and bulk density at harvest of maize did not vary significantly either due to incorporation of different green manures or their ages of incorporation.

Maximum organic carbon content (0.73 %) in soil 30 DAS of maize was recorded with dhaincha incorporated plot which was significantly superior to sunnhemp and pillipesara. Organic carbon contents of dhaincha and sunnhemp as well as sunnhemp and pillipesara incorporated plots were statistically remained on a par with each other. Organic carbon content of 60 days (0.75 %) incorporated green manures was found to be significantly superior to 45 and 30 days incorporated green manure plots. However, organic carbon content in 45 and 30 days incorporated green manure plots did not differ significantly with each other. All the green manure treated plots recorded significantly higher organic carbon content over control. A similar trend was observed after harvest of maize which was decreased.
Undecomposed green manure biomass portion at 30 DAS of maize was found maximum (3.69 t ha\(^{-1}\)) with dhaincha incorporated plot followed by sunnhemp and pillipesara, and all these were found to be significantly superior to one and another. Due to age of incorporation of green manures, maximum undecomposed portion was observed with 60 days age of incorporation followed by 45 and 30 days age of incorporation, but all these were significantly differed with one and another.

The soil available N at 30 DAS of maize did not differ significantly due to incorporation of different green manures. Soil available N at 60 days age of incorporation was found to be significantly superior to 30 days age of incorporation. However, 60 and 45 days age of incorporation as well as 45 and 30 days age of incorporation didn’t differ significantly with each other. The entire green manure treated plots recorded significantly higher soil available N over control. A similar trend was observed for available soil N at harvest of maize crop.

Similar trend of response was observed in respect of P and K at 30 DAS and at harvest of maize crop as that was observed in respect of soil available N except soil available K at harvest which was not significant.

Among all the treatments tried, highest return per rupee investment (N. 4.01) was obtained where dhaincha was incorporated at 45 days followed by dhaincha incorporated at 30 days and sunnhemp incorporated at 30 days.

Overall, it can be concluded that green manuring with dhaincha either at 60 days or 45 days is more beneficial than green manuring with either sunnhemp or pillipesara for kharif maize in realizing higher grain yields, improvement of soil physical properties and soil fertility status.
ABSTRACT

A field experiment was conducted at College farm, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad during kharif 2013-14 to study the “Performance of clusterbean varieties at varied crop geometry” The experiment was laid out in factorial randomized block design with three replications to evaluate the performance of promising varieties of clusterbean (V1- RGC 1025 ,V2- HGS 365, V3-RGC 936 and V4- RGC 1017) and to standardize the crop geometry levels (S1- 30 x 7.5 cm, S2- 30 x 10 cm, S3- 37.5 x 10 cm and S4- 45 x 10 cm) under rainfed semi arid conditions of Andhra Pradesh. The weekly mean maximum and minimum temperature during crop growth period was 30.8°C and 22.0°C respectively and total rainfall received during crop growth period was 475.3 mm in 33 rainy days. Crop was sown on 26 June 2013 at varied crop geometry and each variety was harvested according to their duration as variety RGC 1025, HGS 365 were harvested at 98 DAS while RGC 936 and RGC 1017 were harvested at 90 and 105 DAS respectively, The experimental soil was sandy clay loam in texture, slightly alkaline in reaction, low in organic matter, available nitrogen, phosphorus and medium in available potassium.
There were no significant differences among varieties in respect of initial and final plant population of crop. The results indicated that among the four varieties tested, plant height, dry matter accumulation, leaf area, number of branches plant-1 and crop growth rate (CGR) of RGC 1025 variety was significantly higher as compared to other varieties followed by RGC 936, HGS 365 respectively, RGC 1017 showed inferior performance regarding to growth parameters. The variety RGC 936 maintained higher relative growth rate and net assimilation rate compared to rest of the varieties. Regression coefficient (R² = 0.7) showed positive association between different phenophases and growing degree days.

Among the yield attributes, number of pods cluster-1 were higher with HGS 365 and number of clusters plant-1, pods plant-1 and test weight were higher with RGC 1025 closely followed by RGC 936 which were in turn significantly higher over HGS 365 and RGC 1017. Number of seeds pod-1 observed non significant due to varieties. Variety RGC 936 recorded earlier 50 per cent flowering and maturity followed by RGC 1025 and Similarly, Seed, stalk, gum and protein yield were significantly higher with variety RGC 1025 which was distinctly superior over other varieties and followed by RGC 936, HGS 365 and RGC 1017 respectively. However, RGC 936 found to be higher gum producing variety while protein content was higher with HGS 365. NPK content was found non significant due to varieties and crop geometry in seed and stalk but NPK uptake was significantly higher with variety RGC 1025 compared to rest of the varieties. Maximum gross returns (₹ 28407 ha⁻¹), net returns (₹ 13833 ha⁻¹) and benefit-cost ratio (1.94) were obtained with high yielding variety RGC 1025 and closely followed by RGC 936 while lowest with RGC 1017.

Plant population of clusterbean significantly varied with crop geometry as highest and lowest under closer crop geometry of 30 x 7.5 cm and 45 x 10 cm respectively, Clusterbean performed well under closer crop geometry i.e. 30 x 7.5 cm and almost similar results were obtained under 30 x 10 cm compared to wider crop geometry 45 x 10 cm regarding growth parameters like plant height, dry matter accumulation, leaf area and crop growth rate while higher values of relative growth rate and net assimilation rate recorded under wider crop geometry 45 x 10 cm both parameters were on peak at 45 to 70 DAS and declined towards maturity.

Among the geometry levels, yield attributing characters like number of pods cluster-1, clusters plant-1, pods plant-1, thousand seed weight were higher under wider crop geometry 45 x 10 cm which was significant over narrow crop geometry 30 x 7.5 cm but seed, stalk, gum, protein yield and NPK uptake was higher under narrow crop geometry 30 x 7.5 cm which was at par with 30 x 10 cm and lowest at 45 x 10 cm which was mainly due to yield compensation at narrow geometry by higher plants per unit area. Gum and protein content was found non significant due to crop geometry and interaction of varieties and crop geometry. Maximum Gross return, net return and benefit cost ratio was at closer geometry 30 x 7.5 cm and was at par with geometry level of 30 x 10 cm and lower values were obtained at wider geometry (45 x 10 cm).

Interaction effect of variety RGC 1025 at geometry level 30 x 7.5 cm was higher regarding to growth parameters like plant height, dry matter accumulation, leaf area at all
the growth stages almost similar results were obtained with RGC 936 at same level of geometry (30 x 7.5 cm). Highest number of clusters plant-1, pods plant-1 were observed with variety RGC 1025 under spacing of 30 x 10 cm and on par with RGC 936 at wider crop geometry 45 x 10 cm but only pods cluster-1 was highest with variety HGS 365 under all the crop geometries and also thousand seed weight was highest with RGC 1025 grown under spacing of 45 x10 cm all yield attributes were lower with RGC 1017 under closer spacing 30 x 7.5 cm

Though, yield attributes were higher with varieties under wider crop geometry, variety RGC 1025 performed well under narrow crop geometry 30 x 7.5 cm followed by same variety (RGC 1025) at 30 x 10 cm and RGC 936 at 30 x 7.5 cm spacing regarding to seed, stalk gum, protein yields and N, P and K uptake. Interaction of gum and protein content was found to be non significant.

Gross return, net returns and benefit cost ratio were higher with variety RGC 1025 variety at 30 x 7.5 cm followed by RGC 936 at same level of crop geometry. Therefore, for realizing maximum seed yield, RGC 1025 variety with closer crop geometry (30 x 7.5 or 30 x 10 cm) may be adopted in sandy loam soils in semi arid regions of Andhra Pradesh.

Weather parameters (Rainfall & Temperature) had non significant positive correlation with growth, yield attributes and yield of clusterbean varieties. Plant height (0.8**), pods plant-1 (0.8**) showed significant positive correlation with pods plant-1 and seed yield.

AGRONOMY

Author : JEEVANA JYOTHI, K.
Title of the Thesis : NUTRIENT MANAGEMENT FOR HIGHER PRODUCTIVITY OF rabi MAIZE IN NORTH COASTAL ZONE OF A.P
Major Advisor : Dr. A.V. RAMANA
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, NAIIRA
Accession Number : D 9595

ABSTRACT

A field experiment entitled “Nutrient management for higher productivity of rabi maize in North Coastal Zone of A.P” was conducted at Agricultural College
Farm, Naira on sandy loam soil during the rabi 2012-2013. The treatments consisted of four graded levels of NPK and their combination with Zn as soil application or foliar spray viz., T1: 120-60-90 kg NPK ha\(^{-1}\), T2: 160-80-120 kg NPK ha\(^{-1}\), T3: 200-100-150 kg NPK ha\(^{-1}\), T4: 240-120-180 kg NPK ha\(^{-1}\), T5: 120-60-90 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\), T6: 160-80-120 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\), T7: 200-100-150 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\), T8: 240-120-180 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\), T9: 120-60-90 kg NPK ha\(^{-1}\) + foliar spray of ZnSO\(_4\) @ 0.5%, T10: 160-80-120 kg NPK ha\(^{-1}\) + foliar spray of ZnSO\(_4\) @ 0.5%, T11: 200-100-150 kg NPK ha\(^{-1}\) + foliar spray of ZnSO\(_4\) @ 0.5% and T12: 240-120-180 kg NPK ha\(^{-1}\) + foliar spray of ZnSO\(_4\) @ 0.5%. The design adopted was randomized block design with three replications.

At tasseling and maturity, significantly higher plant growth and dry matter accumulation were recorded with the highest level of NPK + application of Zn as soil application T8 (240:120:180 kg NPK ha\(^{-1}\)+ soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)), which were however, comparable with T12 (240:120:180 kg NPK ha\(^{-1}\)+ ZnSO\(_4\) @ 0.5% as foliar spray), T9 (240:120:180 kg NPK ha\(^{-1}\)), T7 (200:100:150 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)), T11 (200:100:150 kg NPK ha\(^{-1}\) + ZnSO\(_4\) @ 0.5% as foliar spray) and T3 (200:100:150 kg NPK ha\(^{-1}\)), except dry matter production at tasseling. Dry matter accumulation at tasseling was recorded with the highest dose of NPK + Zn as soil application (T8) was found parity only with T7 (200:100:150 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)).

There were no conspicuous differences among the graded levels of nutrients tried with regard to the number of days required to attain 50% tasseling and 50% silking.

Significantly larger yield structure viz., cob length, cob girth, cob weight, number of rows cob\(^{-1}\), number of seeds row\(^{-1}\), kernel weight cob\(^{-1}\) and 1000 kernel weight was observed with application of higher dose of major nutrients along with soil application of ZnSO\(_4\) (T8), while the yield structure was minimum with the lowest dose of NPK tried (T1), which was however comparable with T5 (120-60-90 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)) and T9 (120-60-90 kg NPK ha\(^{-1}\) + foliar spray of ZnSO\(_4\) @ 0.5%).

Significantly higher kernel and stover yield was obtained with the highest dose of NPK + Zn as soil application (T8). However, T8 (240:120:180 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)) was comparable with T7 (200:100:150 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)), T12 (240:120:180 kg NPK ha\(^{-1}\) + ZnSO\(_4\) @ 0.5% as foliar spray) and T11 (200:100:150 kg NPK ha\(^{-1}\) + ZnSO\(_4\) @ 0.5% as foliar spray) with respect to kernel yield, while in case of stover yield, T8 (240:120:180 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)) was comparable with T7 (200:100:150 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\)), T12 (240:120:180 kg NPK ha\(^{-1}\) + ZnSO\(_4\) @ 0.5% as foliar spray) and T4 (240:120:180 kg NPK ha\(^{-1}\)).

Uptake N, P, K and zinc by kernel and stover as well as total uptake were found to be maximum with the application of the highest dose i.e. 240:120:180 kg NPK ha\(^{-1}\) + soil application of ZnSO\(_4\) @ 50 kg ha\(^{-1}\) (T8), while the minimum values were recorded
with $T_1$ (120:60:90 kg ha$^{-1}$) with respect the uptake N, P, K and zinc by grain and stover as well as total uptake except in case of P in stover, which was the lowest with $T_9$ (120:60:90 kg NPK ha$^{-1}$+ foliar application of Zn @ 0.5%).

As regards net returns, highest net returns (Rs. 37526/-) were observed with $T_8$ (240:120:180 kg NPK ha$^{-1}$ + soil application of ZnSO$_4$ @ 50 kg ha$^{-1}$). However, the difference (Rs.440/-) between $T_8$ (240:120:180 kg NPK ha$^{-1}$ along with soil application of ZnSO$_4$ @ 50 kg ha$^{-1}$) and $T_7$ (200:100:150 kg NPK ha$^{-1}$ + soil application of ZnSO$_4$ @ 50 kg ha$^{-1}$) was only marginal, while the B: C ratio (1.1) remained same among $T_8$, $T_7$, $T_{11}$ and $T_3$ fertilization to maize crop. The lowest net returns as well as B:C ratio were associated with $T_5$ (120:60:90 kg NPK ha$^{-1}$ + soil application of ZnSO$_4$ @ 50 kg ha$^{-1}$).

Post harvest available NPK and Zn status of soil was significantly altered due to graded levels of fertilizers. In the present investigation, except for K, maximum N, P and Zn were associated with the highest level of nutrients supplied either through soil ($T_8$) or its immediate lower dose with Zn as foliar spray ($T_{11}$) while in the case of K, the highest post harvest soil available K was noticed with $T_{12}$ (240:120:180 kg NPK ha$^{-1}$ + foliar spray of ZnSO$_4$ @0.5%).

Since comparable yield were obtained with the application of 200:100:150 kg NPK ha$^{-1}$ + ZnSO$_4$ @ 50 kg ha$^{-1}$ as soil application ($T_7$) and at the same level of NPK with Zn as foliar spray ($T_{11}$) as that of the immediate higher levels of NPK+ zinc either as soil application ($T_8$) or foliar application ($T_{12}$), despite marginal numerical difference in net returns between $T_8$ and $T_7$, considering similar values for B:C ratio, application of 200:100:150 kg NPK ha$^{-1}$ + soil application of Zn @50 kg ha$^{-1}$ ($T_7$) could be an effective nutrient package for remunerative maize cultivation.

**AGRONOMY**

Author : KEERTHANA, B.

Title of the Thesis : EFFECT OF SOIL AND CLIMATE BASED DRIP IRRIGATION SCHEDULES ON GROWTH, YIELD AND WATER PRODUCTIVITY OF RABI MAIZE

Major Advisor : Dr. V. RAMULU
ABSTRACT

A field experiment was conducted at Water Technology Centre, College farm, College of Agriculture, Rajendranagar, Hyderabad during rabi 2013-14 to study the “Effect of soil and climate based drip irrigation schedules on growth, yield and water productivity of rabi maize”. The experiment was conducted in a randomized block design with eight treatments in three replications. The treatments comprises of soil and climate based irrigation schedules viz., drip irrigation at 20 cbars (I₁), 30 cbars (I₂), 40 cbars (I₃), 50 cbars (I₄) threshold soil moisture potential level and drip irrigation equivalent to 125% (I₅), 100% (I₆), 75% (I₇) pan evaporation replenishment and surface irrigation at 1.0 IW/CPE with 5 cm irrigation depth (I₈). The experimental soil is sandy loam in texture and low in available nitrogen, medium in available phosphorus and high in available potassium.

Significantly higher plant height and leaf area were observed in drip irrigation scheduled at 20 cbars threshold soil moisture potential closely followed by drip irrigation scheduled at 125% Epan equivalent replenishment at all growth stages except at 30 DAS. Higher LAI and dry matter production plant⁻¹ was noticed with irrigation scheduled at 20 cbars soil moisture potential (I₁) and differ significantly over rest of the irrigation schedulings except with irrigation scheduled at 125% Epan (I₅) and 100% Epan (I₆).

Higher CGR was noticed at all growth stages in maize irrigated at 20 cbars soil moisture potential threshold level and differ significantly with rest of the irrigation schedules except with irrigation scheduled with 125% Epan and 100% Epan. Leaf area duration (LAD) noticed between 30-60 DAS and 60-90 DAS was higher with irrigation scheduled at 20 cbars soil moisture potential and differ significantly over rest of the irrigation scheduling treatments except with irrigation scheduled at 125% Epan and 100% Epan. Whereas between 90 DAS and harvest LAD was significantly higher with drip irrigation scheduled at 20 cbars over rest of the scheduling. Significantly higher SPAD values were associated at 60, 90 DAS and at harvest with drip irrigation scheduled at 20 cbars soil moisture potential (I₁) than rest of the irrigation schedules except with irrigation scheduled at 125% Epan and 100% Epan.

The maize grain yield (9.062 t ha⁻¹) realized with irrigation scheduled at 20 cbars soil moisture potential (I₁) was significantly higher than rest of the irrigation schedulings except with irrigation scheduled at 125% Epan (I₅) and 100% Epan (I₆), while the lowest grain yield was observed in irrigation scheduled at 50 cbars soil moisture potential. The straw yield of maize was significantly higher (19.056 t ha⁻¹) with drip irrigation scheduling at 125% Epan and differed with rest of the irrigation schedulings except with
drip irrigation scheduled at 20 cbars soil moisture potential threshold and at 100% Epan. Comparatively higher harvest index (HI) of maize was noticed with irrigation scheduled at 20 cbars, 30 cbars soil moisture potential threshold level and drip irrigation scheduled at 125% Epan and 100% Epan. The water productivity of maize was relatively higher with drip irrigation scheduled at 100% Epan and 20 cbars soil moisture potential (2.06 kg m\(^{-3}\) and 2.0 kg m\(^{-3}\), respectively) with the water consumption of 3930 m\(^3\) and 4520 m\(^3\), respectively.

Soil moisture potential observed between 0-20, 20-40 and 40-60 cm soil depths in the maize root zone before and after irrigation were in decreasing order irrespective of the treatments from surface to deep into the soil. Lower soil moisture potential was recorded with irrigation scheduled at 125% Epan replenishment and 20 cbars soil moisture potential at all the soil depths throughout the crop growth period. Higher relative leaf water content and leaf water potential were associated with drip irrigation scheduled at 125% Epan replenishment before and after irrigation except with irrigation scheduled at 20 cbars soil moisture potential. Lower relative leaf water content was observed with drip irrigation scheduled at 40 cbars and 50 cbars soil moisture potential.

The results of the present study clearly indicates that for achieving maximum grain yield and optimum water productivity, the rabi grown maize crop can be drip irrigated at 20 cbars soil moisture potential threshold level and 100% Epan replenishment, respectively.
A field experiment entitled “Nutrient management for enhancing the productivity of sweet corn in North Coastal Zone of Andhra Pradesh” was conducted at Agricultural College Farm, Naira on sandy loam soil during the rabi 2012-2013. The seven treatments each replicated four times in randomized block design viz., T₁: Absolute control, T₂: 120-50-40 kg N, P and K ha⁻¹, T₃: 180-75-60 kg N, P and K ha⁻¹, T₄: 120-50-40 kg N, P and K ha⁻¹ + 30 kg N ha⁻¹ through vermicompost, T₅: 180-75-60 kg N, P and K ha⁻¹ + 30 kg N ha⁻¹ through vermicompost, T₆: 120-50-40 kg N, P and K ha⁻¹ + application of vermiwash thrice at 20, 35 & 50 DAS, T₇: 180-75-60 kg N, P and K ha⁻¹ + application of vermiwash thrice at 20, 35 & 50 DAS.

At knee high stage, the tallest plants were observed in treatment T₅, which were however, on a par with T₇ and T₃. The plants were at their shortest stature in absolute control (T₁).

At tasseling stage, the trend in plant height remained same as was observed at knee high stage, except that T₃ and T₄ were comparable with T₆ and T₆ was in turn found parity with T₂. The plants were at their shortest stature in absolute control (T₁).

At knee high stage T₅ registered significantly higher number of leaves plant⁻¹, which was however on par with T₇, T₃, T₄ and T₆. The lowest number of leaves plant⁻¹ was associated with non-supply of nutrients (T₁).

At tasseling stage maximum number of leaves plant⁻¹ was noticed in treatment T₇ which was however, comparable with T₅, T₃, T₆ and T₄. The number of leaves plant⁻¹ was minimum when the sweet corn was supplied with no fertilizer (T₁).

At knee high stage the highest dry matter production was registered with treatment T₅, which was found significantly superior over rest of the treatments except T₇, where as at tasseling stage T₇ was recorded highest dry matter production, which was
however, on par with T. The lowest dry matter production was observed in plots which received no fertilizer application (T) at both the stages.

Significantly higher values for seeds row⁻¹, cob weight and cob girth were registered with T or T. As regards cob length, T was found parity with T and T, while in the case of number of rows cob⁻¹ T, T, and T were comparable with T and T.

The highest cob yield, stover yield and protein content was recorded in treatment T, which was however comparable with T. While in case of stover yield in T was in turn comparable with T and T.

Maximum uptake of NPK by cob and stover was observed with treatment T, which were significantly higher over rest of the treatments tried except T.

Perceptible differences were observed among the nutrient management practices tried with regard to gross and net returns as well as B: C ratio. Among various fertility levels tried, maximum gross returns were recorded with T. The lowest net returns as well as B: C ratio were associated with T (absolute control).

Significantly higher values for post harvest soil available N were registered with T, which were however comparable with T, T, and T.

As regards post harvest available P content maximum value were noticed in treatment T which was found significantly superior with all other treatments tried.

Significantly superior values for post harvest soil available K were noticed in T, which were however on par T. The post harvest available NPK status was the lowest under absolute control (T).

From the above study it can be inferred that since comparable fresh cob yields were obtained with the treatment T and T, considering the higher net monitory returns (Rs. 275847/-) and B: C ratio (5.5), T was found to be the appropriate nutrient management practice to realize higher fresh cob yield and greater economic advantage.
ABSTRACT

A field experiment entitled “Nitrogen management for zero-till rabi castor (Ricinus communis L.) under the influence of different preceding crops” was conducted during kharif and rabi 2010-11 and 2011-12 at College Farm, College of Agriculture, Rajendranagar, ANGRAU. The experiment was laid out in split plot design, replicated thrice, with four preceding crops in main plots (greengram, groundnut, bajra and maize) and five nitrogen levels to rabi castor in sub plots (0, 40, 80, 120 and 160 kg N ha⁻¹).

The results showed that among different preceding crops evaluated, greengram markedly increased growth parameters like plant height, LAI, dry matter production of castor. Similarly, various yield attributes viz., length of primary spike, number of spikes plant⁻¹, number of capsules primary spike⁻¹ and total number of capsules plant⁻¹ of castor were also higher when castor followed greengram. The greengram-castor system recorded higher castor seed yield (3137 and 2875 kg ha⁻¹) over bajra-castor (2949 and 2714 kg ha⁻¹), groundnut-castor (2630 and 2373 kg ha⁻¹) and maize-castor (2479 and 2256 kg ha⁻¹) systems. However, the seed yield of former two systems was found at a par during both the years. Stalk yield, harvest index, oil content, oil yield and nutrient uptake followed the same trend. The post harvest soil available N status at the end of kharif / beginning of rabi season was higher in greengram-castor (292.5 and 300.8 kg ha⁻¹)
and groundnut-castor (277.3 and 289.8 kg ha$^{-1}$) systems compared to that of bajra-castor (243.8 and 256.3 kg ha$^{-1}$) and maize-castor (252 and 265 kg ha$^{-1}$) systems. Similar positive influence of these two preceding crops was also observed at the end of rabi season. Similarly the gross returns (₹75290 and 83379 ha$^{-1}$), net returns (₹56735 and 64024 ha$^{-1}$) and BCR (3.01 and 3.27) of rabi castor were significantly greater when castor followed greengram compared to that of castor grown after other kharif crops. However, it did not differ statistically with bajra-castor.

Among nitrogen levels, application of 160 kg N ha$^{-1}$ and 120 kg N ha$^{-1}$, being at par, recorded taller plants, greater number of leaves plant$^{-1}$ and higher dry matter production at all the stages of crop growth and superior LAI at 90 DAS and better yield components over lower N levels. Similarly, the seed yield (3539 and 3144 kg ha$^{-1}$ and stalk yield (3713 and 3144 kg ha$^{-1}$) of castor at 160 kg N ha$^{-1}$ was comparable to that of 120 kg N ha$^{-1}$ (3396 and 3046 kg ha$^{-1}$ seed yield; 3598 and 3484 stalk yield, during 2010-11 and 2011-12, respectively) and both were found superior to lower N levels during two years of study. The N, P and K uptake also followed same trend. Higher soil available N status was observed at higher N levels viz., 160 kg N ha$^{-1}$ (303.7 and 314.6 kg ha$^{-1}$) and 120 kg N ha$^{-1}$ (277.2 and 289.6) compared to lower N levels at the end of rabi season. Application of 160 kg N ha$^{-1}$ resulted in significantly higher gross returns (₹84936 and ₹91162 ha$^{-1}$), net returns (₹65308 and ₹70734 ha$^{-1}$) and BCR (3.33 and 3.46) over lower N levels, except 120 kg N ha$^{-1}$ which recorded identical values for gross returns (₹81498 and ₹88341 ha$^{-1}$), net returns (₹62356 and ₹68399 ha$^{-1}$) and BCR (3.25 and 3.43) in both the years respectively.

Among different systems, maize-castor with application of 120 kg N ha$^{-1}$ to castor gave greater system productivity in terms of CEY (6685 and 5828 kg ha$^{-1}$ year$^{-1}$), systems gross returns (160440 and 169002 ` ha$^{-1}$ year$^{-1}$), system net returns (124798 and 131460) and BCR (3.5 and 3.5), eventually higher system productivity day$^{-1}$ (18.3 and 16 kg ha$^{-1}$ day$^{-1}$) and system profitability (342 and 360 ` ha$^{-1}$ day$^{-1}$). However, it did not differ statistically with greengram-castor at the same level of ‘N’ with comparable CEY (6356 and 5515 kg ha$^{-1}$ year$^{-1}$), system gross returns (152552 and 159925), system net returns (122510 and 127983), BCR (4.08 and 4.01), system productivity per day (17.4 and 15.1 kg ha$^{-1}$ day$^{-1}$) and system profitability (336 and 351 ` ha$^{-1}$ day$^{-1}$).

The results suggest that for securing higher economic returns, system productivity and profitability, maize-castor/ greengram-castor cropping system with the application of 120 kg N ha$^{-1}$ to zero-till rabi castor may be the better option for enhancing castor production in Southern Telangana Zone of Andhra Pradesh.
Author : MADHU KUMAR, M.

Title of the Thesis : RESPONSE OF SORGHUM (*Sorghum bicolor*) CULTIVARS TO NITROGEN FERTILIZATION UNDER IRRIGATED DRY CONDITIONS DURING POST RAINY (MAGHI) SEASON

Major Advisor : Dr. P. MUNIRATHNAM

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, MAHANANDI

Accession Number : D 9473

ABSTRACT
A field experiment was conducted during post rainy season (maghi) of 2011-12 at RARS, Nandyal of Acharya N.G. Ranga Agricultural University to study the “Response of Sorghum (Sorghum bicolor) cultivars to nitrogen fertilization under irrigated dry conditions during post rainy (Maghi) season”. The experiment was laid out in FRBD with three replications and treatment combinations of three varieties and four nitrogen levels making twelve treatments (three varieties viz., C-43, NTJ-4 and Kinnera were tested against four nitrogen levels viz., 90, 120, 150 and 180 kg N h a⁻¹). Recommended dose of phosphorus (40 kg h a⁻¹) and potassium (30 kg h a⁻¹) were applied uniformly to all the treatments. The salient findings of the investigation are summarized below.

The soil of experimental site was clay in texture and it was moderately strong alkaline in reaction with a pH of 8.6; EC of 0.15 dSm⁻¹, low in organic carbon (0.56%), low in available nitrogen (188.2 kg ha⁻¹), medium in available phosphorus (30.2 kg P₂O₅ h a⁻¹) and high in available potassium (391.9 K₂O kg h a⁻¹).

The growth parameters like plant height and dry matter production were significantly higher for Kinnera compared to other varieties. Application of 180 kg N h a⁻¹ produced significantly taller plants whereas the dry matter per plant was comparable with 150 kg N ha⁻¹. Variety C-43 produced higher number of green leaves per plant while application of 180 kg N ha⁻¹ produced significantly significantly maximum number of days to attain 50 per cent flowering over NTJ-4 but was on par with Kinnera. More number of days was observed with application of 90 kg N ha⁻¹ whereas less number of days with 180 kg N ha⁻¹. Significantly higher dry matter was produced by NTJ-4 at 180 kg N h a⁻¹ and the lowest was produced by NTJ-4 at 90 kg N ha⁻¹ which was comparable with C-43 at 90 kg N h a⁻¹.

The yield components like grain weight per panicle, grain and stover yields were significantly higher for Kinnera compared to NTJ-4, while significantly lower values of all these components were recorded by C-43. Whereas, significantly higher 1000 grain weight was recorded with NTJ-4. Significantly higher grain weight per panicle, 1000 grain weight, grain and stover yields were higher with 180 kg N ha⁻¹ and the lower values of these components were recorded with 90 kg N ha⁻¹. However, the grain weight per panicle was comparable with 150 kg N ha⁻¹. With regards to interaction effect, higher grain and stover yields were produced by the Kinnera at 180 kg N ha⁻¹ which were on par with Kinnera at 150 kg N ha⁻¹. On the other hand, lower grain and stover yields were produced by C-43 at 90 kg N ha⁻¹.

Variety Kinnera had significantly higher harvest index than C-43 and NTJ-4. Significant response was not observed for harvest index with increased levels of nitrogen. With regard to interaction, Kinnera recorded higher at 180 kg N ha⁻¹ which was on par with Kinnera at 150 kg N ha⁻¹, Kinnera at 120 kg N ha⁻¹ and Kinnera at 90 kg N ha⁻¹ while the lower values were recorded by C-43 at 180 kg N ha⁻¹ which was on par with C-43 at 120 kg N ha⁻¹.

With regard to post harvest soil available nutrients, C-43 recorded significantly higher post harvest soil available nitrogen, phosphorus and potassium compared to other
varieties while lower values were recorded by Kinnera. This reveals that the variety Kinnera is more exhaustive compared to NTJ-4 and C-43. Among different levels of nitrogen, higher values for nutrients were recorded with 90 kg N ha\(^{-1}\) except nitrogen which increased with increased nitrogen levels. Lower phosphorus and potassium were recorded with 180 kg N ha\(^{-1}\), whereas lower available nitrogen was recorded with 90 kg N ha\(^{-1}\).

Gross returns, net returns and B:C ratio of Sorghum were significantly influenced by varieties and nitrogen levels but interaction between varieties and nitrogen levels was found to be non significant. Higher gross returns, net returns and B:C ratio were produced by Kinnera over C-43 and NTJ-4. Significantly higher gross returns and net returns were produced with the application of 180 kg N ha\(^{-1}\) compared to lower levels but the net returns were comparable with 150 kg N ha\(^{-1}\). Higher B:C ratio was produced with 150 kg N ha\(^{-1}\) which was comparable with 180 and 120 kg N ha\(^{-1}\).

Among the varieties, Kinnera performed better compared to other varieties. Significant economic returns were obtained with 150 kg N ha\(^{-1}\). Hence, Kinnera can be grown successfully with application of 150 kg N ha\(^{-1}\) for higher yields and returns. The next best option is to go for NTJ-4 with application of 150 kg N ha\(^{-1}\).

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**AGRONOMY**

Author : MAHESH, N.

Title of the Thesis : VALIDATION OF CERES-MAIZE MODEL FOR HYBRID MAIZE UNDER VARIED NITROGEN LEVELS AND PLANT DENSITIES

Major Advisor : Dr. P. LEELA RANI
Degree: M. Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9511

ABSTRACT

An experiment was conducted during kharif, 2013 at College farm, Rajendranagar, Hyderabad. with three plant densities $S_1$: 60x25 cm (66,666 plants ha$^{-1}$), $S_2$: 45x25 cm (88,888 plants ha$^{-1}$), and $S_3$: 45x20 cm (1,11,111 plants ha$^{-1}$) as factor one and four nitrogen levels ($N_1$: 120 kg ha$^{-1}$, $N_2$: 180 kg ha$^{-1}$, $N_3$: 240 kg ha$^{-1}$ $N_4$: 300 kg ha$^{-1}$) as factor two in randomized block design with factorial concept, replicated thrice.

The results revealed that population density of 88,888 plants ha$^{-1}$ ($S_2$) was found to be economical with significant increase in growth and yield attributes to get higher grain yield (7597 kg ha$^{-1}$) with high net return (Rs. 65,476 ha$^{-1}$) and B:C ratio(2.9) but it was onpar with 1,11,111 plants ha$^{-1}$ ($S_3$). However population density of 66,666 plants ha$^{-1}$ ($S_1$) recorded more dry matter production per plant, dry matter partitioning (leaf, stem, cob) and number of rows cob$^{-1}$ (14.4), number of grains row$^{-1}$ (29.4), number of grains cob$^{-1}$ (428) and test weight (29.7 g).

Application of 300 kg N ha$^{-1}$ recorded significantly higher grain yield (8, 425 Kg ha$^{-1}$), stover yield (10,638 Kg ha$^{-1}$), net return (Rs 75,982) and B:C ratio (3.2) over 120 kg N ha$^{-1}$ and 180 kg N ha$^{-1}$. However, grain (8349 Kg ha$^{-1}$) and stover yield (10525), net return (Rs 75233) and B:C ratio (3.2) obtained at 240 kg N ha$^{-1}$ were on par with 300 kg N ha$^{-1}$.

Significant positive correlation existed between growth parameters, yield attributes and yield of maize. The highest intercepted PAR (92.5%) and radiation use efficiency (RUE) (1.95 MJ m$^{-2}$) was observed with population density of 1,11,111 plants ha$^{-1}$ ($S_3$) over 88,888 plants ha$^{-1}$ ($S_2$) and 66,666 plants ha$^{-1}$ ($S_1$). With respect to nitrogen levels, the highest intercepted PAR (92.3%) and radiation use efficiency (RUE) (1.83 MJ m$^{-2}$) was observed with $N_4$ (300 kg ha$^{-1}$) followed by $N_3$ (240 kg ha$^{-1}$) and $N_2$ (180 kg ha$^{-1}$) and the lowest was observed in $N_1$ (120 kg ha$^{-1}$).

Evaluation of CERES-Maize model confirmed that simulation of LAI, phenology, biomass and grain yield was considered as excellent with NRMSE value being less than 10%. But, simulation of number of grains cob$^{-1}$ and nitrogen uptake by maize grain was good as the NRMSE value was ranged in between 10.1 to 20%. So model can be used as a research tool in the variable agro-environments of Andhra Pradesh to suggest suitable planting density and optimum nitrogen level. Based on seasonal analysis, the optimum plant density and nitrogen level for maize would be 88,888 plants ha$^{-1}$ and 210 kg N ha$^{-1}$. 
AGRONOMY

Author : MANASA RANI, D.
Title of the Thesis : BIO-FORTIFICATION OF RICE GRAIN THROUGH ZINC NUTRITION

Major Advisor : Dr. CH.PULLA RAO

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, BAPATLA

Accession Number : D 9592

ABSTRACT

A field experiment entitled “Bio-fortification of rice grain through zinc nutrition” was conducted on clay loam soil of the Agricultural College Farm, Bapatla during kharif 2012-13 to study the effect of zinc nutrition on rice grain fortification.

The experiment consisted of three varieties (BPT 2231, MTU 1061, NLR 145) and six treatments viz., Recommended NPK only (T1), T1 + 10 t ha-1 FYM (T2), T1 + 50 kg ZnSO4 ha-1 as soil application (T3), T1 +10 t ha-1 FYM+ 50 kg ZnSO4 ha-1 as soil application (T4), T1 + 10 t ha-1 FYM + 0.5 % ZnSO4 foliar spray at panicle initiation (PI) and heading stages (T5), T1 + 0.5 % ZnSO4 foliar spray at PI and heading stages (T6). The experiment was laid out in a Randomized Block Design with Factorial Concept and replicated thrice.

The findings of the experiment revealed that the growth parameters such as plant height, number of tillers m-2 and drymatter production measured at different intervals were significantly influenced by varieties and treatments. However, interaction between varieties and treatments was not significant.

Significantly taller plants were produced with MTU 1061 variety, whereas, higher drymatter accumulation, more number of tillers was with BPT 2231. There was a significant improvement in all the growth parameters viz., plant height, number of tillers m-2 and drymatter production with 10 t ha-1 FYM + 50 kg ZnSO4 ha-1 as soil application (T4) at 30 and 60 DAT. But, at 90 DAT and at maturity significant improvement in all the growth parameters viz., plant height, number of tillers m-2 and drymatter production with recommended NPK+10 t ha-1 FYM + 0.5 % ZnSO4 foliar spray at PI and heading stages (T5).

Days to 50% flowering and days to maturity were more for the variety BPT 2231. Among the various treatments, T5 (recommended NPK+10 t of FYM + Zn 0.5% foliar spray twice at PI and heading stages) took fewer days to attain 50% flowering and maturity.

The maximum productive tillers m-2 (203), highest number of total (173) and filled grains panicle-1 (152), grain yield (5765 kg ha-1), straw yield (6966 kg ha-1) and
harvest index (45.8) were observed with BPT 2231 whereas, maximum test weight (21.4g) was recorded with MTU 1061. Significant increase in yield attributing characters, grain and straw yields (5632 and 6967 kg ha\(^{-1}\), respectively), harvest index (46.8\%) were observed with recommended NPK+10 t of FYM + Zn 0.5\% foliar spray twice at PI and heading stages, which was however, comparable with Zn 0.5\% foliar spray twice at PI and heading stages.

Higher nitrogen (140.6 kg ha\(^{-1}\)), phosphorus (16.8 kg ha\(^{-1}\)), potassium (67 kg ha\(^{-1}\)) and zinc uptake (1027.1 g ha\(^{-1}\)) were observed with the variety, BPT 2231. Significant increase in nitrogen, phosphorus, potassium and zinc uptake (132.7, 14.7, 62.2 and 0.96 kg ha\(^{-1}\), respectively) was recorded with recommended NPK+10 t of FYM + Zn 0.5\% foliar spray twice at PI and heading stages, which was however, comparable with Zn 0.5\% foliar spray twice at PI and heading stages.

The variety, BPT 2231 recorded more zinc content in grain and straw compared to other varieties. The maximum Zn content in grain and straw (41.30 ppm and 137 ppm, respectively) was recorded with T5 (10 t of FYM + Zn 0.5\% foliar spray twice at PI and heading stages), which was on a par with T6 (Zn 0.5\% foliar spray twice at PI and heading stages).

Significantly better quality parameters of rice grain such as hulling per cent, milling per cent, head rice recovery, protein content, volume expansion ratio were observed with the variety, MTU 1061, whereas, amylose content was more with the variety BPT 2231 and recommended NPK+10 t of FYM + Zn 0.5\% foliar spray twice at PI and heading stages (T5), which was however, comparable with Zn 0.5\% foliar spray twice at PI and heading stages (T6). However, interaction between varieties and treatments was non significant.

The highest gross returns, net returns and return per rupee investment were registered with the variety, BPT 2231. Among the different treatments, the highest gross returns (Rs.81,665) were obtained with T5 (recommended NPK+10 t of FYM + Zn 0.5\% foliar spray twice at PI and heading stages) while, the net returns (Rs.54, 180) and returns per rupee investment were maximum (Rs.2.14) with T6 (recommended NPK+Zn 0.5\% foliar spray twice at PI and heading stages).

From the present investigation, it can be concluded that under clay loam soils of Bapatla, BPT 2231 performed better in giving the maximum yield, net returns and returns per rupee investment. Quality characteristics of MTU 1061 manifested supremacy over NLR 145 and BPT 2231. Application of 10 t of FYM along with Zn 0.5\% foliar spray twice (PI and heading stages) and Zn 0.5\% foliar spray twice (PI and heading stages) were found to be better, which resulted in higher productivity, better economic returns, improved quality characteristics and higher content of nutrients (N, P, K and Zn) in rice grain.
AGRONOMY

Author : NAGENDER, T.
Title of the Thesis : STUDIES ON INTEGRATED WEED MANAGEMENT IN GREENGRAM (Vigna radiata L.)
Major Advisor : Dr. A. SRINIVAS
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9539

ABSTRACT

A field experiment entitled “Studies on integrated weed management in greengram (Vigna radiata L.)” was conducted during kharif, 2013-14 at Student Farm, College of Agriculture, Rajendranagar. The soil of the experimental field was sandy loam in texture with pH of 7.8. The soil was low in available nitrogen (230 kg ha\(^{-1}\)), low in available phosphorus (23.42 kg ha\(^{-1}\)) and medium in available potassium (409.2 kg ha\(^{-1}\)) contents. A medium duration cultivar MGG-295 was used as a test variety. The experiment was laid out in a randomized block design with twelve treatments, pendimethalin 38.7% CS @ 580 g a.i. ha\(^{-1}\) as pre-emergence, imazethapyr 10% SL @ 75 g a.i. ha\(^{-1}\) as pre-emergence, pendimethalin 30% EC @ 1.0 kg a.i. ha\(^{-1}\) + imazethapyr 10% SL @ 50g a.i. ha\(^{-1}\) as pre-emergence + hand weeding at 20 DAS, imazethapyr 10% SL @ 75 g a.i. ha\(^{-1}\) as pre-emergence + hand weeding at 20 DAS, imazethapyr 10% SL @ 75 g a.i. ha\(^{-1}\) at 15 DAS as post-emergence, imazethapyr 10% SL+ imazamox 35%WG @ 70g a.i. ha\(^{-1}\) at 15-20 DAS as post-emergence, pendimethalin 38.7% CS @ 580g a.i. ha\(^{-1}\) as pre-emergence + Quizalofop 5% EC @ 50g a.i. ha\(^{-1}\) at 15-20 DAS as post-emergence, imazethapyr 10% SL @ 100g a.i. ha\(^{-1}\) + Quizalofop 5% EC @ 50g a.i. ha\(^{-1}\) at 15-20 DAS as post-emergence, weed free (hand weeding from 15 DAS at 15 days interval; 15,30 and 45 DAS), hand weeding at 20 and 40 DAS and weedy check and replicated thrice.

The weed spectrum of the experimental field consisted of three groups of weeds like grasses, sedges and broad leaved weeds. Grasses viz., Cynodon dactylon, Dactyloctenium aegyptium and Celotia argentia, sedges viz., Cyperus rotundus and broadleaved weeds
viz., Digera arvensis, Trianthema portulacastrum, Commelina benghalensis, Parthenium hysterophorus, Euphorbia hirta and Hemidismus indica.

Weed free (hand weeding from 15 DAS at 15 days interval; 15, 30 and 45 DAS) treatment and hand weeding at 20 and 40 DAS recorded the lowest weed density; weed dry matter, nutrient uptake and the highest weed control efficiency compared to other treatments at all the stages of crop growth. Among the integrated weed treatments, application of imazethapyr 10% SL @ 75 g a.i. ha$^{-1}$ as pre-emergence + hand weeding at 20 DAS and pendimethalin 38.7% CS @ 580g a.i. ha$^{-1}$ as pre-emergence + hand weeding at 20 DAS were found effective in limiting weed growth.

As regards to the effect of treatments on greengram, it was found that plant height, dry matter production, number of pods plant$^{-1}$ and seeds pod$^{-1}$ were significantly higher with Weed free (hand weeding from 15 DAS at 15 days interval; 15, 30 and 45 DAS) treatment followed by hand weeding at 20 and 40 DAS and application imazethapyr 10% SL @ 75 g a.i. ha$^{-1}$ as pre-emergence + hand weeding at 20 DAS in comparison to all treatments.

Weed free (hand weeding from 15 DAS at 15 days interval; 15, 30 and 45 DAS) treatment gave significantly higher seed (1,149 kg ha$^{-1}$), haulm (1,676 kg ha$^{-1}$) yields and nutrient uptake (N-49.37; P-9.04; K-50.99 kg ha$^{-1}$) over all other treatments. This was closely followed by hand weeding at 20 and 40 DAS which recorded a seed yield of 1085 kg ha$^{-1}$ with a weed index of 5.60. Among integrated weed control treatments, application of imazethapyr 10% SL @ 75 g a.i. ha$^{-1}$ as pre-emergence + hand weeding at 20 DAS proved efficient in recording higher weed control efficiency (88.62%) at 30 DAS, seed (1,040 kg ha$^{-1}$) and haulm (1,548 kg ha$^{-1}$) yields with better weed index (9.95).

In terms of economics, the highest gross returns (Rs. 27043 ha$^{-1}$) were obtained when the crop was given hand weeding at 15, 30 and 45 DAS, but the highest benefit: cost ratio of 2.21 was realized due to application of imazethapyr 10% SL+ imazamox 35% WG @ 70g a.i ha$^{-1}$ at 15-20 DAS as post-emergence.
ABSTRACT

A field experiment entitled “Studies on Integrated Weed Management in Sunflower (Helianthus annuus L.)” was conducted during kharif 2013 at student Farm, College of Agriculture, Rajendranagar. The soil of the experimental field was sandy loam in texture with pH of 7.8. The soil was low in available nitrogen (230 kg ha-1), medium in available phosphorus (23.42 kg ha-1) and high in available potassium (349.2 kg ha-1). The experiment was laid out in randomized block design with three replications and thirteen treatments viz., pendimethalin @ 580 g a.i ha-1 as PE, oxyflourfen @ 150 g a.i ha-1 as PE, pendimethalin @ 580 g a.i ha-1 as PE + HW at 25 DAS, oxyflourfen @ 150 g a.i ha-1 as PE + HW at 25 DAS, pendimethalin @ 580 g a.i ha-1 as PE + quinalofop-p-ethyl @ 50 g a.i ha-1 as PoE at 15-20 DAS, oxyflourfen @ 150 g a.i ha-1 as PE + quinalofop-p-ethyl @ 50 g a.i ha-1 as PoE at 15-20 DAS, pendimethalin @ 580 g a.i ha-1 as PE + fenoxaprop-p-ethyl @ 56.25 g a.i ha-1 as PoE at 15-20 DAS, oxyflourfen @ 150 g a.i ha-1 as PE + fenoxaprop-p-ethyl @ 56.25 g a.i ha-1 as PoE at 15-20 DAS,
pendimethalin @ 580 g a.i ha-1 as PE + paraquat @ 600 g a.i ha-1 as PoE at 15-20 DAS (directed spray), oxyflourfen @ 150 g a.i ha-1 as PE + paraquat @ 600 g a.i ha-1 as PoE at 15-20 DAS (directed spray), hand weeding at 20 and 40 DAS, weed free (HW from 15 DAS to harvest at 15 days interval) and control (weedy check).

The prominent weed species observed in experimental site were grasses viz., *Cynodon dactylon* and *Dactyloctenium aegyptium*, sedges viz., *Cyperus rotundus* and broadleaved weeds viz., *Celosia argentea*, *Digera arvensis*, *Trianthema portulacastrum*, *Commelina benghalensis*, and *Parthenium hysterophorus*.

At 30 DAS, oxyflourfen @ 150 g a.i ha-1 with one weeding at 25 DAS recorded the lowest weed density, weed dry matter, nutrient removal and the highest weed control efficiency compared to other treatments. At 60 DAS and at harvest among the integrated weed treatments, weed free treatment, hand weeding twice at 20 and 40 DAS and application of oxyfluorfen @ 150 g a.i ha-1 as PE fb hand weeding at 25 DAS and pendimethalin @ 580 g a.i ha-1 as PE fb hand weeding at 25 DAS were found effective in limiting weed growth.

As regards to the effect of treatments on sunflower, it was found that plant height, dry matter production, number of seeds head-1 were significantly higher with weed free treatment and hand weeding twice at 20 and 40 DAS followed by application of oxyfluorfen @ 150 g a.i ha-1 as PE fb hand weeding at 25 DAS and pendimethalin @ 580 g a.i ha-1 as PE fb hand weeding at 25 DAS in comparison to all other treatments.

Weed free conditions and hand weeding twice at 20 and 40 DAS gave significantly higher seed and stalk yields and nutrient uptake over all other treatments. Among integrated weed control treatments, oxyfluorfen @ 150 g a.i ha-1 as PE fb hand weeding at 25 DAS proved efficient in recording higher weed control efficiency, seed and stalk yields with better weed index.

In terms of economics, the higher gross returns were obtained with weed free or else the crop provided with two hand weedings at 20 and 40 DAS, but the higher benefit: cost ratio was realized due to application of oxyfluorfen @ 150 g a.i ha-1 as PE fb hand weeding at 25 DAS and oxyfluorfen @ 150 g a.i ha-1 as PE fb paraquat @ 600 g a.i ha-1 as PoE (directed spray) at 15-20 DAS.
AGRONOMY

Author : NARESHA, R.

Title of the Thesis : EFFECT OF MOISTURE REGIMES AND PHOSPHOGYPSUM LEVELS ON GROWTH AND YIELD OF RABI GROUNDNUT

Major Advisor : Dr. P. LAXMINARAYANA

Degree : M. Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9535

ABSTRACT

A field experiment was conducted at College farm, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad during rabi 2013-14 to study the
Effect of moisture regimes and phosphogypsum levels on growth and yield of rabi groundnut. The experiment was laid out in split plot with combinations of three moisture regimes viz., 0.6, 0.8 and 1.0 IW/CPE ratios and five phosphogypsum fertilizer levels viz., Pg: Control (500 kg ha⁻¹ gypsum at flower initiation), Pg: Phosphogypsum @ 250 kg ha⁻¹ at flower initiation, Pg: Phosphogypsum @ 250 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg: Phosphogypsum @ 500 kg ha⁻¹ (½ as basal and ½ at flower initiation), Pg5: Phosphogypsum @ 500 kg ha⁻¹ at flower initiation and was replicated thrice. Groundnut variety K-6 (kadiri-6) was sown on 10-10-2013 at a spacing of 22.5 x 10 cm with one seed hill⁻¹. Recommended NPK applied to all the treatments @ 30: 50: 50 kg ha⁻¹. N, P and K were applied through urea, DAP and muriate of potash respectively. Total P, K and ½ N applied basal and ½ N at 25-30 DAS. The experimental soil was sandy loam in texture, neutral in reaction. The fertility status of the experimental soil was low in organic carbon and available nitrogen, medium in available phosphorous, sulphur, calcium and high in potassium. The mean maximum and minimum temperatures were 32.8°C and 22.1°C respectively during crop growth period. About 272.2 mm rainfall was received during the crop growing season in 10 rainy days. The mean bulk density and total available soil moisture in 60 cm depth of soil was 1.6 g cm⁻³ and 127.6 mm respectively.

Plant height, number of branches plant⁻¹, LAI and dry matter production were not influenced by moisture regimes and phosphogypsum levels at 30 DAS. Days to 50% flowering was not influenced by moisture regimes and phosphogypsum levels. The maximum plant height, number of branches plant⁻¹, LAI, dry matter production and number of root nodules plant⁻¹ (at 60 DAS) were recorded with I₃ (1.0 IW/CPE) moisture regimes at 60, 90 DAS and at harvest and statistically on par with I₂ (0.8 IW/CPE) except in dry matter production and leaf area index at 90 DAS and at harvest.

Yield attributes (number of pods plant⁻¹, number of kernels pod⁻¹, 100 kernel weight (g) shelling percentage), Yields (pod and haulm yields), harvest index, oil content, oil yield and uptake of nutrients were significantly higher at moisture regime I₃ (1.0 IW/CPE) and was on par with I₂ (0.8 IW/CPE) in recording yield, number of kernels pod⁻¹, 100 kernel weight (g), shelling percentage and sulphur uptake at 60 DAS.

Among the phosphogypsum levels, application of phosphogypsum @500 kg ha⁻¹ at flower initiation recorded the highest plant height, number of branches plant⁻¹, LAI, dry matter production, number of root nodules, yield attributes, yields, harvest index, oil content, oil yield and nutrient uptake, this was statistically on par with application of gypsum 500 kg ha⁻¹ at flower initiation for all above parameters except in pod yield, harvest index, oil yield, nutrient uptake, while dry matter production at 90 DAS, at harvest and leaf area at 60, 90 DAS respectively.

Among the growth characters and yield attributes, dry matter production at 60 DAS and number of pods plant⁻¹ were significantly influenced by interaction of moisture regimes and phosphogypsum levels. Significantly higher dry matter production was recorded at interaction of I₃ (1.0 IW/CPE) and phosphogypsum @ 500 kg ha⁻¹ at flower initiation (Pg5), which was on par with I₂Pg5 (0.8 IW/CPE and phosphogypsum @ 500
kg ha$^{-1}$ at flower initiation interaction). However significantly maximum number of pods plant$^{-1}$ was recorded at interaction of I2Pg5 (0.8 IW/CPE and phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation interaction).

The interaction effect was found significant between moisture regimes and phosphogypsum levels in recording pod yield, haulm yield, oil content and uptake of ‘S’ at harvest. Significantly the highest pod yield was recorded at interaction level I3 (1.0 IW/CPE) and phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation (Pg5), which was on par with I3Pg1, I2Pg5 while significantly higher haulm yield obtained at interaction I2Pg5 followed by I3Pg2, I2Pg1, I3Pg1, I3Pg4 and I2Pg4 interactions. Significantly the highest oil content observed with phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation (Pg5) at I3, I2 and I1. Sulphur uptake at harvest was significantly influenced by interaction of phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation (Pg5) and at I3 (1.0 IW/CPE) moisture regimes.

The highest measured applied irrigation water was 267 ha.mm I3 (1.0 IW/CPE ratio) treatment followed by I2 (0.8 IW/CPE ratio) (222 ha.mm) and I1 (0.6 IW/CPE ratio) (178 ha.mm) with five, four and three irrigations respectively along with one irrigation to all treatments one day before harvesting. The highest (472.2 mm) crop Etc was recorded with I3 (1.0 IW/CPE) compared to other treatments. Reducing the amount of water in term of irrigations caused appreciable reduction in ETo (267.6 mm) recorded with I1 (0.6 IW/CPE ratio). The highest crop coefficient value recorded at floweringpegging & pod initiation stage (41-90 DAS) of crop compared to other vegetative (0-40 DAS) and pod filling to maturity (91-128 DAS) stages.

Among the moisture regimes, I2 (0.8 IW/CPE ratio) recorded significantly higher (4.2 kg ha.mm$^{-1}$) FWUE followed by moisture regime at I3 (4.0 kg ha.mm$^{-1}$) (1.0 IW/CPE ratio) and I1 (3.9 kg ha.mm$^{-1}$) (0.6 IW/CPE) respectively and significantly the highest (5.4 kg ha.mm$^{-1}$) crop water use efficiency was observed under I1 (0.6 IW/CPE ratio) followed by moisture regime at I2 (0.8 IW/CPE ratio) and I3 (1.0 IW/CPE ratio).

Among the phosphogypsum levels, field and crop water use efficiency increased with increase in phosphogypsum levels. Significantly the highest field and crop water use efficiency (4.3 and 5.2 kg ha.mm$^{-1}$) was registered with phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation (Pg5). The interaction effect between moisture regimes and phosphogypsum levels exerted significant influence with the highest crop water use efficiency (5.9 kg ha.mm$^{-1}$) at interaction of I1Pg5 (0.6 IW/CPE ratio) (phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation) and on par with I1Pg1 and with I1Pg4. The highest field water use efficiency (4.4 kg ha.mm$^{-1}$) observed with interaction level I2Pg5 (0.8 IW/CPE ratio) (phosphogypsum @ 500 kg ha$^{-1}$ at flower initiation), which was on par with I2Pg4, I2Pg1, I3Pg5, I1Pg5, I2Pg2.

The economics of groundnut as influenced by moisture regimes and phosphogypsum levels revealed that higher gross returns (72999 ₨ ha$^{-1}$), net return (42909 ₨ ha$^{-1}$) was recorded at I3 (IW/CPE 1.0) irrigation level with five irrigations whereas the highest B: C ratio (2.4) was recorded at irrigation I2 IW/CPE 1.0 and 0.8
with five and four irrigations respectively. The lower gross returns (59228 \text{ ha}^{-1}), net returns (29767 \text{ ha}^{-1}) and B: C ratio (2.0) was obtained under I2 (IW/CPE 0.6) moisture regime with three irrigations. Higher gross returns (72624 \text{ ha}^{-1}), net return (42776 \text{ ha}^{-1}) and B: C ratio (2.4) was observed at phosphogypsum application @ 500 kg ha-1 at flower initiation (Pg5) followed by Pg1, Pg2 and Pg4 treatments.

The highest gross returns and net returns (78302 and 48124 \text{ ha}^{-1}) were recorded with interaction level I3Pg5 (1.0 IW/CPE ratio and phosphogypsum @ 500 kg ha-1 at flower initiation), which was on par with I3Pg1, I2Pg5 (gross returns) and I3Pg5, I3Pg2, I3Pg1 (net returns) respectively.

It is concluded from this study that irrigation with I2 (0.8 IW/CPE) and application of phosphogypsum @ 500 kg ha-1 once during flower initiation resulted in higher yield and economic returns (B: C ratio 2.4) of \textit{rabi} groundnut under semi-arid climate of Hyderabad.

**AGRONOMY**

Author : NASEERUDDIN, R.
Title of the Thesis: WEED MANAGEMENT IN DRUM SEEDED RICE (Oryza sativa L.)

Major Advisor: Dr. D. SUBRAMANYAM

Degree: M. Sc. (Ag.)

College: S.V. AGRICULTURAL COLLEGE, TIRUPATI

Accession Number: D 9625

ABSTRACT

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati campus of Acharya N.G. Ranga Agricultural University of Andhra Pradesh, during kharif, 2012, to identify the most economic and viable weed management practice in drum seeded rice.

The present investigation was laid out in a randomized block design with three replications. There were ten treatments viz., pre-emergence application of pretilachlor @ 500 g a.i ha-1 (T1), pre-emergence application of oxadiargyl @ 75 g a.i ha-1 (T2), pre-emergence application of pretilachlor @ 500 g a.i ha-1 + mechanical weeding with power weeder at 40 DAS (T3), pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + mechanical weeding with power weeder at 40 DAS (T4), pre-emergence application of pretilachlor @ 500 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 at 40 DAS (T5), pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 at 40 DAS (T6), pre-emergence application of pretilachlor @ 500 g a.i ha-1 + bispyribac-sodium @ 30 g a.i ha-1 at 40 DAS (T7), pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + bispyribac-sodium @ 30 g a.i ha-1 at 40 DAS (T8), two hand weeding at 20 and 40 DAS (T9) and unweeded check (T10). The test variety of rice was Somasila (NLR-33358).

Weed species belonging to eight taxonomic families were observed in the experimental field, of which five were grasses, four were sedges and six were broad leaved weeds. Among the weed management practices tried, two hand weedings at 20 and 40 AS resulted in significantly lesser density and dry weight of total weeds with higher weed control efficiency and it was closely followed by the pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 (T6) or bispyribac-sodium @ 30 g a.i ha-1 (T7) applied at 40 DAS. Pre-emergence application of oxadiargyl @ 75 g a.i ha-1 (T2) or pretilachlor @ 500 g a.i ha-1 (T1) recorded the highest density and dry weight of total weeds with lesser weed control efficiency, among the herbicides tried. Post-emergence application of bispyribac-sodium @ 30 g a.i ha-1 was effective for control of grasses and broad leaved weeds and azimsulfuron @ 30 g a.i ha-1 was effective for control of sedges in drum seeded rice. The highest density and dry weight of weeds was associated with unweeded check (T10). Heavy weed infestation in unweeded check resulted in the highest uptake of nitrogen, phosphorus and potassium.
Pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 applied at 40 DAS (T6) resulted in significantly higher stature of growth parameters viz., plant height, leaf area, total number of tillers m-2 and dry matter production and yield attributes viz., panicles m-2, total and filled grains panicle-1. All these parameters were comparable with hand weeding twice at 20 and 40 DAS (T9).

The highest grain and straw yield along with higher harvest index were recorded with pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 applied at 40 DAS (T6) and it was comparable with hand weeding twice at 20 and 40 DAS (T9). The grain yield was reduced by 51 per cent in unweeded check compared to the best weed management practice i.e pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 applied at 40 DAS (T6).

The highest gross and net returns were realized with pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 applied at 40 DAS (T6), which were comparable with two hand weeding at 20 and 40 DAS (T9). However, the highest benefit-cost ratio was registered with the former weed management practice (T6).

In conclusion, the present study has revealed that pre-emergence application of oxadiargyl @ 75 g a.i ha-1 + azimsulfuron @ 30 g a.i ha-1 applied at 40 DAS (T6) resulted in the highest grain yield and maximum economic returns with broad spectrum weed control and it was comparable with hand weeding twice at 20 and 40 DAS (T9), indicating the fact that, wherever the labour availability for hand weedings is abundant, timely and cheaper, one can go for hand weeding; or else, opt for the said herbicide recommendation, taking into the economical considerations.
ABSTRACT

A field experiment entitled “NPK rate effects on growth and yield of sweet corn” was conducted at Agricultural College Farm, Bapatla on clay loam soil during rabi 2012-13. The treatments consisted of four different NPK rates (T1-120:60:60, T2-150:75:75, T3-180:90:90 and T4-210:105:105 kg NPK ha⁻¹). The design adopted was Randomized Block Design with five replications.

All the growth parameters (viz. plant height, drymatter production), days to 50% tasseling, days to 50% silking, number of barren plants, yield components (viz. number of cobs plant⁻¹, number of grains cob⁻¹, grain weight (g) cob⁻¹, test weight (g), shelling per cent, green cob yield and stover yield (kg ha⁻¹) and harvest index (%) were increased with increased NPK rates, nutrient content and uptake of nitrogen, phosphorus and potassium at different stages of crop growth at 30, 60 DAS and at harvest increased significantly with increasing the rates of NPK application from 120:60:60 to 210:105:105 kg NPK ha⁻¹. The highest N P K uptake was observed with higher rate of NPK 210:105:105 kg ha⁻¹ at different stages of the crop i.e. 30, 60 DAS and at harvest and the N P K uptake increased significantly with each increment of NPK rates.

The highest plant height (96.1, 251.2 and 265.0 cm) and drymatter production (691, 8798 and 15007 kg ha⁻¹) was observed and at 30 DAS, 60 DAS and at harvest, respectively. The maximum green cob yield (12327 kg ha⁻¹) was observed with higher NPK rate i.e. 210:105:105 kg ha⁻¹. The differences between 120:60:60, 150:75:75 and 180:90:90 kg NPK ha⁻¹ were found to be significantly different between themselves. Supply of more nutrients to sweet corn increases the nutrient uptake and the highest uptake of N, P and K was observed with 210:105:105 kg NPK ha⁻¹ at different stages of crop i.e. at 30, 60 DAS and at harvest. The higher gross, net return and B:C ratio (227753, 181129 and Rs.3.25, respectively) was observed with the highest rate of 210:105:105 kg NPK ha⁻¹ application to sweet corn.
Overall the study has indicated that application of 210:105:105 kg NPK ha$^{-1}$ found to be better for realizing higher yield of sweet corn on clay loam soils of Bapatla.

**ABSTRACT**

A field experiment entitled “Agro-climatic model for prediction of growth and yield of rabi maize (Zea mays L.)” was conducted at Agricultural College Farm, Bapatla on sandy clayloam soil during rabi 2012-13. The treatments consisted of twelve dates of sowing from 15th November to 31st January at weekly interval as the first factor and three maize hybrids viz. 30V92, 900M and Sandhya as second factor. The design adopted was Randomized Block Design with factorial concept with three replications.

The findings of the experiment revealed that the growth parameters viz. plant height, drymatter production, days to 50% tasseling, days to 50% silking, days to milking and days to physiological maturity were significantly influenced due to dates of sowing and hybrids, except plant height at 30 DAS and days to 50% tasseling, which are non-significant for hybrids. The maximum drymatter at harvest was recorded with the hybrid 900M which also took the maximum days to milking and physiological maturity. Among different dates of sowing, early sowing (15th November to 13th December) resulted in the maximum plant height at harvest. Similar to plant height, higher drymatter at harvest was produced with early sowing. In case of days to 50% tasseling and days to 50% silking there was delay with mid sowing (20th December to 10th January). Days to milking and physiological maturity were higher with early sowing (15th November to 6th December). Among hybrids, significantly higher growth parameters viz. plant height and drymatter was recorded with Sandhya. Days to 50% tasseling and days to 50% silking were higher...
with hybrid 30V92, whereas, days to milking and physiological maturity were higher with 900M.

Significant interaction was observed with per cent barren plants, number of grains per cob, 100-grain weight and grain yield. All yield attributes were significantly influenced by dates of sowing and hybrids, except number of cobs per plant and shelling percentage. Among dates of sowing, the least per cent barren plants were recorded with early dates of sowing. Number of cobs per plant, number of grains per cob and 100-grain weight was higher with early sowing. Grain weight per cob was higher with early sowing (22nd November to 13th December). Grain yield (8651 kg ha⁻¹), stover yield (8774 kg ha⁻¹) and harvest index (49.8%) was significantly higher with early sowing of 22nd November (D₂), whereas, the least values were recorded with 31st January sowing. Among hybrids, 900M recorded significantly higher per cent barren plants, number of grains per cob and grain weight per cob. 100-grain weight and harvest index (48.1 %) were higher with Sandhya, whereas, the highest grain yield (5848 kg ha⁻¹) and stover yield (6651 kg ha⁻¹) was observed with 30V92.

Days to attain each phenological stage for hybrids differed in their duration. The maximum of 107.7 days to maturity were with hybrid 900M followed by 30V92 (103.6) and Sandhya (102.7 days).

Among the agro-climatic indices, growing degree days, heliothermal units, photothermal units and thermophoto ratio requirement of hybrid 900M was the highest as compared to 30V92 and Sandhya, whereas, heat use efficiency, heliothermal use efficiency, photothermal use efficiency and phenothermal index was higher with hybrid Sandhya than 30V92 and 900M.

Significant linear relationships were observed for drymatter and grain yield of three hybrids with agro-climatic indices viz., growing degree days, photothermal units, heat use efficiency, heliothermal use efficiency, photothermal use efficiency and phenothermal index, whereas, relationship was non-linear with heliothermal unit. In case of sowing window, significant multiple linear relationships were observed between pooled grain yield of three hybrids and agro-climatic indices viz. GDD, HTU, PTU and TPR. Sowing window-1st (15th November - 29th November) and 5th (13th December - 27th December) were significant for grain yield.
A field experiment entitled “Nutrient management in finger millet (Eleusine coracana L.) under Melia azedarach based agri-silvi system” was conducted during kharif, 2013 at agroforestry research block, Acharya N. G. Ranga Agricultural University campus, Rajendranagar, Hyderabad, Andhra Pradesh. The experimental soil was sandy loam texture with pH(7.57), EC (0.195 dS m\(^{-1}\)) and OC (0.75 %). The soil was medium in available nitrogen (259.2 kg ha\(^{-1}\)), phosphorus (40.85 kg ha\(^{-1}\)) and high in available potassium (352.1 kg ha\(^{-1}\)). This experiment was laid out in a Randomized block design and replicated thrice treatments comprised of T\(_1\) FYM 10 t ha\(^{-1}\), T\(_2\) 100% RDF (40:20:20 - N: P\(_2\)O\(_5\): K\(_2\)O kg ha\(^{-1}\)), T\(_3\) 75% RD N + 25% N FYM, T\(_4\) 75% RD N + 25% N Vermicompost, T\(_5\) 75% RD N + 25% N Poultry manure, T\(_6\) 75% RD N + Azospirillum
@ 5 kg ha\(^{-1}\), T\(_7\) 75% RD N + PSB @ 5 kg ha\(^{-1}\), T\(_8\) 75% RD N + *Azospirillum* + PSB @ 5 kg ha\(^{-1}\) and T\(_9\) Sole crop without trees. The results revealed that, integrated nutrient management practices in finger millet significantly influenced the growth and physiological parameters, yield attributes, nutrient content and uptake (NPK), organic carbon and available nutrient status (NPK).

Plant height, dry matter production, productive tillers m\(^2\), number of fingers earhead\(^{-1}\), finger length, weight of grains earhead\(^{-1}\), test weight were significantly superior at all growth stages with 75% RD N + 25% N poultry manure and 100% RDF on par with sole crop without trees over control. Physiological parameters LAI, SPAD, CGR, RGR and NAR were increased at growth stages of crop under sole cropping followed by 75% RD N + 25% N poultry manure and 100% RDF over control.

The highest grain (2681 kg ha\(^{-1}\)) and straw yield (5063 kg ha\(^{-1}\)) resulted with sole crop on par with 75% RD N + 25% N poultry manure (2405 and 4733 kg ha\(^{-1}\)) and 100% RDF (2393 and 4745 kg ha\(^{-1}\)). The lowest grain (1583 kg ha\(^{-1}\)) and straw yield (3402 kg ha\(^{-1}\)) was found with control FYM @ 10 t ha\(^{-1}\).

Among the nutrient management practices, 75% RD N + 25% N poultry manure (0.77, 0.151, 2.64%) and 100% RDF (0.76, 0.150, 2.62) on par with sole crop (0.82, 0.152, 2.68) significantly increased NPK content at harvest respectively over control.

The NPK content in grain at harvest was found highest with integrated use of 75% RD N + 25% N poultry manure (1.31, 0.264, 0.47%) and 100% RDF (1.28, 0.257, 0.47%) on par with sole crop (1.32, 0.265, 0.43%). The total NPK uptake by finger millet resulted highest in sole crop without trees (76.94, 12.44, 148.50 kg ha\(^{-1}\)) over control (45.72, 6.95, 80.80 kg ha\(^{-1}\)).

Soil pH and EC were not influenced significantly by integrated nutrient management practices. In case of OC content slight built up (0.88%) was found with conjoint use of 75% RD N and 25% N poultry manure and on par 100% RDF (0.87%) with sole crop (0.92%). Regarding available nitrogen, phosphorus and potassium were increased significantly in 75% RD N + 25% N poultry manure (291.84, 39.04, 355.34 kg ha\(^{-1}\)) and 100% RDF (283.94, 38.72, 354.79 kg ha\(^{-1}\)) on par with sole crop (316.97, 37.76, 366.06 kg ha\(^{-1}\)) compared to control (213.25, 27.94, 322.55 kg ha\(^{-1}\)).

Tree parameters (tree height, girth, canopy spread) and tree-crop interactions (percent decrease in light penetration) were found to be non-significant with regard to nutrient management practices followed in finger millet crop.

Gross monetary returns (₹42,747 ha\(^{-1}\)), net monetary returns (₹26,987 ha\(^{-1}\)) and B:C ratio (2.71) were highest with sole crop followed by 100% RDF and 75% RD N + 25% N poultry manure compared to other treatment combinations.

From the present investigation, it can be inferred that, among nutrient management practices tested, 75% RD N + 25% N poultry manure and 100% RDF in agri-silvi culture system was better for realizing higher growth parameters, yield attributes, grain yield, straw yield, nutrient content and economic returns apart from sustaining better soil nutrient status on sandy loam soils of Southern Telangana region of Andhra Pradesh.
ABSTRACT

A field investigation was carried out during kharif and rabi of 2010-11 and 2011-12 entitled “Influence of rice crop establishment methods and weed management practices on succeeding zero-till maize” at College Farm, College of Agriculture,
Rajendranagar, Hyderabad on sandy loam soil. The experiment consisted of three establishment methods as main treatments (SRI, direct sowing of sprouted seeds under puddled condition and transplanting) four weed management practices as sub treatments (Bensulfuron methyl 60 g \textit{a.i} + pretilachlor 600 g \textit{a.i} ha-1 as PE followed by mechanical weeding at 30 DAS/T, Bispyribac sodium @ 25 g \textit{a.i} ha-1 as early post emergence, farmer’s practice i.e. hand weeding twice at 20 and 40 DAS in transplanted rice as well as in direct seeded rice, conoweeding thrice from 20 DAT in SRI and weedy check) which replicated thrice. During \textit{rabi}, zero-tilled maize was grown in sequence to rice and weed management practices (weedy check, atrazine 1.0 kg \textit{a.i} ha-1 as PE, atrazine @ 1.0 kg \textit{a.i} ha-1 fb topramezone @ 30 g \textit{a.i} ha-1 and weed free (hand weeding at 20 and 40 DAS)) were imposed in maize as sub- sub treatments in split-split design. The objective of the study was to evaluate efficient weed management practice in relation to crop establishment methods and to suggest suitable weed management package to rice- maize \textit{cropping}.

There was significant improvement in growth characters like plant height, tillers m-2, dry matter under transplanted method of establishment compared to SRI and direct seeded rice. All the yield attributing components \textit{viz.}, number of panicles m-2, panicle length, number of grains panicle-1 and number of filled grains panicle-1 and yield were significantly more with transplanted rice followed by SRI and lesser was obtained with direct seeded rice.

Plant nutrient uptake by grain and stover was significantly higher under transplanted method. Whereas lower nutrient removal by weeds was also observed significantly with transplanted rice in contrast to significantly higher nutrient removal as observed under direct seeded rice.

Weed management practices imposed to \textit{kharif} rice significantly lowered the weed density and dry weight. Farmer’s practice of weeding recorded significantly lower weed density and dry matter followed by application of bensulfuron methyl 60 g \textit{a.i} + pretilachlor 600 g \textit{a.i} ha-1 as PE \textit{fb} mechanical weeding at 30 DAS/T and bispyribac sodium @ 25 \textit{a.i} ha-1. Higher weed density and weed dry matter was registered with weedy check. Even though higher yield and high gross returns were observed with farmer’s practice, higher B:C ratio was obtained with bensulfuron methyl 60 g \textit{a.i} + pretilachlor 600 g \textit{a.i} ha-1 as PE \textit{fb} mechanical weeding at 30 DAS/T due to low cost of cultivation.

During \textit{rabi}, significantly higher plant height, dry matter production of maize was obtained when maize was grown after transplanted rice. Similar trend of enhanced yield components and yield of maize were noticed when it followed transplanted rice than that of SRI and direct seeded rice.
Farmer’s practice of weeding *kharif* rice registered significantly lower weed density and dry matter in succeeding zero till maize. As a result, higher growth parameters, yield components and grain yield were recorded. The next best treatment was bensulfuron methyl 60 g *a.i* + pretilachlor 600 g *a.i* ha-1 fb mechanical weeding at 30 DAS/T and bispyribac sodium @ 25 g *a.i* ha-1. Significantly higher values of weed density and dry matter and lower values of growth parameters and yield attributes were observed under weedy check.

The decreased weed density, weed dry matter and nutrient removal by weeds were observed under different weed management practices followed in maize. Weed free (hand weeding twice at 20 and 40 DAS) recorded significantly lower weed density and dry matter which was evident by recording higher growth characters, yield attributes and next best treatment was atrazine @ 1.0 kg *a.i* ha-1 fb topramezone 30 g *a.i* ha-1 at 30 DAS and atrazine @ 1.0 kg *a.i* ha-1 as pre-emergence alone. Lower values of growth and yield attributes were observed under weedy check along with higher values of weed density, dry matter of weeds. Higher B:C ratio was obtained with application of atrazine @ 1.0 kg *a.i* ha-1 fb topramezone 30 g *a.i* ha-1 and atrazine @ 1.0 kg *a.i* ha-1 compared to weed free (hand weeding twice) due to lower cost of cultivation.

With regards to system productivity and B:C ratio, of the three crop establishment methods, transplanted rice method recorded higher system productivity and B:C ratio. Among weed management practices followed in *kharif* rice, the treatment which received application of bensulfuron methyl 60 g *a.i* + pretilachlor 600 g *a.i* ha-1 as pre-emergence fb mechanical weeding at 30 DAS/T recorded higher B:C ratio whereas amongst weed management practices evaluated in zero till maize during rabi, the highest B:C ratio was registered with application of atrazine @ 1.0 kg *a.i* ha-1 fb topramezone 30 g *a.i* ha-1 at 30 DAS.

**AGRONOMY**

Author : PRAVEENA SIRIPURAPU  
Title of the Thesis : EFFECT OF TILLAGE AND WEED MANAGEMENT ON NITROGEN USE EFFICIENCY OF MAIZE (*Zea mays* L.)
ABSTRACT

A field experiment entitled “Effect of tillage and weed management on nitrogen use efficiency of maize (Zea mays L.)” was conducted on clayloam soils of the Agricultural College Farm, Bapatla during rabi 2012-2013. The experiment was laid out in a split plot design, with four methods of tillage assigned to main plots and four nitrogen levels assigned to sub plots.

The dominant weed flora of the experimental plot consisted of Cynodon dactylon, Echinochloa crusgalli, Cyperus rotundus, Trianthema portulacastrum, Phyllanthus niruri, Digera arvensis, Physalis minima, Euphorbia hirta, Aristolochia bracteata, Merremia everta, Commelina benghalensis, Sida acuta and Cleome viscosae.

The lowest weed dry matter was recorded with conventional tillage with herbicides. Among nitrogen levels, 240 kg N ha⁻¹ recorded the highest weed dry matter. Weed control efficiency was significantly influenced by tillage methods only. The highest weed control efficiency was recorded with conventional tillage with herbicides.

The initial and final plant population were not significantly influenced by tillage methods, nitrogen levels and their interaction. The maximum plant height was attained with conventional tillage with herbicides and it was on a par with zero tillage with herbicides and conventional tillage alone treatments. At 30 DAS, 60 DAS and 90 DAS, application of 240 kg N ha⁻¹ produced significantly taller plants than rest of the nitrogen levels tried, whereas at harvest, the highest plant height recorded with application of 240 kg N ha⁻¹ and was at par with application of 200 kg N ha⁻¹ and 160 kg N ha⁻¹. Dry matter accumulation was high with conventional tillage with herbicides. Application of 240 kg N ha⁻¹ produced significantly higher amount of dry matter over rest of the nitrogen levels at all the stages of crop growth. Conventional tillage with herbicides lessened the number of days to 50% tasseling and per cent barrenness over the other treatments. Number of days to 50% silking was significantly influenced by nitrogen levels. The number of days taken to 50% tasseling and silking and barrenness was significantly lowered when the crop was supplied with 240 kg N ha⁻¹.

Number of cobs plant⁻¹, cob length, test weight and shelling percentage of maize were not significantly influenced by tillage methods. Conventional tillage with herbicides recorded the highest number of grains cob⁻¹ which was on a par with zero tillage with herbicides. The yield parameters viz., cobs plant⁻¹, cob length, number of grains cob⁻¹,
The highest grain yield (5397 kg ha\textsuperscript{-1}) was obtained with conventional tillage with herbicides and it was on a par with zero tillage with herbicides. Stover yield was not significantly influenced by tillage methods. Application of 240 kg N ha\textsuperscript{-1} significantly improved the grain and stover yield of maize over 120, 160 and 200 kg N ha\textsuperscript{-1}. Harvest index was significantly higher at conventional tillage with herbicides and it was on a par with zero tillage with herbicides. Among nitrogen levels, 240 kg N ha\textsuperscript{-1} recorded the highest harvest index which was on a par with 200 and 160 kg N ha\textsuperscript{-1}. Nitrogen uptake by grain was highest with conventional tillage with herbicides and it was on a par with zero tillage with herbicides. Conventional tillage with herbicides has maximum nitrogen uptake by stover. Nitrogen uptake by grain and stover increases with increase of nitrogen level and it was highest with application of 240 kg N ha\textsuperscript{-1}.

Nitrogen use efficiency decreases with increase of nitrogen level. Conventional tillage with herbicide recorded high nitrogen use efficiency value (69) which is followed by zero tillage with herbicides at 160 kg N ha\textsuperscript{-1}. The highest gross and net returns were recorded under conventional tillage with herbicides with 240 kg N ha\textsuperscript{-1} and the highest BCR (3.46) was recorded from maize grown under zero tillage with herbicides under 240 kg N ha\textsuperscript{-1}.

The present study indicated that zero tillage with pre-emergence herbicide atrazine @ 1.25 kg ha\textsuperscript{-1} fb post-emergence directed spray of paraquat @ 0.6 kg ha\textsuperscript{-1} at 3WAS with 240 kg N ha\textsuperscript{-1} was found to be effective and economical for growing rabi maize.
ABSTRACT

A field experiment entitled “Performance of baby corn as influenced by nitrogen levels and weed control practices” was conducted on a sandy clay loam soil of the Agricultural College Farm, Bapatla, during kharif, 2012-13 under irrigated condition. The treatments consisted of three levels of nitrogen (N1= 120, N2= 150 and N3= 180 kg N ha⁻¹) allotted to main plots and five weed control methods (W1: weedy check, W2: two handweedicings at 15 and 30 DAS, W3: atrazine @ 1.0 kg a.i. ha⁻¹ as pre-emergence application, W4: 2,4-D amine @ 0.58 kg a.i ha⁻¹ as post-emergence at 30 DAS, W5: pendimethalin @ 1.0 kg a.i. ha⁻¹ as pre emergence application fb @ 2,4-D amine @ 0.58 kg a.i. ha⁻¹ at 30 DAS allotted to sub plots. The experiment was arranged in a split plot design and replicated thrice.

Application of 120 kg N ha⁻¹ recorded significantly lower weed density and drymatter at all the stages of crop growth over 150 and 180 kg N ha⁻¹. Among the weed control practices, hand weeding twice (W2) followed by pendimethalin @ 1.5 kg a.i. ha⁻¹ as pre emergence application fb 2,4-D amine @ 0.58 kg a.i. ha⁻¹ at 30 DAS significantly reduced the weed density and weed drymatter at all the stages of crop growth except at 15 DAS. Similarly, the higher weed control efficiency with lower weed index was noticed under hand weeding twice (W2) followed by pendimethalin @ 1.0 kg a.i. ha⁻¹ fb 2,4-D amain @ 0.58 kg a.i ha⁻¹ at 30 DAS.

Application of 180 kg N ha⁻¹ recorded significantly more plant height, more number of leaves and drymatter accumulation compared to that of 150 and 120 kg N ha⁻¹ throughout the crop growth period. Hand weeding twice (W2) recorded significantly more plant height, more number of leaves and drymatter accumulation at all the stages of crop growth except at 15 DAS. The number of days taken to 50 percent tasseling, silking and harvest were significantly lowered when the crop was fertilized with 180 kg N ha⁻¹. Hand weeding twice (W2) recorded significantly less number of days to 50 percent tasseling, silking and harvest.
Yield attributing characters like individual cob weight and ear weight were significantly superior with the application of 180 kg N ha\(^{-1}\) when compared to 150 and 120 kg N ha\(^{-1}\), whereas, individual ear length and ear girth of baby corn recorded under 180 kg N ha\(^{-1}\) were on a par with that of 150 kg N ha\(^{-1}\). Among the weed control practices, hand weeding twice (W\(_2\)) recorded significantly more yield attributing characters like individual ear length, ear weight, cob weight, ear weight and ear to cob ratio over the other treatments.

Significant increase in baby corn yield and stover yield was noticed with increasing level of nitrogen. Higher cob and ear yields were obtained with the application of 180 kg N ha\(^{-1}\) but it was on a par with 150 kg N ha\(^{-1}\) in case of cob yield. Among weed control measures, hand weeding twice (W\(_2\)) recorded significantly higher cob and ear yield. The highest husk and dry fodder yield was recorded with the application of 180 kg N ha\(^{-1}\). Application of 180 kg N ha\(^{-1}\) recorded maximum green fodder yield but, it was on a par with 150 kg N ha\(^{-1}\). Husk and dry fodder yields were the highest due to hand weeding twice (W\(_2\)). The highest green fodder yield was obtained under hand weeding twice (W\(_2\)) but, it was on a par with the application of pendimethalin @ 1.0 kg a.i. ha\(^{-1}\) as pre emergence fb 2,4-D amine @ 0.58 kg a.i. ha\(^{-1}\) at post-emergence (W\(_5\)).

The maximum nitrogen content and uptake in stover and ear was recorded with the application of 180 kg N ha\(^{-1}\) at all the stages of crop growth. Whereas hand weeding twice (W\(_2\)) recorded significantly higher nitrogen content and uptake in stover and ear. Application of 180 kg N ha\(^{-1}\) recorded significantly higher crude protein, crude fibre and ash content over the 150 and 120 kg N ha\(^{-1}\). Among the weed control practices, hand weeding twice (W\(_2\)) recorded significantly higher crude protein, crude fibre and ash content.

The highest gross returns, net returns and returns per rupee investment were higher under hand weeding twice at all the levels of nitrogen.
ABSTRACT

The present study entitled “Influence of planting methods and integrated nutrient management on growth, yield and quality of rice” was conducted at Agricultural Research Institute, Rajendranagar during kharif season of 2010-11 and 2011-12 on sandy clay soil. The experiment was laid out in split plot design with three replications. The treatments comprised of four methods of transplanting (SRI method of transplanting, planting with Yangio-China transplanter, Kobota transplanter and farmer’s method of transplanting) as main treatments and four levels of organic manure and inorganic fertilizer combinations (RDF+FYM @ 5 t ha\(^{-1}\), RDF + GLM (Dhaincha) @ 5 t ha\(^{-1}\), RDF + BF(@ Azospirillum 2.5 kg ha\(^{-1}\) and PSB @ 5 kg ha\(^{-1}\)) and RDF alone with 150 N : 60 P\(_2\)O\(_5\) : 40 K\(_2\)O kg ha\(^{-1}\)) as sub-plot treatments. Medium duration variety Satya was taken for the experiment. Seedlings of 10 days, 15 days and 25-30 days age were transplanted in SRI, with Yangio-China, Kobota transplanter and in farmer’s method, respectively. FYM and GLM were incorporated one week before transplanting. Biofertilizers were applied three days after transplanting. 1/3 N, total P & 2/3 K were applied basally at the time of transplanting. Remaining 2/3 N was applied at maximum tillering and panicle initiation stages equally along with 1/3 K at panicle initiation stage. The total rainfall received during kharif 2010 [1\(^{st}\) July-30\(^{th}\) October (120 days)] was 485.9 mm in 31 rainy days and during 2011 [1\(^{st}\) July- 7\(^{th}\) November) (127 days)] was 615.8 mm in 39 rainy days. The weekly mean maximum temperature ranged from 27.7 to 35.0 °C with an
average of 31.2 °C during 2010-11 and 27.5 °C to 33.1 °C with an average of 30.1 °C during 2011-12. The weekly mean minimum temperature ranged from 19.9 °C to 24.2 °C with an average of 20.1 °C during 2010-11 and 16.7 °C to 24.9 °C with an average of 23.8 °C during 2011-12.

Kobota transplanter planted uniform number of seedlings hill⁻¹ and hills m⁻² compared to Yangio-China transplanter. The growth parameters viz., plant height, tiller number and dry matter production at all the crop growth stages in both the years were highest when the crop was transplanted with Kobota transplanter. Though the initial plant population in farmer’s method was significantly higher than the other methods, it was found on par to Kobota transplanting with comparable plant heights at 30 DAT and dry matter production at all the stages in both the years. SRI method of transplanting was noted to be on par to Kobota transplanting with respect to tiller number in 2011. Kobota transplanting and SRI method, brought about significant increase in root length and root volume of rice with comparably highest values. Yangio-China transplanting showed lower values of above growth parameters, but was at par to these methods with respect to root volume in 2010-11.

Kobota transplanter method proved to be a best method of transplanting with highest leaf area, crop growth rate and SPAD values at all the stages of growth, but the leaf area index and leaf area duration were significantly higher in farmer’s method of transplanting. However it was found at par to Kobota transplanting with respect to leaf area duration and leaf area index at the observed stages in both the years.

Yield attributes viz., productive tillers, panicles m⁻² and grains panicle⁻¹ were significantly higher with the crop transplanted with Kobota transplanter which ultimately resulted in higher grain yield, and straw yield in both the years and pooled mean. Farmer’s method of transplanting performed equivalent to Kobota transplanting with respect to no. of panicles m⁻² in both the years, grains per panicle and hence grain yield in 2011-12. SRI method of transplanting had putforth productive tillers at par to Kobota transplanting during 2010-11 alone. Grain yield of SRI method was at par with farmers method during both the years. Lowest yield attributes and yield was obtained with Yangio-China transplanter method.

Nutrient uptake of nitrogen, phosphorus and potassium was also higher in the crop transplanted with Kobota transplanter at all the stages in both the years followed by farmers method, SRI method and Yangio-China transplanter respectively. Conversely, soil available nutrient status (nitrogen, phosphorus and potassium) was significantly higher in the crop transplanted with Yangio-China transplanter and at par with SRI method during 2010-11.

Kobota transplanter method was economically feasible method as it registered highest gross, net returns and benefit cost ratio during both the years and pooled mean but was on par to farmer’s method of transplanting during 2011-12. It was followed by SRI method and lowest gross returns were obtained with Yangio-China transplanter. Though the grain yield and gross returns of SRI Method was at par with farmers method, net returns were less due to increased cost of cultivation.
Among the INM practices, application of FYM along with RDF showed significantly higher values of growth characters in terms of plant height, tiller number, dry matter production, leaf area, leaf area index, leaf area duration, crop growth rate and SPAD at different stages in both the years. The root dynamics in terms of root length, root volume and root dry weight were also higher with this treatment. The yield attributes, yield and plant nutrient uptake were outstandingly higher with RDF + FYM treatment in both the years and pooled mean. FYM application also showed higher available nitrogen, phosphorus and potassium in the soil.

Application of RDF + green leaf manure was found at par to RDF + FYM treatment with respect to tiller number at all the stages in both the years, crop growth rate, productive tillers, grains per panicle and grain yield in 2011 and panicles m$^{-2}$ and SPAD at harvest in 2010. This treatment was also found equivalent to RDF + FYM treatment in accumulation of soil phosphorus and potassium in 2010-11. Green manure treatment has putforth B:C ratio at par to RDF+ FYM treatment in 2011-12.

Transplanting with Kobota transplanter along with application of RDF + FYM was found best with significantly higher dry matter production, root growth, leaf area at different growth stages among the growth parameters and higher grains panicle$^{-1}$ among the yield attributes resulting in significantly higher nitrogen, phosphorus and potassium uptake in both the years. Application of RDF+GLM with Kobota transplanting and application of either FYM or GLM in farmers method were found on par to the above treatment for various growth and yield parameters. Kobota transplanting along with RDF+GLM performed well with equivalent grain yield as that of Kobota transplanter along with RDF + FYM in both the years of the study.

Among the planting methods and INM combinations, the best combination with highest net returns and benefit cost ratio was found to be Kobota transplanting with RDF + FYM which however was found on par to Kobota transplanting with RDF + GLM and farmer’s method of transplanting with RDF + FYM or GLM based on pooled mean of two years.
A field experiment entitled “Weed management studies in rice-fallow groundnut under coastal sandy soils” was conducted during rabi, 2012-13 on sandy loam soils of Agricultural College Farm, Bapatla. The experiment was laid out in a randomized block design with eight treatments comprising of T1- Handweeding at 20 and 40 DAS; T2- Pendimethalin @ 1.0 kg a.i. ha-1 as preemergence; T3-Imazethapyr @ 63 g a.i. ha-1 as post-emergence at 20 DAS; T4- Propaquizafop @ 63 g a.i. ha-1 as post-emergence at 20
DAS; T5-Pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb handweeding at 40 DAS; T6-Pendimethalin @ 1.0 kg a.i. ha-1as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 as post-emergence at 20 DAS; T7- Pendimethalin @ 1.0 kg a.i. ha-1as pre-emergence fb propaquizafop @ 63 g a.i. ha-1 as post-emergence at 20 DAS and T8-Weedy check. The treatments were replicated three times.

The dominant weed species which infested the experimental plot were *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Alternanthera triandra*, *Eclipta alba* (L.) Hassk., *Trianthema portulacastrum* L. and *Paspalum notatum* L..

Total weed density, dry weight of weeds were lower with pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6) and pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb handweeding at 40 DAS (T5) and are comparable with hand weeding at 20 and 40 DAS (T1). Weed control efficiency was higher in these treatments. As a result nutrient uptake by weeds was lower in these treatments. Grasses were susceptible to both imazethapyr and propaquizafop. Highest susceptibility of sedges was recorded with the treatments where post-emergence application of imazethapyr was involved. More than 50 per cent susceptibility of broad leaved weeds was recorded with the treatments where pre-emergence application of pendimethalin was involved. Slight stunting and light orange yellow discoloration of leaves was observed till 14 days after spraying of imazethapyr, however, these symptoms vanished and crop was normal by 20 days after spraying.

Plant height, number of branches per plant were higher with application of pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6), pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb propaquizafop @ 63 g a.i. ha-1 at 20 DAS (T7) and pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb handweeding at 40 DAS (T5) next to handweeding at 20 and 40 DAS (T1).

The dry matter accumulation was maximum with handweeding at 20 and 40 DAS (T1). Among herbicide treatments application of pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6), pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb handweeding at 40 DAS (T5) and pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb propaquizafop @ 63 g a.i. ha-1 at 20 DAS (T7) treatments were found effective. Uptake of nutrients by the crop was higher in handweeding at 20 and 40 DAS (T1), pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6) was also equally effective.

Yield attributes and yield was found to be superior with the treatments which received pendimethalin @ 1.0 kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6) and pendimethalin @ 1.0 kg a.i. ha-1 as preemergence fb handweeding at 40 DAS (T5), comparable with the handweeding at 20 and 40 DAS (T1).

Eventhough higher grain yields and gross returns were recorded in handweeding but net returns and BCR were low due to labour charges. Therefore, pendimethalin @ 1.0


kg a.i. ha-1 as pre-emergence fb imazethapyr @ 63 g a.i. ha-1 at 20 DAS (T6) was more profitable than handweeding at 20 and 40 DAS.

AGRONOMY

Author : SONIYA, T.
Title of the Thesis : EVALUATION OF DIFFERENT CROPS AND INTERCROPPING SYSTEMS ALTERNATE TO COTTON IN RAINFED ALFISOLS
Major Advisor : Dr. G. VEERANNA
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9630
ABSTRACT

A field experiment was conducted at Agricultural Research Station, Warangal during kharif, 2011 to “Evaluation of different crops and intercropping systems alternate to cotton in rainfed alfisols”. The soil was sandy loam in texture with low in nitrogen, medium in phosphorus and high in potassium. There was a rainfall of 349.9 mm distributed in 26 rainy days during the crop growing period.

The layout of the experiment was randomized block design with 12 treatments and three replications. Cotton, redgram, castor, maize, greengram, groundnut were sown as sole crops and then cotton and castor were intercropped with greengram where as redgram and maize were intercropped with both greengram and groundnut. The density of intercrop component was 66 per cent in cotton, redgram, castor and 50 per cent in maize. The vegetative crop growth, yield components and yield were in general more under sole cropping than intercropping. The reduction in seed cotton yield was 12.77, redgram 6.60, castor 5.56 and maize 2.3 per cent when intercropped with greengram, whereas with groundnut intercropping maize yielded 96.9 per cent and redgram 92.1 per cent of their respective sole crop yields.

Soil analysed after harvest of the crops and intercropping systems, revealed that nitrogen was significantly influenced whereas phosphorus and potash were unaffected. Maximum nitrogen depletion (189 kg ha$^{-1}$) noticed with sole maize and minimum with sole groundnut (276 kg ha$^{-1}$). At harvest, NPK uptake in sole and intercropping systems were significant. The nitrogen (108.0 kg ha$^{-1}$) and phosphorus (17.8 kg ha$^{-1}$) uptake was significantly higher with redgram + greengram and potassium with cotton + greengram (102.8 kg ha$^{-1}$). The soil had relatively more moisture content in 30 cm depth than 15 cm depth throughout the crop period.

Equivalent seed cotton yield of 2493 kg ha$^{-1}$ was realized from cotton + greengram intercropping which was at par with redgram + greengram (2216 kg ha$^{-1}$) and significantly superior over other sole and intercropping systems.

The land equivalent ratios were more than unity with the all intercropping systems indicating the advantage of intercropping. Maximum land equivalent ratio (1.48) was with castor + greengram intercropping and minimum (1.17) with maize + greengram. The area time equivalent ratios recorded best advantage of increased productivity per unit land and time by intercropping of groundnut between redgram (1.28) or maize (1.27).

Graphical representations are furnished to choose a more desired intercrop to attain threshold minimum standardized yield of sole crops for effective land equivalent ratios (1.49) and staple land equivalent ratios (1.41) were recorded by intercropping greengram between castor was the best system.

An economic evaluation indicated that the intercropping of greengram between redgram was the best for higher net returns (Rs. 48381 ha$^{-1}$) whereas net returns Rs.Re$^{-1}$
2.77 was realized with sole redgram. Though relative net return index was significantly not influenced by different intercrops in rainfed alfisols, numerically higher value (1.18) was recorded when castor was intercropped with greengram.

AGRONOMY

Author : SOWMYA, CH.
Title of the Thesis : DRIP FERTIGATION AND PLASTIC MULCH STUDIES IN TOMATO – SWEET CORN CROPPING SYSTEM
An investigation entitled “Drip fertigation and plastic mulch studies in Tomato – Sweet corn cropping system” was conducted at Precision Farming Development Centre, College Farm, College of Agriculture, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad. The study consisted of field experiments on tomato- sweet corn cropping system during rabi and summer seasons in successive years of 2010-11 and 2011-12 respectively. The experimental soil was sandy clay loam in texture, neutral in reaction, medium in organic carbon, low in available nitrogen and medium in available phosphorous and available potassium.

The experiments were laid out in split plot design, replicated thrice. The treatments consisted of four nitrogen levels i.e. 100% recommended dose of nitrogen (RDN) through drip, 80% RDN through drip, 60% RDN through drip and 100% RDN through conventional method allotted to main plots and three mulch treatments viz., black mulch (25 μ), red mulch (25 μ) and soil mulch assigned to sub plots.

Results of the first experiment conducted in tomato (2010-11 and 2011-12) revealed that among nitrogen levels, growth in terms of plant height and dry matter production at 60, 90, 120 days after planting (DAP) and at final harvest; yield attributes and yield viz., number of fruits per plant, fruit weight, yield per plant and yield per hectare; quality parameters such as total soluble solids, acidity and lycopene content; N, P and K uptake at final harvest were highest with 100% RDN through drip and 80% RDN through drip treatments which were on par with each other and significantly superior to 60% RDN through drip and 100% RDN through conventional method. Further, 60% RDN through drip was significantly superior to 100% RDN through conventional method. With respect to yield, 100% RDN through drip recorded an yield increase of 73.9% and 77.4% over the conventional method supplemented with the same dose of nitrogen during 2010-11 and 2011-12. The drip fertigation treatments outperformed the conventional irrigation method with an yield increase of 54.1% and 59.2% during respective years. Among the mulches, black and red mulch were on par with each other and recorded significantly higher growth parameters, yield attributes, fruit yield and N, P and K uptakes at harvest over soil mulch. A yield increase of 17.0% and 14.4% was recorded with black and red mulch over soil mulch during 2010-11 and 2011-12 respectively.

Lowest weed dry matter was recorded under drip fertigation treatments over 100% RDN through conventional method at 30, 45 and 60 DAP. Black and red mulch
were efficient in suppressing the weeds and recorded significantly lesser weed dry matter over soil mulch.

Highest agronomic efficiency for extra fertilizer nitrogen was recorded with 80% RDN through drip treatment over 100% RDN through drip during 2010-11 and 2011-12.

Water saving to an extent of 22.3% and 28.1% during 2010-11 and 2011-12 respectively was obtained with drip fertigation treatments over conventional method. The 100% RDN through drip treatment recorded higher WUE of 186.8 kg ha⁻¹ mm⁻¹ and 205.3 kg ha⁻¹ mm⁻¹ during respective years.

The soil moisture (before and after irrigation) fluctuated in a narrow range in the drip fertigation treatments as compared to conventional method. Similarly moisture fluctuation was narrow in black and red mulch treatments over soil mulch.

In terms of the post harvest N, P and K status of the soil, drip fertigation treatments had significantly higher available N, P and K soil status over 100% RDN through conventional method. Black and red mulch differed significantly with soil mulch and recorded higher post harvest soil nutrient status.

As a consequence of improved growth parameters, less weed competition under treatment combination 100% RDN through drip along with black mulch reflecting in greater yield attributes, yields, increased nutrient uptake and quality parameters, the highest net returns (ha⁻¹) accrued with 100% RDN through drip along with black mulch were 1, 97,998 and 2, 20,098 as against 60,944 and 70,494 with 100% RDN through conventional method. The benefit: cost ratio (B: C ratio) was 3.25 and 3.53 in the former and 1.83 and 1.97 in the latter in 2010-11 and 2011-12 respectively.

Drip fertigation resulted in a saving of 23.7% and 30.1% of irrigation water over conventional method during 2011 and 2012. 100% RDN through drip treatment recorded higher WUE of 24.5 kg ha⁻¹ mm⁻¹ in both the years while lowest WUE of 21.0 and 15.1% was observed with the 100% RDN through conventional method in 2011 and 2012. Results of the second experiment wherein sweet corn was tested in sequence after tomato revealed that 100% RDN through drip and 80% RDN through drip were on par and recorded significantly higher growth parameters (plant height and dry matter production), yield attributes and yield (individual cob weight, cob and green fodder yield) and quality parameter (sugar content) over 60% RDN through drip and 100% RDN through conventional method. Further, the drip fertigation treatment at lowest level of nutrient supply (60% RDN) through drip and 100% RDN through conventional method were in turn on par with each other. Black and red mulch treatments were at par and significantly superior to soil mulch in terms of growth parameters, yield attributes and yield and sugar content of sweet corn.

100% RDN and 80% RDN through drip improved the cob yield of sweet corn to an extent of 22.8% and 22.4% over 100% RDN supplied through conventional method (surface irrigation) during respective years. Among mulches, the two plastic mulch treatments (black and red) were significantly superior to soil mulch with an increase of 11.5 and 9.9% over soil mulch.
As a result of improvement in growth parameters and yield attributes, resulting in higher cob yield and green fodder yield, the highest net returns (53,059 and 57,103 `ha⁻¹ during 2011 and 2012 respectively) as well as B: C ratio (4.56 and 4.84 during 2011 and 2012 respectively) was obtained with the treatment combination of 100% RDN through drip along with soil mulch while lowest net returns of 31032 and 33018 `ha⁻¹ and B: C ratio of 2.41 and 2.50 was recorded with 100% RDN through conventional method in respective years.

The economics of the cropping system (tomato- sweet corn sequence) revealed that the total net returns (`ha⁻¹) was highest with the treatment combination of 100% RDN through drip along with black mulch (2, 49,498 and 2, 75,653 during first and second year). However, highest B: C ratio was recorded with drip fertigation treatments at 100% RDN levels with soil mulch (3.29) during 2010-11 in contrast to 2011-12 wherein 100% RDN through drip with black mulch recorded significantly highest benefit: cost ratio (3.46). Lowest net returns of 91976 and 1, 035, 12 `ha⁻¹ and B: C ratio of 1.97 and 2.09 were obtained from the treatment combination of 100% RDN through conventional method with soil mulch during respective years.

As there is no marginal difference between the B:C ratio of black mulch and soil mulch treatments owing to higher cost incurred on plastic mulches, the present results favour the use of 100% RDN through drip along with black mulch to realize higher yields and B: C ratio in tomato- sweet corn cropping system. This is in view of the higher yields realized by the use of plastic mulches and its benefits of weed control and water saving. Further, if intensive cropping is practiced, cost of cultivation incurred on mulch sheet can be overcome in view of higher yields that can be realized under drip fertigation with 100% RDN in conjunction with black mulch thus elevating the B: C ratio.
ABSTRACT

A field experiment entitled “Yield, quality and nutrient uptake of rice as affected by time and application of organic sources of nitrogen” was conducted at Agricultural College Farm, Bapatla during *kharif* 2012. The experiment was laid out in a randomized complete block design with nine treatments viz., 100% RDN through inorganic sources (120:60:40 kg N, P2O5, K2O) (T1), 100% RDN through poultry manure (10 days before puddling) (T2), 100% RDN through FYM (10 days before puddling) (T3), 100% RDN through neem cake (10 days before puddling) (T4), 100% RDN through vermicompost (10 days before puddling) (T5), 50% RDN as basal +50% at 10 days before PI stage through poultry manure (T6), 50% RDN as basal +50% at 10 days before PI stage through FYM (T7), 50% RDN as basal +50% at 10 days before PI stage through neem cake (T8), 50% RDN as basal +50% at 10 days before PI stage through vermicompost (T9). These treatments were replicated thrice. The experimental soil was clay loam in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in available phosphorus, high in available potassium.

Maximum plant height, number of tillers and drymatter accumulation were obtained with the application of recommended dose of chemical fertilizers which was significantly superior to 100% RDN through poultry manure (T2) at 30 DAT but remained on a par at 60 DAT. Both these treatments differed significantly with the remaining treatments. At 90 DAT and at maturity stages, significantly higher growth parameters were observed with T1, which was on a par with 50% RDN as basal + 50% at 10 days before PI stage through poultry manure (T6). However, the T6 was remained on
The highest number of yield attributes viz., productive tillers m-2, number of grains panicle-1 and number of filled grains panicle-1 was obtained with the application of recommended dose of chemical fertilisers, which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T6), but proved significantly superior to all other treatments. Among different organic manure treatments, T6 recorded highest yield attributes which was on a par with 100% RDN through poultry manure (T2). These were followed by 50% RDN as basal +50% at 10 days before PI stage through vermicompost (T9) and 100% RDN through vermicompost (T5) which were however, on a par with each other and but recorded marked differences over 50% RDN as basal +50% at 10 days before PI stage through neem cake (T8) and 100% RDN through neem cake (T4) which were however on a par with each other.

Significantly higher grain and straw yields (5856 and 6902 kg ha-1 respectively) were recorded with recommended dose of fertilizer (120:60:40 kg N, P2O5, K2O ha-1), which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T6), but proved significantly superior to the rest of the treatments.

There were no significant differences between organic manure treatments in respect of quality parameters of rice grain such as protein, amylose contents, milling per cent, hulling per cent, head rice recovery, L/B ratio, volume expansion ratio, kernel elongation ratio, water uptake and solid loss.

The maximum N, P and K uptake were recorded with the application of recommended dose of chemical fertilisers which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T6). Significantly higher soil available N, P and K were observed with the treatment receiving 100% RDN through FYM (T3) which was on a par with 50% RDN as basal +50% at 10 days before PI stage through FYM (T7).

Higher net returns (Rs. 58170 ha-1) and returns per rupee invested (2.9) were registered with the application of recommended dose of chemical fertilizers followed by 50% RDN as basal +50% at 10 days before PI stage through poultry manure (T6).

From the present study, it can be concluded that among the organic sources tested, application of 50% RDN as basal + 50% at 10 days before PI stage through poultry manure (T6) or 100% RDN through poultry manure (T2) are more beneficial in registering higher grain yield and profitability.
ABSTRACT

A field experiment entitled “Nutrient management for sustained productivity of newly developed groundnut genotypes” was carried out during rabi, 2012 on sandy clay loam soils of dry land farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in a split plot design and replicated thrice. The treatments consisted of four genotypes viz., Greeshma (G1), Rohini (G2), TCGS-1073 (G3) and TCGS-1043 (G4) assigned to main plots and three nutrient levels viz., Control (N1), 100% RDF (N2) and 150% RDF (N3) allotted to sub plots. The RDF is 30:40:50 kg N, P2O5 and K2O ha⁻¹. Genotypes and nutrient levels significantly influenced the plant growth characters, yield attributes, yield, quality parameters, economic returns and nutrient uptake by groundnut as well as the post harvest soil fertility status.
The genotype TCGS-1073 (G3), recorded the tallest plants, highest leaf area index and dry matter production, while all of them were found to be the lowest with TCGS-1043 (G4). Successive enhancement of nutrient levels from control to 150% RDF resulted in progressive increase in the growth parameters viz., plant height, leaf area index and dry matter production. At all the crop growth stages of observation, all the growth parameters were found to be at their best with 150% RDF (N3), while all of them were at their lowest with no nutrient application (N1).

The yield attributes of groundnut viz., total number of pods plant-1, number of filled pods plant-1, hundred pod weight and hundred kernel weight were the highest with the genotype TCGS-1073 (G3), while all of them were the lowest with TCGS-1043 (G4). Successive enhancement of nutrient levels from control to 150% RDF had resulted in significant improvement in the stature of all the yield attributes of groundnut. All the yield attributes of groundnut maintained the highest stature with 150% RDF.

Groundnut pod and haulm yields were the highest with genotype TCGS-1073 (G3) and the lowest with the genotype TCGS-1043 (G4). Application of 150% RDF (N3) recorded highest pod and haulm yields, while lowest yields were produced with non application of any nutrients (N1).

Oil content of groundnut was not significantly influenced by genotypes. The highest oil content was noticed with application of 150% RDF (N3), while the lowest was obtained with control (N1).

The nitrogen, phosphorus and potassium uptake by groundnut were the highest with the genotype TCGS-1073 (G3), while the lowest nutrient uptake was found to be with TCGS-1043 (G4). The highest nutrient uptake was recorded with 150% RDF (N3), while the nutrient uptake was found to be lowest with control (N1).

The highest post harvest soil available nitrogen, phosphorus and potassium were recorded with TCGS-1043 (G4), while the lowest were recorded with TCGS-1073 (G3). Application of 150% RDF resulted in highest soil available nitrogen, phosphorus and potassium, while it was found to be lowest with control (N1).

In conclusion, the study has revealed that higher productivity of groundnut could be obtained with cultivation of new genotype TCGS-1073 and supply of 150% RDF during rabi, in the present domain of study. The above combination of agro-techniques has also maintained the soil fertility status, without any impairment of soil health, thus satisfying the sustainability criterion.
AGRONOMY

Author : THIMMAPPA, V.
Title of the Thesis : RESPONSE OF KHARIF MAIZE (Zea mays L.) TO NITROGEN LEVELS AND PLANT DENSITIES
Major Advisor : Dr. M. SRINIVASA REDDY
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, MAHANANDI
Accession Number : D 9569

ABSTRACT

A field experiment was conducted during kharif, 2012-13 on sandy loam soils of College Farm, Agricultural College, Mahanandi, Acharya N.G. Ranga Agricultural University, Andhra Pradesh to study the “Response of kharif maize (Zea mays L.) to different nitrogen levels and plant densities. The experiment was laid out in Factorial Randomized Block Design and replicated thrice. The treatments consisted of three
nitrogen levels *viz.*, N1 (150 kg N ha\(^{-1}\)), N2 (200 kg N ha\(^{-1}\)) and N3 (250 kg N ha\(^{-1}\)) and six plant densities *viz.*, D1: 75 cm X 20 cm (66,667 plants ha\(^{-1}\)), D2: 75 cm X 15 cm (88,889 plants ha\(^{-1}\)), D3: 60 cm X 20 cm (83,333 plants ha\(^{-1}\)), D4: 60 cm X 15 cm (1,11,111 plants ha\(^{-1}\)), D5: 45 cm X 30 cm (74,074 plants ha\(^{-1}\)) and D6: 45 cm X 20 cm (1,11,111 plants ha\(^{-1}\)). Pioneer hybrid 30v92 was tested in the experiment. Recommended dose of phosphorus (60 kg ha\(^{-1}\)) and potassium (40 kg ha\(^{-1}\)) was applied uniformly to all the treatments. The salient findings of the investigation are summarized below.

The soil was sandy loam and it was slightly alkaline in reaction with a pH of 7.98, EC of 0.06 dSm\(^{-1}\). The soil was low in organic carbon and available nitrogen, medium in available phosphorous and high in available potassium.

At 60 and 90 DAS taller plants (252.67 cm and 278.46 cm, respectively) were produced by 200 kg N ha\(^{-1}\) which was however statistically at par with the other two treatments of 150 and 250 kg N ha\(^{-1}\). At 60 and 90 DAS taller plants (263.08 and 286.84 cm, respectively) were produced by a spacing of 75 cm X 20 cm which was statistically at par with 75 cm X 15 cm and significantly superior over rest of the treatments tried.

The highest leaf area index (LAI) was recorded with 250 kg N ha\(^{-1}\), which was significantly superior over 150 and 200 kg N ha\(^{-1}\) at all the growth stages of the crop. The lowest leaf area index (LAI) was recorded with 150 kg N ha\(^{-1}\) at all the growth stages of the crop. The highest LAI was recorded at a spacing of 45 cm X 20 cm, which was significantly superior over rest of the treatments tried. The lowest LAI was recorded at a spacing of 75 cm X 20 cm at 60 and 90 DAS, with 45 cm X 30 cm at 30 DAS which was on par with 75 cm X 15 cm at 30 DAS. Application of 250 kg N ha\(^{-1}\) was found significantly superior in dry matter accumulation by the crop at all stages 30 (205.27 g m\(^{-2}\)), 60 (628.56 g m\(^{-2}\)) and 90 DAS (964.27 g m\(^{-2}\)) over 150 and 200 kg N ha\(^{-1}\). With regard to plant densities, significantly highest dry matter (g m\(^{-2}\)) was produced at a spacing of 60 cm X 15 cm at 60 and 90 DAS and with 75 cm X 15 cm at 30 DAS which was on par with 60 cm X 15 cm at 30 DAS. The lowest dry matter was produced at spacing of 75 cm X 20 cm at all growth stages of the crop.

Application of higher dose of N (250 kg N ha\(^{-1}\)) took significantly less number of days to 50 per cent silking (52.61) followed by 200 (53.05) and 150 (54.00) kg N ha\(^{-1}\). Lower plant density with a spacing of 75 cm X 20 cm had taken significantly less number of days (52.22) to reach 50 per cent silking stage and higher plant density with a spacing of 60 cm X 15 cm and 45 cm X 20 cm took maximum days (54.66).

The highest cob length (17.82 cm) was recorded at 200 kg N ha\(^{-1}\) which was significantly superior over 150 kg N ha\(^{-1}\) (17.02 cm) and was at par with 250 kg N ha\(^{-1}\) (17.18 cm). The longer cobs (18.37 cm) were observed at a spacing of 75 cm X 20 cm and it was on par with rest of spacings tried. The lowest cob length (16.07 cm) was recorded at a spacing of 45 cm X 20 cm. The cob girth was significantly highest with N level of 250 kg ha\(^{-1}\) over 150 and 200 kg N ha\(^{-1}\). The maximum cob girth (14.97 cm)
was associated with lower plant density i.e. 75 cm X 20 cm and the minimum girth was found (14.16 cm) at a spacing of 60 cm X 15 cm.

The hundred seed weight (30.61g) obtained with 250 kg N ha-1 was significantly superior over 150 and 200 kg N ha-1. The maximum hundred grain weight (30.33 g) was obtained at a spacing of 45 cm X 20 cm and it was on par with rest of the plant densities. The maximum number of rows (14.21) was recorded with the application of 250 kg N ha-1 which was significantly superior over 150 and 200 kg N ha-1. The lower number of rows was observed at 150 kg N ha-1. Maximum number of rows per cob (14.29) was found at a spacing of 60 cm X 20 cm which was at par with 75 cm X 20 cm, 75 cm X 15 cm and 45 cm X 20 cm. The lowest number of rows (13.26) was observed at a spacing of 60 cm X 15 cm and it was at par with 45 cm X 20 cm.

The highest cob yield (9492.12 kg ha-1) and grain yield (6513.20 kg ha-1) was recorded with 250 kg N ha-1 which was significantly superior to 150 kg N ha-1. The lowest cob yield (8346.78 kg ha-1) and grain yield (5369.70 kg ha-1) was recorded at 150 kg N ha-1. The highest cob yield (9777.74 kg ha-1) and grain yield (6241.10 kg ha-1) was recorded at a spacing of 75 cm X 15 cm. The lowest cob yield (8096.39 kg ha-1) and grain yield (4987.19 kg ha-1) was recorded at 60 cm X 15 cm.

The highest gross returns, net returns and benefit:cost ratio was obtained with application of 250 kg N ha-1 while the lowest gross returns, net returns and benefit:cost ratio was recorded with application of nitrogen 150 kg ha-1. Regarding to plant densities highest gross returns and net returns was recorded at spacing of 75 cm X 15 cm and highest benefit:cost ratio at 75 cm X 20 cm while it was at par with all the spacings except 60 cm X 15 cm which recorded the lowest gross returns, net returns and benefit:cost ratio.

Application of 200 kg N ha-1 had resulted in highest plant height, 250 kg N ha-1 had resulted in highest growth parameter like leaf area index, dry matter production and days to 50 % flowering. Application of 250 kg N ha-1 produced higher grain and stover yields and also higher net returns than other levels (150 and 200 kg N ha-1) but net returns were comparable with 200 kg N ha-1. Therefore, it is recommended to apply 200 kg N ha-1 for realizing higher net returns.

Growth parameters were inconsistent with different spacings. The highest plant height was recorded at spacing of 75 cm X 20 cm, maximum leaf area index was recorded at 45 cm X 20 cm and dry matter production was higher at 60 cm X 15 cm. However with regard to yield parameters higher cob yield, grain yield and net returns were obtained at spacing of 75 cm X 15 cm. Therefore it is recommended to plant at a spacing of 75 cm X 15 cm.
AGRONOMY

Author : THIRUPATHI, I.

Title of the Thesis : STUDY ON INFLUENCE OF VARYING LEVELS OF NITROGEN AND SULPHUR ON GROWTH AND YIELD OF SINGLE CROSS HYBRID MAIZE (Zea mays L.)
ABSTRACT

Experiment on Study on influence of varying levels of nitrogen and sulphur on growth and yield of single cross hybrid maize (*Zea mays* L.) was conducted during *Kharif, 2013* at College farm, College of Agriculture, Rajendranagar, Hyderabad to find out optimum dose of sulphur in combination with nitrogen in maize and to evaluate the effect of nitrogen and sulphur on growth, yield attributes and yield of maize. The soil of the experimental site was sandy loam in texture, neutral in reaction, low in organic carbon, available nitrogen, medium in available phosphorus and sulphur and high in available potassium. The experiment was carried out with two nitrogen levels (N1: 180 kg ha\(^{-1}\), N2: 225 kg ha\(^{-1}\)) as first factor and five sulphur levels (S0: 0 kg ha\(^{-1}\), S1: 20 kg ha\(^{-1}\), S2: 40 kg ha\(^{-1}\), S3: 60 kg ha\(^{-1}\) and S4: 80 kg ha\(^{-1}\)) as second factor comprising ten treatment combinations were laid out in randomized block design with factorial concept replicated thrice.

With respect to levels of nitrogen, the highest plant height, leaf area index (LAI), dry matter production per plant, yield attributes, grain and stover yield were recorded with N2 (225 kg ha\(^{-1}\)) and it was significantly higher than N1 (180 kg ha\(^{-1}\)). The number of days taken to attain silking was less with increase in levels of nitrogen application. However, the number of days to attain different phenophases was not influenced by nitrogen levels.

Significantly higher nutrient uptake and crude protein content in grain was observed significantly highest with N2 (225 kg ha\(^{-1}\)) than N1 (180 kg ha\(^{-1}\)) and also highest net returns (60014) and B: C ratio (3.12) were obtained with N2 (225 kg ha\(^{-1}\)).

With respect to sulphur levels, the highest plant height, leaf area index (LAI), dry matter production per plant, yield attributes, grain and stover yield were recorded with S3 (60 kg ha\(^{-1}\)) and it was significantly higher than S2 (40 kg ha\(^{-1}\)), S1 (20 kg ha\(^{-1}\)), and S0 (0 kg ha\(^{-1}\)). However, it was on par with S4 (80 kg ha\(^{-1}\)). The number of days to attain different phenophases was not influenced by different sulphur levels.

With respect to nitrogen and sulphur interaction effects, application of N and S @ 225 and 60 kg ha\(^{-1}\) recorded highest dry matter, total number of grains per cob and grain yield and stover yield than other nitrogen and sulphur combinations but it was on par with N and S @ 225 and 80 kg ha\(^{-1}\).
Significantly the highest net return of 65658 was obtained with N and S@ 225 and 60 kg ha$^{-1}$. With respect to sulphur levels, the highest net returns of Rs 48364 and B: C ratio of 3.30 was obtained with S3 (60 kg ha$^{-1}$) and was on par with S4 (80 kg ha$^{-1}$) and significantly superior to S2 (40 kg ha$^{-1}$), S1 (20 kg ha$^{-1}$), and S0 (0 kg ha$^{-1}$).

It is concluded that application of nitrogen in combination with sulphur @ 225 and 60 kg ha$^{-1}$ found economical in obtaining higher yield with high net return and B: C ratio.
ABSTRACT

An experiment was conducted during kharif, 2013 at College farm, Rajendranagar, Hyderabad, with three plant densities $S_1$: 1 seedling hill$^{-1}$, $S_2$: 3 seedlings hill$^{-1}$, $S_3$: 5 seedlings hill$^{-1}$ as factor one and four age of seedlings $D_1$: 15 days old seedlings, $D_2$: 25 days old seedlings, $D_3$: 35 days old seedlings, $D_4$: 45 days old seedlings as factor two in randomized block design with factorial concept, replicated thrice.

The experimental results revealed that planting density of 5 seedlings hill$^{-1}$ ($S_3$) was found to be economical with significant increase in growth and yield attributes to get higher grain yield (5817 kg ha$^{-1}$) with high net return (Rs. 23,670 ha$^{-1}$) and B:C ratio (1.44). The increased yield with 5 seedlings hill$^{-1}$ was due to more dry matter production, dry matter partitioning (stem, leaf, grain) and panicles m$^{-2}$ (288).

Among the age of seedlings 25 days old seedlings ($D_2$) recorded significantly higher grain yield (6583 Kg ha$^{-1}$), straw yield (7570 Kg ha$^{-1}$), net return (Rs 34,484) and B:C ratio (1.64) over 15 ($D_1$), 35 ($D_3$) and 45 days old seedlings ($D_4$).

Dry matter partitioning of 58.1% to 58.4% towards grain was observed at physiological maturity with different plant densities. With respect to age of seedlings, 53.9% to 59.6% dry matter partitioning towards grain was observed at physiological maturity. Significant positive correlation existed between growth parameters and yield, yield attributes and yield of rice. From regression studies, nitrogen uptake at maturity accounted for 77% of total variation in grain yield of rice.

The highest intercepted PAR (66.3%) was observed with 5 seedlings hill$^{-1}$ ($S_3$) over 3($S_2$) and 1($S_1$) seedling hill$^{-1}$ at heading stage. With respect to age of seedlings, the
highest intercepted PAR (71.8%) was observed with D₂ (25 days old seedlings) followed by 15 (D₁) and 35 days old seedlings (D₃) and the lowest (47.1%) was observed in 45 days old seedlings (D₄) at heading stage.

Evaluation of CERES-Rice model confirmed that simulation of phenology was considered as excellent with NRMSE value being less than 10%. But, simulation of biomass and grain yield of rice was good as the NRMSE value was ranged in between 10.1 to 20%. So model can be used as a research tool in the variable agro-environments of Andhra Pradesh to suggest suitable planting density and age of seedlings. Based on seasonal analysis, the optimum plant density and age of seedlings for rice would be 5 seedlings hill⁻¹ and 20 days old seedlings.
ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla, during Rabi 2012-13 to evaluate the greengram (Vigna radiata (L.) Wilczek) genotypes for tolerance to waterlogging. The experiment was laid out in split plot design with main three treatments i.e., control (W0), waterlogging for two days (W1) and waterlogging for four days (W2) five sub treatments (genotypes) with three replications. Waterlogging was imposed at vegetative stage i.e. 21 DAS.

The findings of the experiment revealed significant differences between waterlogging treatments and genotypes. The growth parameters such as plant height, number of branches, number of leaves, leaf area and total drymatter measured at different intervals were significantly affected by waterlogging. The effect of four days waterlogging was more acute compared to two days waterlogging.

The soil moisture content of different treatments varied significantly at 25 DAS where the soil moisture content was increased by 31.19 percent in two days waterlogging treatment and 74.39 percent increased in case of four days waterlogging treatment over the control.

Imposing four days waterlogging resulted in decrease in plant height (32.17 %), number of branches (33.85 %), number of leaves (30.74 %) over control. TM 96-2 maintained higher values of all the above parameters followed by LGG 460 where as LGG 407 recorded lowest values of all the above parameters, control and by 14.01 per cent over two days waterlogging. The total drymatter decreased by 30.27 per cent over control and by 15.94 percent over the two days waterlogging. TM 96-2 maintained higher values of all the above parameters followed by LGG 460 and LGG 407 showed lowest values of all the above parameters.
The results indicated that the growth characteristics like CGR, RGR, NAR, SLA and LAD decreased with the waterlogging due to decrease in the leaf area and drymatter production. TM 96-2 maintained higher values of all the above parameters followed by LGG 460 and LGG 407 showed lowest values of all the above parameters.

Waterlogging resulted in decrease of relative water content by 14.21 per cent compared to control in four days waterlogging. TM 96-2 maintained higher RWC followed by LGG 460 and LGG 407 showed lowest RWC.

The results of biochemical parameters indicated that four days waterlogging decreased the SPAD chlorophyll content, CSI, total sugars by 35.09, 22.28, and 49.05 respectively over the control. Four days waterlogging decreased the N, P, K content and uptake by 23, 33.11, 20 and 46.24, 56.52, 53.69 percent respectively over the control. Among the genotypes, TM 96-2 maintained higher values of all the above parameters followed by LGG 460 and LGG 407 showed lowest values of all the above parameters.

Four days waterlogging increased the MII and proline content by 50.28 91.04 percent respectively over the control. TM 96-2 maintained higher proline content and lower MII followed by LGG 460 and LGG 407 showed lowest proline content and highest MII.

Waterlogging for four days decreased the yield and yield attributes. Four days waterlogging decreased the number of pods per plant (50.52 %), number of seeds per pod (26.85%), test weight (2.75%), and the yield ha-1 (70.51%) compared to control. Four days waterlogging decreased the harvest index by 33.44 percent over control and 18.57 percent compared to the two days waterlogging. Among the genotypes, TM 96-2 maintained higher yield and its attributes, apart from higher physiological and biochemical traits followed by LGG 460 and LGG 407 recorded lowest values of all the above parameters. Hence TM 96-2 and LGG 460 are considered to posses submergence tolerance among the five genotypes studied in the experiment.
CROP PHYSIOLOGY

Author : PUNNIA VISWAN

Title of the Thesis : PHYSIOLOGICAL BASIS OF DROUGHT TOLERANCE IN RESPONSE TO FOLIAR SPRAY OF KINETIN AND BRASSINOSTEROIDS IN GROUNDNUT (Arachis hypogaea L.)

Major Advisor : Dr. K. L. NARASIMHA RAO

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, BAPATLA

Accession Number : D 9574

ABSTRACT

The present investigation entitled “Physiological basis of drought tolerance in response to foliar spray of kinetin and brassinosteroids in groundnut” was undertaken at the Agricultural College Farm, Bapatla during rabi 2012-13. The treatments comprised of single (32 DAS) and double (32 & 45 DAS) foliar sprays of kinetin @ 5 ppm and 10 ppm and brassinosteroids @ 0.5 ppm, 1 ppm and 2 ppm, water stress and irrigation without foliar spray as control in RBD with three replications. The treatment plots were exposed to water stress by withholding irrigation at 30 DAS, continuing for 20 days and relieving at 50 DAS.

Sprays of 28-homobrassinolide @ 1 ppm at 32 & 45 DAS (T₁₀) recorded higher plant height (18.58 cm), physiological parameters like total dry matter accumulation (25.90 g plant⁻¹), CGR (19.28 g m⁻² day⁻¹), relative water content (89.2%), and biochemical parameters like chlorophyll stability index (93.5%), leaf proline content (202.6 µg g⁻¹ fresh wt.), nitrate reductase activity (20.15 µM NO₂⁻ g⁻¹ hr⁻¹) and less membrane injury (12.5%).
Kinetin sprays @ 10 ppm at 32 & 45 DAS (T₅) showed better results in number of branches per plant (19.69), number of flowers per plant (15.00, at 40 DAS) and stem dry matter (8.85 g plant⁻¹).

Physiological parameters like RGR (0.085 g g⁻¹ day⁻¹) and NAR (2.94 g m⁻² day⁻¹) was higher with the water stressed plants sprayed with 28-homobrassinolide @ 0.5 ppm at 32 DAS (T₆).

Biochemical parameters like oil content and total proteins of seeds were increased with foliar sprays of brassinosteroids. The SPAD Chlorophyll Meter reading was observed higher in the treatment of spray of brassinosteroids @ 1 ppm at 32 & 45 DAS (T₁₀). This treatment (T₁₀) increased chlorophyll content to an extent of 42.0 per cent when compared with water stress.

Foliar spray of HBL @ 1 ppm at 32 & 45 DAS (T₁₀) increased the yield and yield components like number of mature pods per plant, pod yield per plant, kernel yield per plant, test weight, shelling percentage and harvest index, ultimately leading to high pod yield. The higher test weight recorded was 49.77 g plant⁻¹ and higher harvest index was 43%. Pod yield recorded higher with double spray of HBL @ 1 ppm (T₁₀-3720 kg ha⁻¹) with a net return of Rs.40, 664 and B-C ratio of 1.80.
An experiment entitled “Identification of key adaptive traits associated with drought avoidance in green gram genotypes” was conducted during *rabi*, 2013-14 at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment was laid out in split plot design with three irrigation levels as main treatments (T1, T2 and T3) and five genotypes as sub treatments (MGG 295, MGG 347, MGG 348, WGG 37 and WGG 42). Among treatments, T1 was irrigated control, irrigated throughout the growth period, while T2 and T3 were water stress treatments, where T2 was irrigated at flowering stage and T3 was irrigated at flowering and pod filling stages. The experiment
was replicated thrice and observations were recorded at three stages viz., stage 1 (maximum vegetative stage), stage 2 (5 days after irrigation at flowering) and stage 3 (5 days after irrigation at pod filling).

Plant height of the mungbean genotypes ranged from 24.25–27.82 cm and number of leaves from 15.03 to 20.25. Among the genotypes WGG 37 recorded maximum plant height and number of leaves. Both plant height and number of leaves were significantly effected by water stress at all the three stages. There was a significant and positive correlation of plant height (r=0.969) and number of leaves (r=0.985) with seed yield. Leaf area was significantly effected by water stress at all the three stages and among the genotypes WGG 37 recorded the highest leaf area (12740 cm2), and lowest by MGG 347 (11020 cm2). Branch number was not effected by water stress except in stage 2. Both leaf area (r=0.970) and number of branches (r=0.919) were significantly and positively correlated with seed yield. Days to 50% flowering was not effected by water stress, while genotype differences were statistically significant.

Total dry matter was effected by water stress at stage 1 and stage 2. While genotypical variations were non significant at any of the three stages, and this parameter was positively and significantly correlated with seed yield.

Physiological parameters viz., photosynthetic rate, transpiration rate and stomatal conductance were significantly effected at stage 1 by water stress, while the differences were non significant during stage 2 and 3. Since the plants received irrigation during these 2 stages, the above physiological parameters recovered from water stress and registered high values in T2 and T3 treatments, which are on par with T1. Genotype WGG 37 recorded highest photosynthetic rate (15.18 μmoles of CO2 m-2 s-1), transpiration rate (5.90 mmoles of H2O m-2 s-1) and stomatal conductance (350.54 moles of H2O m-2 s-1), while lowest photosynthetic rate (13.57 μmoles of CO2 m-2 s-1), transpiration rate (4.81 mmoles of H2O m-2 s-1) and stomatal conductance (301.66 moles of H2O m-2 s-1) was observed in MGG 347. These physiological parameters measured at maximum vegetative stage were significantly and positively correlated with seed yield.

SPAD chlorophyll meter reading (SCMR) and relative water content were significantly effected by water stress at 30 DAS and 47 DAS. Genotypic variations with respect to RWC was observed at 47 DAS, while the differences were non significant at rest of the stages. WGG 42 maintained high relative water content (76.63%) and also recorded highest SCMR (47.83). While lowest relative water content was recorded by MGG 347 (59.51%), and lowest SCMR was recorded by MGG 348 (34.73). These two parameters were positively and significantly correlated with seed yield.

All most all the biochemical parameters were significantly effected by water stress. Proline, catalase and peroxidase showed increased activity due to water stress, and negatively correlated with seed yield and correlation was significant for catalase and peroxidase. Proline (r= -0.404) was non significantly and negatively correlated with seed yield. The total chlorophyll content decreased due to water stress and it was positively
and significantly correlated with seed yield. All the biochemical parameters recorded higher values in genotype WGG 37, whereas lowest total chlorophyll and leaf proline were recorded in MGG 348 and lowest catalase and peroxidase activity by MGG 347.

Yield parameters viz., number of pods per plant (r=0.546) and seed weight per plant (r=0.999) had significant and positive correlation with seed yield, while number of seed per plant (r=0.480) was not correlated significantly with seed yield. Harvest index was not effected by water stress. Highest seed yield was recorded by the genotype WGG 37 (1058.71 Kg/ ha), followed by WGG 42 (1052.22 Kg/ ha), while lowest seed yield was recorded in MGG 348 (951.42 Kg/ ha).

CROP PHYSIOLOGY

Author : SIVA NAGESWARA RAO DAVULURI
Title of the Thesis : “RESPONSE OF BLACKGRAM TO FOLIAR NUTRITION UNDER RECEDEING SOIL MOISTURE CONDITION”
Major Advisor : Dr. T. C. M. NAIDU
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D 9573
ABSTRACT

A field experiment was conducted during rabi season of 2012-13 at Regional Agricultural Research Station, Lam, Guntur, with an aim to find out the response of blackgram to foliar nutrition (KNO3 @ 1%, Urea @ 2%, DAP @ 2%, K2SO4 @ 1%, Triacontanol @ 1 ppm and water spray) under receding soil moisture conditions in split plot design with irrigation and no irrigation as main treatments and foliar sprays as sub treatments. Supplemental irrigation for irrigated main plot was given at 33 DAS and unirrigated main plot was maintained without any irrigation and foliar spray was done during flower and pod initiation stages.

Growth parameters such as plant height, leaf area and shoot dry weight showed significant reduction due to drought both before and after foliar spray. But, root dry weight reduced significantly only due to severe drought. Physiological parameters such as water potential, SCMR, RWC, photosynthetic rate, stomatal conductance and transpiration rate decreased significantly and canopy temperature increased due to drought both before and after foliar spray. Biochemical parameters such as chlorophyll a, chlorophyll b, total chlorophyll and protein content decreased and proline content, peroxidase activity and SOD activity increased due to drought.

In irrigated treatments urea @ 2% proved superior to other foliar sprays. But under receding soil moisture condition (moisture stress) KNO3 @ 1% proved superior over other foliar sprays by maintaining high leaf water potential, leaf RWC, leaf proline content, peroxidase activity, SOD activity and stomatal resistance and low canopy temperature and recorded more plant height, leaf area, shoot dry weight, root dry weight, chlorophyll content, leaf protein content and photosynthetic rate. KNO3 @ 1% gave higher yields under receding soil moisture condition compared to other foliar sprays.

Based on the experimental results foliar spray of KNO3 @ 1% can be recommended for blackgram under moisture stress.

CROP PHYSIOLOGY

Author : VEMA, P.

Title of the Thesis: PHYSIOLOGICAL MANIPULATION OF SEX EXPRESSION IN PISTILLATE AND MONOEIOCIOUS LINES OF CASTOR.

Major Advisor: Dr. S. NARENDER REDDY

Degree: M. Sc. (Ag.)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
ABSTRACT

The present investigation entitled “Physiological manipulation of sex expression in pistillate and monoecious lines of castor” was conducted at Students Farm, College of Agriculture, Rajendranagar, Hyderabad during Rabi 2013. The field trial was conducted following randomized block design with 12 treatments and replicated thrice.

The treatments consisted of three concentrations of ethrel, one control (water spray) and three castor genotypes viz., M-574, DPC-9 and DCS-107. Ethrel was sprayed at 100 ppm, 150 ppm and 200 ppm concentration at 15, 30, 45 and 60 days after sowing.

Sex expression was significantly affected by ethrel treatments in castor. Ethrel treatments at all concentration were found effective in reducing or suppressing the Interspersed Staminate Flowers (ISFs) in primary and secondary spikes of castor. In general with increase in concentration of ethrel a decreasing trend in number of ISF was observed.

Ethrel @ 200 ppm showed a gradual reduction in plant height in three genotypes and minimum plant height was observed in M-574. The ethrel treatments showed significant difference in phenological characters like days to initiation of primary spike, days to 50 percent flowering, days to maturity. Spraying ethrel at 200 ppm resulted in early flowering, less number of days to 50 percent flowering and maturity. The pistillate line DPC-9 attained early flowering and maturity.

Ethrel sprayed at different concentrations resulted in increasing yield and yield components. However, ethrel @ 200 ppm recorded maximum spike length, more number of capsules per spike, increased seed weight and increased seed yield.

Maximum number of capsules were recorded in DPC-9. The 100-seed weight was more in DCS-107. While the seed yield(g)/plant was highest in DPC-9.

CROP PHYSIOLOGY

Author : VENKATESH BABU, D.
Title of the Thesis : EVALUATION OF RAGI GENOTYPES FOR THERMOTOLERANCE WITH HIGH WUE TRAITS
Major Advisor : Dr. P.SUDHAKAR
The present investigation was aimed at evaluating the relative performance of ragi genotypes for high temperature tolerance using TIR technique and drought tolerance with good yielding abilities using reliable, morphological, physiological, Water Use Efficiency traits, thermostolerant traits and yield traits.

A set of diverse ragi germplasm comprising of 100 genotypes were screened for intrinsic tolerance using the standardized Thermo Induced Response (TIR) protocol. Among the 100 ragi genotypes, 10 genotypes (GP-3, GP-24, GP-25, GP-27, GP-23, GP-104, GP-111, GP-149, GP-153, GP-160) showed highest thermo tolerance in terms of higher seedling survival and no reduction in root and shoot growth. Three genotypes GP-25, GP-111 and GP-153 also recorded higher thermo tolerance with no reduction in root and shoot growth, but seedling survival was reduced only by 10 per cent. The present study revealed that the TIR technique can very well be used in ragi crop.

The selected ten genotypes with high thermotolerance were further tested under field conditions for drought tolerance in terms of high physiological efficiency, water use efficiency capabilities and yield traits. The field experiment was conducted during late Rabi, 2012-13 at wet land farm, college of Agriculture, Tirupati. Field experiment was laid out in factorial randomized block design, replicated thrice with two main treatments i.e. adequately irrigated, imposed stress from 35-60 DAT (panicle initiation to grain filling stage) and ten sub treatments (genotypes). During the experiment moisture stress was successfully imposed as there was no intermittent rainfall during the stress periods.

Growth and physiological traits viz. plant height, crop growth rate (CGR), net assimilation rate (NAR), leaf area index (LAI) and leaf area duration (LAD) and WUE traits (SLA, SCMR, CID, RWC) and thermostolerance tolerance traits (CSI) significantly reduced under moisture stress conditions compared to irrigated control. Similarly yield components viz., number of tillers plant-1, number of fingers plant-1, 1000 grain weight, straw yield as well as grain yields were significantly reduced due to moisture stress compared to control.

The genotypes, GP-153, GP-111 and GP-104 which maintained higher leaf area and dry matter also recorded superior growth and physiological traits compared to other entries. These genotypes also recorded low SLA and high SCMR and high thermo stability, which denotes efficiency in performing under drought condition. GP-153 and GP-111 also recorded higher yield and yield components. Other genotypes GP-160, GP-27 and GP-149 showed moderate performance in all attributes.
The present study reveals that moisture stress at panicle initiation is more sensitive. The genotypes GP-153, GP-111 are superior in terms of thermotolerance, physiological efficiency, drought tolerance, yield and yield components. GP-25 possess thermotolerance with poor WUE and yield attributes, whereas GP-104 is a drought tolerant genotype with moderate thermotolerance trait.

The genotypes GP-153, GP-111 and GP-104 are suitable for irrigated as well as rainfed conditions. GP-153, GP-111 and GP-25 possess intrinsic thermotolerance which can be explored as donor source in breeding programmes aimed for global warming.
ABSTRACT

A pot culture experiment was conducted at S.V. Agricultural College and RARS, Tirupati, during *Rabi*, 2012. The experiment was laid out in factorial randomized block design with four main treatments i.e., Control, Waterlogging during vegetative growth (20-29 DAS), Waterlogging during flowering (30-39 DAS), Waterlogging during pod development (40-49 DAS) and three sub treatment genotypes viz., TM 96-2, LGG 407 and LGG 460.

The greengram genotypes differed in their response to waterlogging and observations were recorded on morphological, physiological and biochemical parameters at the end of each waterlogging treatment. Data on the yield and yield components were recorded at harvest.

All the morphological and physiological characters used for evaluation under waterlogged conditions viz., plant height, SPAD chlorophyll meter reading, number of leaves, leaf area, root volume, number of adventitious roots, number of nodules and dry matter production varied significantly among waterlogging treatments and genotypes at all stages of crop growth. The effect was more pronounced when plants were exposed to waterlogging at vegetative stage followed by waterlogging at flowering stage. Among the genotypes, TM 96-2 recorded superior growth and physiological traits followed by LGG 460 and LGG 407.

Waterlogging treatments resulted in formation of aerenchyma in the roots and stem. Among the genotypes tested LGG 460 showed a prominent aerenchyma in the root and stem when waterlogged at flowering stage.

Waterlogging treatments resulted variation in biochemical changes in all the mungbean genotypes. Chlorophyll content and nitrate reductase activity decreased significantly compared to control. Whereas, antioxidant enzymes like superoxide dismutase, catalase and peroxidase increased under waterlogging stress. Chlorophyll content decreased to a greater extent when plants exposed to waterlogging at vegetative stage. Whereas, nitrate reductase activity declined to a greater extent when waterlogged
at pod development stage. Waterlogging at flowering stage caused increase in the activity of antioxidant enzymes.

Among the genotypes, LGG 460 maintained higher superoxide dismutase activity, peroxidase and nitrate reductase activity followed by TM 96-2. Whereas, TM 96-2 maintained higher chlorophyll content, catalase activity followed by LGG 460.

Yield components viz., number of pods/cluster, number of pods/plant, number of seeds/pod, pod length, pod yield and seed yield varied significantly among waterlogging treatments and genotypes. Waterlogging at pod development stage resulted in greater loss in yield and yield components. Among the genotypes, TM 96-2 maintained higher yield and yield components followed by LGG 460.

The results revealed that waterlogging at flowering and pod development stages proved detrimental as it affected the sink size and yield components. Hence yield reduction of more than 50 per cent was recorded. Among the genotypes tested, TM 96-2 is considered to be tolerant to waterlogging followed by LGG 460 in terms of growth, development, enzyme activity, harvest index and seed yield. LGG 407 is susceptible to waterlogging at any stage of the plant growth.
ENTOMOLOGY

Author : CHITTI BABU GIDDI

Title of the Thesis : NUTRITIONAL AND ENVIRONMENTAL REQUIREMENTS FOR THE SURVIVAL AND DEVELOPMENT OF THE LEGUME POD BORER/ COTTON BOLLWORM, Helicoverpa armigera (Hubner)

Major Advisor : Dr. G. RAGHAVAIAH

Degree : Ph. D.

College : AGRICULTURAL COLLEGE, BAPATLA

Accession Number : D 9602

ABSTRACT

Laboratory experiments were conducted to study the “Nutritional and environmental requirements for survival and development of cotton bollworm/legume pod borer, Helicoverpa armigera (Hubner)” at the International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India between 2009 - 2011.

The results showed that there was no significant effect of vitamin E on survival and development of H. armigera. Larval survival ranged from 86.3 to 90.0, 85.0 to 90.0 and 83.8 to 91.25 per cent in the first, second, and third generations, respectively. However, vitamin E at dosage of 200 mg/ 400ml diet in the artificial diet resulted in better larval and pupal survival and adult emergence. The fecundity of the H. armigera increased with an increase in Vitamin E in the artificial diet.

Larval survival of H.armigera varied from 97.9-100 per cent when reared on diets with different multivitamin concentrations. There were significant differences in the larval and pupal weights in first and second generations when the larvae were fed on diets with different concentrations of multivitamins. Adult emergence was greater (80.0%) in diets with multivitamins than in the control diet (70.0%). The fecundity of H.armigera increased gradually over generations when reared on multivitamin amended diets. There were no significant effects of different amounts of stigmasterol (0 to 0.04%) in the artificial diet on larval, pupal and adult survival of H. armigera. Highest pupal recovery was observed in insects reared on diets with 0.0375% stigmasterol in the second and third generations. There were no significant effects of stigmasterol on fecundity of H. armigera females.
Larval duration increased with an increase in cholesterol concentration in the diet (0.1 to 0.3%). The larval weights also increased with an increase in cholesterol concentration in the diet up to 0.25%, but declined in diets with greater amounts of cholesterol in the artificial diet in both the generations. In diets with higher concentrations of cholesterol (0.2 to 0.3%), the adult emergence and fecundity also decreased significantly. The Larval survival, pupation per cent and larval, pupal development was greater in the β-sitosterol incorporate diets as compared to the insects reared on diets without β-sitosterol.

The survival and development of *H. armigera* did not vary significantly when the insects were reared on diets with all the sterols. There were no advantage of providing additional amounts of amino acids in the diet, on survival and development of *H. armigera*, except on pupation.

There was 100% larval survival of pob borer, when reared on diets with leaf powder of the different chickpea genotypes. Nearly 50 - 75% decrease in the larval weights was recorded in insects reared on diets with leaf powder of different chickpea genotypes as compared to the larvae reared on the standard artificial diet. The larval and pupal periods were prolonged in insects reared on chickpea genotypes incorporated diets.

In the diets incorporated with pod powder of pigeonpea genotypes, the larval survival ranged from 62.5 to 91.7 per cent. There was 25 - 32% decrease in the larval survival in insects reared on diets with pigeonpea pod powder as compared to the standard control diet. The adult emergence decreased drastically (20.8 to 41.7%) in diets with leaf/pod powder of different pigeonpea diets. Highest larval survival (97.5 and 93.7%) was observed in insects reared on wheatgerm based diet in first and second generations, respectively, followed by those reared on chickpea based modified diet (93.7%).

The highest larval survival (90.0%) was recorded in insects reared on diets containing all the antibiotics, followed by those reared on the diets containing rifampicin and pencillin (87.8%). The adult emergence was also greater in insects reared on diets with all the antibiotics, and in diets with rifampicin (67.78%). Formalin had a significant effect on the larval survival, pupal weight, and fecundity of *H. armigera*. Highest fecundity (722.4 eggs/female) was recorded in insects reared on diets with 2.0% formalin. Sodium hypochlorite did not exhibit any significant effect on adult emergence of *H. armigera*. Sodium hypochlorite at 2.5 - 3.0% was found to be effective in reducing pathogen infection and the proportion of healthy adults was 84.0, 85.5, 89.3% in first, second, third generations, respectively.

Larval survival was significantly greater in insects reared individually in cell-wells (95.3%) followed by those reared in glass vials (79.3 %). The indigenously available cell well plates were quite suitable for rearing *H. armigera* and these are amenable to surface sterilization, reusable, and hence, suitable for mass rearing of *H. armigera*. 
ENTOMOLOGY

Author : KAMAKSHI, N.
Title of the Thesis : SCREENING OF CERTAIN RICE GENOTYPES TO RICE LEAFFOLDER, *Cnaphalocrocis medinalis* (Guenee) AND ITS MANAGEMENT”
Major Advisor : Dr. P. RAJASEKHAR
Degree : Ph. D.
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D 9603

ABSTRACT

Studies on the reaction of fifty rice genotypes against rice leaffolder *Cnaphalocrocis medinalis* (Guenee) and various aspects of morphological, biochemical and molecular characterization of high performing entries of rice together with effect of different nitrogen fertilizers and efficacy of certain newer insecticides on rice leaffolder was conducted for *kharif* 2009-10 and 2010-11 at farmers field, Agricultural Research Station, Nellore and at Biotechnology Lab, School of Frontier Technology, Tirupati. In addition to this, a preliminary survey was conducted at different mandals of SPSR Nellore district for leaffolder species diversity and their natural enemies identification.

Two leaffolder species *viz.*, *Cnaphalocrocis medinalis* and *Marasmia patnalis* were present in SPSR Nellore district with the predominance of *C. medinalis*
In the natural enemy fauna, among the predators the abundance was in the order of spiders, coccinellids, ground beetles, damsel flies, gryllids and earwigs. Among different parasitoids on rice leaffolder, main species observed were Trichogramma japonicum and T. chilonis from eggs, Macrocentrus philippinensis, Cotesia angustibasis and Goniozus spp, from larvae, and Brachymelia spp from pupae. The extent of parasitization was more in kharif season than in rabi. The mean parasitization during kharif 2009-10, rabi 2009-10 and kharif 2010-11 was in the order of 27.3, 20 and 25.7 per cent, respectively.

The cumulative mean incidence of rice leaffolder in fifty rice genotypes during two years indicated that the mean per cent damage was 22.06 and the damage ranged from 11.4 to 37.39. The lowest leaf damage was recorded in Jhitpiti (11.4%) and the highest damage was observed in NLR 145 (37.39 %) and TN 1 (37.16%).

Based on the leaffolder damage during two years, the genotypes were given ratings according to Standard Evaluation System (IRRI). All the fifty genotypes under study fell under three different ratings that is ‘1’ (resistant) – ten genotypes, ‘3’ (moderately resistant) - thirty genotypes and ‘5’ (moderately susceptible) – ten genotypes and none of the genotypes were highly resistant (‘0’) and highly susceptible (‘9’).

The resistant (10) and moderately susceptible (10) genotypes were processed for morphological, biochemical and molecular analysis.

Among morphological characters, leaf length did not affect the leaffolder incidence, where as positive significant correlation observed with leaf width and chlorophyll content. Among biochemical constituents, phenols and silica exhibited negative correlation with leaffolder damage.

The 20 selected rice genotypes were screened with eleven Simple Sequence Repeat Markers which indicated the presence of wide range of genetic diversity at molecular level. These 20 genotypes clearly formed into two different clusters indicating the phenotypic diversity present among resistance and susceptible genotypes that reflected at DNA level also.

The leaffolder damage was increased with the increase of nitrogen dose from 80 Kg to 160 Kg and among different sources of N, neem cake recorded lowest leaf damage, where as urea alone recorded the highest. But Cost Benefit Ratio was high in the treatment where urea alone applied @ 120 Kg N/ ha.

Among different insecticidal treatments, flubendiamide was found most effective in reducing the leaffolder damage, increasing in yield and attained high Cost Benefit Ratio. The other treatments that followed in the descending order of efficacy in reducing leaffolder damage were indoxacarb, lambda cyhalothrin, acephate, novaluron, chlorpyriphos, emamectin benzoate,cartap hydrochloride and NSKE. Spinosad and buprofezin recorded lowest mean per cent reduction of leaf damage over control indicating their poor efficacy against rice leaffolder.
ABSTRACT

The present investigation was carried out to study the effect of Rice husk ash (RHA), a silicon source and Imidazole, a silicon solubiliser against yellow stem borer,
Scirpophaga incertulas (Walker) in selected rice cultivars both in greenhouse and field conditions at Department of Entomology, Directorate of Rice Research, Rajendranagar and Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad during 2011-13.

The varieties tested, namely, KRH 2, MTU 1010, BPT 5204 and Vandana were almost on par with respect to per cent dead heart and white ear damage but PB 1 was highly susceptible to YSB infestation, both under greenhouse and field conditions. Among silicon sources, RHA+imidazole (twice) was the best treatment in greenhouse conditions and it was almost on par with Carbofuran 3G treatment in field conditions followed by RHA+imidazole (once), imidazole, RHA and untreated control.

The varietal effect was not observed with respect to number of larvae recovered from plants, larval weight and per cent larval mortality both under greenhouse and field conditions but among silicon sources, RHA+imidazole (twice) was proved to be the best treatment with lowest number of larvae recovered from plants, lowest larval weight and highest per cent larval mortality followed by RHA+imidazole (once), imidazole, RHA and untreated control.

No significant effect of either varieties or silicon sources was noticed with respect to mean width of larval mandibles but with respect to length of mandibular incisor cusps, highest wearing was observed in RHA+imidazole (twice) with least length of incisor cusps, followed by RHA+imidazole (once), imidazole, RHA and untreated control.

The histological studies on larval midgut revealed highly altered anatomy of larval midgut epithelium due to the feeding on silicon treated plants with high vacuolation, loss in compactness of columnar cells, rupturing of epithelial cells and discharging the cellular contents into the lumen and disintegration of peritrophic membrane.

With respect mean silicon content, KRH 2 was proved to be the maximum silicon accumulator followed by MTU 1010, BPT 5204, and Vandana and PB 1 was least silicon accumulator upon application of silicon sources and solubilisers. Among silicon treatments, RHA+imidazole (twice) was found best treatment with maximum silicon content followed by RHA+imidazole (once), imidazole, RHA and untreated control. Neither varietal effect nor silicon sources effect was observed on other biochemical parameters of the rice plant viz., nitrogen, phosphorus, potassium, total sugars and total phenols.

Correlation and step-wise regression analysis revealed that, larval weight, length of incisor cusps, silicon content at one day before and seven days after application of treatments and mean total phenols had significant effect on per cent dead hearts damage and all of them together could influence to the tune of 92 per cent ($R^2=0.92$) and larval recovery, silicon content at seven days after application of treatments and mean total phenols had significant effect on per cent white ear damage and all of them together could influence to the tune of 89 per cent ($R^2=0.89$). Under field conditions, the
relationship did not fit properly may be because of influence of other biotic and abiotic stresses that exists under field conditions.

The growth and development of YSB on RHA and imidazole treated stem cuttings from the rice variety, BPT 5204 revealed that there were five larval instars were observed across all the treatments including untreated control at two levels of temperature and humidity (25°C, 60% RH and 25°C, 75% RH). The total larval duration and pupal period was to the tune of 41.96±1.52 and 12.14±1.24 days in treated stem cuttings when compared to untreated control (39.37±1.39 and 8.31±0.36 days) at 25°C, 60% RH. At 25°C, 75% RH slightly lesser larval duration and pupal period was noticed on treated (37.83±2.01 and 7.48±0.07 days) and untreated stem cuttings (36.69±1.24 and 6.78±0.24 days). Effect of temperature and humidity on per cent mortality of larval instars was not pronounced at both levels, but highest mortality to the tune of 30-40 per cent was observed at IV and V instar stage across all the treatments in comparison to untreated control (20-25 per cent).

ENTOMOLOGY

Author : MOUNIKA, G.

Title of the Thesis : ‘GROWTH REGULATORY EFFECTS OF BENZOYL PHENYL UREAS AGAINST Spodoptera litura FAB. AND THEIR COMBINATIONS WITH CERTAIN
FUNGICIDES ON Alternaria macrospore ZIMM.’

Major Advisor : Dr. P.V. KRISHNAYYA
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D 9610

ABSTRACT

The present investigation entitled ‘Growth regulatory effects of benzoyl phenyl ureas against Spodoptera litura Fab. and their combinations with certain fungicides on Alternaria macrospora Zimm.’ was carried out in the Department of Entomology, Agricultural College, Bapatla during 2012-13.

The LC50 (LD50) values of lufenuron, diflubenzuron and novaluron against third instar larvae of S. litura by topical method were 44.073 ppm (2.93 μg/g), 90.048 ppm (6 μg/g) and 59.885 ppm (3.9 μg/g), whereas the values against fifth instar larvae were 92.646 ppm (6.17 μg/g), 177.500 ppm (11.8 μg/g) and 105.327 ppm (7.02 μg/g), respectively.

The LC50 (LD50) values of lufenuron, diflubenzuron and novaluron against third instar larvae of S. litura by ingestion method were 62.581 ppm (104 μg/g), 75.828 ppm (126 μg/g) and 74.731 ppm (124 μg/g), whereas the values against fifth instar larvae were 117.669 ppm (11.7 μg/g), 129.024 ppm (12.9 μg/g) and 124.552 ppm (12.4 μg/g), respectively.

Lufenuron was efficacious followed by novaluron and diflubenzuron. Lufenuron followed by novaluron were more toxic by topical application, whereas, diflubenzuron was by ingestion method.

Lufenuron was relatively more efficacious in resulting mean larval feeding inhibition by topical method (18.92% at 100 ppm) compared to ingestion method of diflubenzuron (14.29% at 120 ppm) and novaluron (12.64% at 120 ppm).

Lufenuron was relatively more efficacious in reducing the mean larval weight by topical method (28.39% at 100 ppm) compared to ingestion method of diflubenzuron (24.62 at 120 ppm) and novaluron (19.48% at 120 ppm).

Lufenuron was more efficacious in prolonging the larval periods of by topical method (13.3 days at 100 ppm) compared to ingestion method of diflubenzuron (12.6 days at 120 ppm) and novaluron (10.6 days at 120 ppm).

Lufenuron was more efficacious by topical application (10.0 days at 100 ppm)
compared to ingestion method of diflubenzuron (9.6 days at 120 ppm) and novaluron (9.0 days at 120 ppm) in prolonging the pupal periods.

The per cent reduction of chitin in third instar larvae of *S. litura* due to lufenuron, diflubenzuron and novaluron at their median lethal concentrations (LC50) in ingestion method was 21.35, 18.11 and 12.97, whereas in fifth instar it was 28.27, 24.96 and 13.34, respectively. But the per cent reduction of chitin in third instar larvae of *S. litura* due to lufenuron, diflubenzuron and novaluron at their LC50 values in topical method was 26.24, 22.00 and 15.55, whereas in fifth instar it was 29.20, 26.04 and 14.58, respectively.

Chitin inhibition was more with topical application of lufenuron in fifth instar larvae compared to third instar larvae.

The test BPUs lufenuron (100 ppm), diflubenzuron (125 ppm) and novaluron (100 ppm) either alone or in combination with test fungicides copper oxychloride (1500 ppm), mancozeb (1500 ppm) and hexaconazole (1000 ppm) significantly inhibited the radial growth of *A. macrospora*. The radial growth inhibition was cent per cent with hexaconazole and its combinations with the BPUs. The combinations of the BPUs with fungicides inhibited the radial growth of the fungus to the extent of 64.70 to 79.6%. Though numerically marginal, the test BPUs significantly reduced the radial growth effect of the fungicides.
ENTOMOLOGY

Author : NAGARAJU ALUGOJU

Title of the Thesis : STANDARDIZATION OF X-RAY RADIOGRAPHY METHODOLOGY FOR THE DETECTION OF HIDDEN INSECT INFESTATION IN GROUNDNUT AND BER

Major Advisor : Dr. T. RAMESH BABU

Degree : M. Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9549

ABSTRACT

Standardization of X-ray radiography methodology for the detection of hidden insect infestation in groundnut and ber was undertaken during September 2013 – March 2014.

The primary objective of detecting hidden infestation in the groundnut and ber has been achieved with investigations on different combinations of input factors of X-ray radiography viz., the voltage in kilovolts (KV), current in milliampere (mA) and period of exposure in seconds (s) to radiation. The results of experiment showed that these input factors varied with the different seed materials viz., groundnut and ber. Compared to the light materials, high amounts of voltage and current is required for dense seed materials. Best contrast of image was obtained, when the exposure period varied from 10 – 12 seconds.

The results indicated that the standardized value for the detection of Caryedon serratus Oliver in different varieties of groundnut was 15 KV, 6 mA for 10 seconds for Kadiri-4, 20 KV, 6 mA for 10 seconds for Narayani and JCG 88, 22 KV, 6 mA for 10 seconds for Abhaya, Rohini, ICGV 91114 and Harithandhra, 22 KV, 7 mA for 10 seconds for JCG 1014 and Kadiri-5, 25 KV, 6 mA for 10 seconds in case of Anantha, Greeshma, Dharani, ICGV 03043 and ICGV 06236, 25 KV, 7 mA for 10 seconds for TCGS 1073, 26 KV, 6 mA for 10 seconds in case of Kadiri-6, 26 KV, 8 mA for 10 seconds for TCGS 750, 28 KV, 6 mA for 10 seconds for Kadiri-7, 30 KV, 6 mA for 10 seconds for Kadiri-8 and 30 KV, 8 mA for 10 seconds in case of Bheema variety of groundnut. In the ber standardized value to detect internal injuries caused by Meridarchis scyrodes Meyrick was 32 KV, 9 mA for 12 seconds.
Until now standardization of X-ray radiography technique in groundnut and ber for the detection of hidden insect infestation is an untouched area.

Usage of sticky (adhesive) tapes was found highly helpful to locate and pick out the hidden infested seed from the healthy ones.

X-rays emanating from the voltage and current intensities used to detect the hidden infestation are soft X-rays and do not affect the viability of the seed materials. Germination percentage for different X-ray combinations varied from 90-100% in case of groundnut. While in ber it ranged from 85-100%.
ABSTRACT

Laboratory studies on “Differential resistance of maize hybrids and varieties to rice moth (Corcyra cephalonica Stainton) and its management under laboratory conditions” were conducted in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad during 2012-13.

The performance of 18 maize hybrids/varieties to C. cephalonica was assessed based on the development of the insect and weight loss of the grains. Significant variation was observed among the treatments with respect to pest development and weight loss of grains. The treatments were classified into 5 categories based on the index of susceptibility as resistant, moderately resistant, moderately susceptible, susceptible, and highly susceptible. Seed Tech 2324 which recorded 4.5 index of susceptibility was categorized as moderately resistant while the ten treatments viz., BPCH 6, Bulland, Sugar 75, BIO-9637, BQLMH 7, PMH 5, Varun, BQPMH 38, CMH-08-282 and Amber Pop Corn which recorded the index of susceptibility ranging between 5.3-7.5 were moderately susceptible to the pest. Madhuri Sweet Corn variety was highly susceptible to the pest infestation and recorded high index of susceptibility of 10.5. The rest of the six treatments viz., X35C537, DHM 117, WOSC, Ashwini, KNMH 4202 and
CMH-08-287 with the index of susceptibility ranging between 7.6 and 9.8 were susceptible to the pest infestation.

Among the physical parameters grain hardness and grain weight significantly influenced the growth and development of rice moth. Among the chemical constituents high ash, fibre and phenol contents offered resistance mechanism while the susceptible varieties possessed more nitrogen and crude protein content. Other physical parameters like grain size, intergranular space did not exert independent effect on the insect but the combined effect of various physico – chemical parameters showed significant influence on various biological parameters of test insect.

Among the six grain protectants comprising two oils viz., neem oil and karanj oil and four chemical protectants viz., spinosad, deltamethrin, emamectin benzoate and novaluron used in the study, chemical protectants were proved to be effective over oils. Among the chemical grain protectants also, emamectin benzoate and deltamethrin were more effective over novaluron and spinosad and caused 100% mortality after 3 days of treatment. Among the two bags used in the study, gunny bags were superior over cloth bags and similar results were obtained with insecticide treated gunny bags over cloth bags. Among the various bag treatments emamectin benzoate was equally effective and was on par with deltamethrin treatment in preventing the pest infestation and development.
ABSTRACT

Laboratory studies on “Crop Isolate based Variations in Biological Attributes & Virulency Levels in Verticillium lecanii (Zimmermann) Viegas Native strains” were conducted at AICRP on Biological Control of Crop pests and Weeds, Agricultural Research Institute, Rajendranagar, Hyderabad during 2012-13.

The soil samples were collected from different crop rhizospheres. The isolated fungi was purified. After the isolation and purification they were evaluated for biological attributes such as radial growth, conidia per unit area (conidial concentration), conidial
viability and also virulency against the mealybug (*Phenacoccus solenopsis*). The isolated strains were designated by the crop from which they were isolated.

A total of 6 isolates from different crop rhizospheres viz., BCSH VSF CF (sunflower), BCSH VM CF (maize), BCSH VGN FF (groundnut), BCSH VRG SF (redgram), BCSH VJ AF (jowar) and BCSH VT AF (tomato) were evaluated for their biological attributes and levels of virulency against the target pest, *Phenacoccus solenopsis*. PDBC isolate was used as standard check and lab culture was considered as local check for comparisons. Among test isolates BCSH VT AF isolate from Tomato showed maximum radial growth (59.17 mm), highest conidial concentration (1.58x10^{9}), highest percentage of conidial viability (94.24 per cent) and highest virulency against mealybug (94.37 per cent). Maize isolate (BCSH VM CF) found to be the next promising isolate with radial growth of 41.97 mm, conidial concentration of 1.41x10^{9}, conidial viability of 90.58 per cent and virulency of 85.80 per cent. Least radial growth (24.30 mm), conidial concentration (1.18x10^{9}), conidial viability (81.02 per cent) was noticed in an isolate from groundnut crop rhizosphere.

On the basis of the data obtained and also in view of the above inferences BCSH VT AF isolate is found to be better and promising for further processing and commercialization.

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**ENTOMOLOGY**

**Author** : RAJASEKHAR, Y.

**Title of the Thesis** : POPULATION DYNAMICS AND INSECTICIDAL MANAGEMENT OF INSECT PESTS ON BT AND VARIETAL COTTONS WITH EMPHASIS ON MEALYBUG, *PHENACOCCUS SOLENOPTIS TINSLEY*

**Major Advisor** : Dr. P.V. KRISHNAYYA

**Degree** : Ph. D.

**College** : AGRICULTURAL COLLEGE, BAPATLA

**Accession Number** : D 9606

**ABSTRACT**

The present investigation on “population dynamics and insecticidal management of insect pests on bt and varietal cottons with emphasis on mealybug, phenacoccus
solenopsis tinsley” was conducted under Department of Entomology, Agricultural College, Bapatla at Regional Agricultural Research Station, Lam, Guntur during two seasons kharif, 2009-10 and kharif, 2010-11.

Seasonal incidence of insect pests was studied by raising a bulk crop of 500 m² following the normal agronomic practices without any insect pest management practices. The data on insect pests was recorded at weekly interval on 25 randomly selected tagged plants from initiation of the pest and continued till last picking in all the three cotton hybrids/variety (RCH 2 BG II, Mallika BG II and L 604 non-Bt variety). The populations of aphids, leafhoppers, thrips, whiteflies and mealybugs were higher during 43rd-46th, 39th-46th, 39th-41st, 51st-1st and 2nd-8th std. weeks, respectively in all cotton hybrids/variety. While no larval incidence of tobacco caterpillar, american bollworm and pink bollworm in stacked Bt cotton hybrids (RCH 2 and Mallika), but were higher during 46th-49th, 44th-46th and 6th-8th std. weeks, respectively in L 604 non-Bt variety. However, incidence of cotton mealybug was high on stacked Bt hybrids (RCH 2 BG II and Mallika BG II) compared to L 604 non-Bt variety.

All the weather variables viz., maximum and minimum temperatures, morning and evening relative humidities, and rainfall accounted for 42.9, 57.2, 69.7, 27.6, 21.9 and 68.7 per cent variation in aphids, leafhoppers, thrips, whiteflies, mealybugs and pink bollworm populations significantly (R²=0.429*, 0.572*, 0.697*, 0.276*, 0.219* and 0.687*, respectively). Of the five variables maximum temperature on whiteflies, mealybug and pink bollworm, minimum temperature on thrips, whiteflies and mealybugs, morning relative humidity on thrips and whiteflies, and rainfall on whiteflies exerted significant influence on the variation of population independently.

The influence of plant morphological characters on the sucking insect pests was evaluated by assessing the hair density and length, and leaf thickness on leaf lamina discs (10 mm²) from each test cotton plant from the terminal leaves using stereozoom microscope, ocular micrometer and micrometer, respectively. The mean incidence of aphids, thrips and whiteflies was high on the Mallika BG II having moderate hair density and leaf thickness, and more hair length followed by L 604 non-Bt variety having high hair density and leaf thickness and moderate hair length and RCH 2 BG II having low hair density and leaf thickness, and less hair length, while leafhoppers were high on RCH 2 BG II followed by L 604 non-Bt variety and Mallika BG II.

The influence of plant canopy on the incidence of major sucking insect pests was studied by recording pest population on three leaves one each at top, middle and bottom portions from two monopodials and on top three leaves of the main stem from 45 days after sowing to last picking at weekly interval on 25 randomly selected plants in each cotton type. The populations of leafhoppers, thrips and whiteflies within the plant were higher at top canopy level followed by middle and bottom canopy levels. While aphids were higher on the bottom canopy level followed by middle and top canopy level irrespective of the cotton hybrids/variety.

Efficacy of insecticides against insect pests with emphasis on sucking pests was studied in the field conditions employing Split Plot Design with nine insecticidal treatments as sub treatment on three cotton hybrids/variety as main treatments. The data
was recorded on five randomly selected tagged plants per plot at 3, 9 and 14 days after treatment. Imidacloprid (Gaucho) 70 WS seed treatment @ 7.5 g/kg seed was significantly superior to untreated check up to 40 DAS against aphids, leafhoppers, thrips and whiteflies irrespective of the cotton hybrids/variety and it could keep the leafhoppers below economic threshold level (ETL=2no./leaf) up to 23 DAS in RCH 2 BG II and up to 30 DAS in both Mallika BG II and L 604 non-Bt variety.

Among the insecticidal treatments, imidacloprid 70 WS seed treatment @ 7.5g/kg seed+need based insecticidal spray on ETL basis was promising in keeping the insect pest populations (mainly leafhoppers, tobacco caterpillar and american bollworm) below ETL throughout the crop growth period resulting in high seed cotton yield and cost benefit ratio in all the cotton hybrids/variety except in RCH 2 BG II, where plant protection costs were high against leafhoppers resulting low cost benefit ratio and occupied second position after imidacloprid 70 WS seed treatment @ 7.5g/kg seed+fipronil 5 SC @ 2 ml/L spray.

Fipronil 5 SC @ 2.0 ml/L was highly effective against leafhoppers and thrips and could successfully keep the leafhoppers below the ETL up to 9 DAT in RCH 2 BG II and up to 14 DAT in both Mallika BG II and L 604 non-Bt variety. While both acetamiprid 20 SP @ 0.2 g/L and stem application of monocrotophos 36 SL (1:4) kept the leafhoppers population below the ETL only up to 3 DAT in RCH 2 BG II (less leaf thickness, hair density and length) and up to 7 and 9 DAT in the respective insecticides in both Mallika BG II and L 604 non-Bt variety (more leaf thickness, hair density and length). Acetamiprid 20 SP @ 0.2 g/L was the most effective against aphids and whiteflies with per cent mortality was more than 80 and 75, respectively at 3 DAT and 45 and 60, respectively at 9 DAT at all the three spray schedules irrespective of the cotton hybrids/variety.

Among the solo insecticidal treatments, stem application of monocrotophos 36 SL (1:4) was the most effective against cotton mealybug in different cotton hybrids/variety followed by fipronil 5 SC @ 2.0ml/L was also effective on tobacco caterpillar and american bollworm in L 604 non-Bt variety.

The seed treatment with imidacloprid 70 WS @ 7.5 g/kg seed followed by the spray of acetamiprid 20 SP @ 0.2 g/L or fipronil 5 SC @ 2ml/L, or stem application with monocrotophos 36 SL (1:4 ratio) at 30, 45 and 60 DAS was significantly superior in reducing the sucking insect pests up to 55 DAS than individual sprays/application.

A total number of 6-7 insecticidal sprays were necessary for RCH 2 BG II as against 4-5 both in Mallika BG II and L 604 non-Bt against leafhoppers, in addition two more sprays are required for L 604 non-Bt against tobacco caterpillar and american bollworm.

Biology of the mealybug was studied by rearing them on sprouted potatoes in the laboratory (temperature of 27 ± 2°C and per cent relative humidity 75 ± 5). The mean fecundity of female cotton mealybug was 362.70 with a mean egg period of 444.85 min. Morphologically there is no distinct difference in sex up to the end of third instar. Thereafter males can be identified by the presence of white silken threads secreted around the body. Females moults three times to become adult, whereas the males moults four
times. The mean nymphal periods of first, second, third and fourth instar (cocoon of male) was 5.38, 4.58, 4.90 and 6.73 days, respectively. The mean pre-oviposition, oviposition and post-oviposition periods of female cotton mealybug was 19.13, 16.20 and 1.45 days, respectively. Male and female longevity are 1.50 and 36.78 days, respectively. The total life span of male was also shorter than that of female with a mean of 23.08 days as against 51.63 in females. The mean per cent males developed from total crawlers was 5.86.

Toxicity of the insecticides was evaluated against the second instar nymphs from laboratory reared homogeneous population of cotton mealybug using potato slices with sprouts. Mealybug mortality was recorded after 72 h of exposure to insecticides. The LC₅₀ value (ppm) of spirotetramat, buprofezin, methylparathion, profenophos, methomyl, imidacloprid and fipronil against second instar cotton mealybug was 1420, 770, 390, 330, 280, 260 and 110 ppm, respectively with order of toxicity was fipronil > imidacloprid > methomyl > profenophos > methylparathion > buprofezin > spirotetramat.

**ENTOMOLOGY**

Author : RAMA KRISHNA RAO, A.

Title of the Thesis : POPULATION DYNAMICS AND MOLECULAR
CHARACTERIZATION OF THRIPS AND THEIR MANAGEMENT IN GROUNDNUT (Arachis hypogea L.)

Major Advisor : Dr. P. RAJENDRA PRASAD
Degree : Ph. D.
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D 9620

ABSTRACT

The study on the “Population dynamics and molecular characterization of thrips and their management in groundnut” with field experiments conducted during Kharif, 2011, Rabi, 2011-12 and Kharif, 2012 at S.V. Agrl. College Farm, Tirupati to document the thrips population, damage in different seasons, their management in groundnut and to evaluate groundnut genotypes for thrips resistance. A survey was conducted in Chittoor and Anantapur districts for thrips incidence and laboratory studies pertaining to molecular characterization of thrips and morphological, biochemical characters were undertaken at Institute of Frontier Technology, Regional Agricultural Research Station, Tirupati, Andhra Pradesh.

During Kharif, 2011, 2012 and Rabi, 2011-12, 2012-13 the roving survey was conducted and recorded the incidence of thrips, Peanut Bud Necrosis Disease (PBND) and Peanut Stem Necrosis Disease (PSND) on groundnut conducted in six mandals of Chittoor and Anantapur districts with five villages in each mandal, in each village five farmer fields were selected. The roving survey was conducted at five different stages of the crop viz., vegetative, flowering, pegging, pod formation and pod development stage.

The roving survey in Chittoor and Anantapur districts revealed that the thrips damage was high during both Kharif and Rabi seasons particularly from vegetative stage to peg penetration stage while the PBND incidence was noticed from the flowering stage to pod formation stage. With regard to PSND the disease incidence was more in Anantapur district compared to Chittoor district particularly during Kharif.

The fixed plot survey conducted at S.V. Agrl. College farm, Tirupati and A.R.S., Kadiri revealed that maximum temperature, minimum temperature and wind speed had significant positive influence on thrips incidence when groundnut was sown during first fortnight of July in both the cultivars i.e., Narayani (r = +0.39, +0.32, +0.67) and K-6 (r = +0.39, +0.32, +0.65), morning relative humidity and evening relative humidity showed significant negative influence in Narayani (r = -0.57, -0.35) and K-6 (r = -0.56, -0.36), respectively.

The data analyzed by using step down regression revealed that rainfall, rainy days, sunshine hours and wind speed together influenced to an extent of 90 ($R^2=0.90$) and 89 ($R^2=0.89$) per cent of foliar damage due to thrips in D1 sown Narayani and K-6 cultivars of groundnut crop and regression equation models developed were $Y= -18.11 -0.23 RF +4.27 RD-1.71 SSH +6.55WV$ and $Y= -435.55 +8.20 max temp -$
0.24 RF +1.74 RD -0.30 SSH +8.12 WV, respectively. In case of Narayani sown in D2, maximum temperature, minimum temperature rainy day and wind speed influenced to the extent of 70 per cent ($R^2=0.70$), regression model developed was $Y= -184.75 +1.84 \text{ max temp} +4.97 \text{ min temp} +2.88\text{RD} +1.40 \text{ WV}$ and incase of K-6 maximum temperature, minimum temperature, evening relative humidity and rainy day influenced to 73 per cent ($R^2=0.73$) and model developed was $Y= -337.74 +4.74 \text{ max temp} +5.88 \text{ min temp} +0.89 \text{ Eve RH} +1.39 \text{ RD}$. Whereas, in D3 sown Narayani and K-6 morning relative humidity, evening relative humidity and rainfall resulted in 84($R^2=0.84$) and 87($R^2=0.87$) per cent thrips incidence and developed forward selection regression equations were $Y= 37.25 -0.70 \text{ mor RH} +0.51 \text{ Eve RH} -0.07 \text{ RF}$ and $Y= 45.48 -0.82 \text{ mor RH} +0.54 \text{ Eve RH} -0.06 \text{ RF}$, respectively.

Random Amplified Polymorphic DNA (RAPD) is a rapid and sensitive technique in genetic diversity analysis of insect pests. Ten arbitrary primers (OPA-01, OPA-07, OPA-08, OPA-13, OPC-02, OPC-08, OPC-15, OPE-04, OPE-08, OPE-15) were used for RAPD analysis and generated scorable PCR products by amplifying the template DNA with Taq polymerase. The RAPD products generated a total of 106 fragments with an average of 10.60 fragments per primer and the fragments were found 100% polymorphic. The maximum number of polymorphic bands (14) was obtained with OPA-01 and minimum number (5) was obtained with primer OPA-08. 100% polymorphism was observed in all the primers.

The similarity index values obtained for each pair wise comparison among the 19 thrips population based on 106 RAPD fragments ranged from 0.16 to 0.625. The maximum genetic similarity value was 0.625 between ATP2 and ATP10 population followed by 0.552 similarity between ATP6 and ATP8 population, while the lowest genetic similarity value of 0.016 was found between population of CTR4 and CTR8. Generation of higher number of markers or alleles in the present study indicated higher amount of genetic diversity among different populations of Thrips palmi. Among the ten primers all showed 100 per cent polymorphism in T. palmi population of Chittoor and Anantapur districts.

The use of PCR for amplification of the internal transcribed spacer (ITS) region of the rDNA has the advantage of combining highly conserved sequences in the 16S rDNA regions with variable sequences in the ITS regions at species level. Six thrips of Anantapur district population and six thrips of Chittoor District were selected and extracted DNA. The PCR primers (located in the 5.8 S and 28 S regions flanking the ITS2 region of ribosomal DNA) used in this assay were 5′-TGTGAACATGCAGGACACATGA-3′ and 5′-GGTAATCTACCTGAACTGAGGTC-3′. The thrips DNA with these primers were capable of amplifying nearly full-length 16S rDNA fragments and shows no polymorphism in length of the amplified rDNA region.

The PCR product was purified and was sequenced at Sigma Genomics India Pvt. Ltd, Bangalore. The resultant sequences were blasted in NCBI for comparison. The data obtained from the 16S rDNA nucleotide sequences provides strong support that the
samples were indeed *Thrips palmi* and *Scirotroths dorsalis*. Based on the similarity index the sequences were aligned in Sequin Program and generated files were submitted to NCBI GenBank. The NCBI GenBank accession numbers for *Thrips palmi* of the Tirupati region are KF680274, KF680275 and for *Scirotroths dorsalis* the accession number is KF680273.

When the phylogenetic dendrogram was constructed with already available nucleotide sequences of *Thrips palmi* in the NCBI GenBank and for two *T. palmi* sequences of this region, *T. palmi* with accession number KF680274 alone form one cluster which is completely different from six *T. palmi* sequences deposited in GenBank as they all form into a cluster. The nucleotide sequence of *T. palmi* of this region with accession number KF680275 is forming a cluster with available GenBank sequences FM956423, FM956422 and FM956428 while AM932141 and AB063341 is forming a completely different cluster. Phylogenetic dendrogram with respect to nucleotide sequence of *S. dorsalis* of this region KF680273 is closely associated with four sequences of NCBI data base JQ352779, JQ352780, FN546035 and FN546035 and they all form into one cluster while FN546038, FN546039 are forming another cluster.

The screening of genotypes for two seasons (*Kharif*, 2011 and 2012) at S.V. Agri. College farmland revealed that IVK-I-2007-I-16, K-1814, K-1789, K-9, K-1811, TCGS-1114, TCGS-1137, TCGS-1218, TCGS-1274, TCGS-1043, ICGV-07045, ICGV-06039, ICGV-07045, ICGV-00351, ICGV-07234, ICGV-87846, ISK-I-2011-16 and ISK-I-2011-14 were the relatively resistant genotypes for thrips during *Kharif* season. The resistance in these genotypes was conferred due to high leaf and stems trichomes, more leaf thickness, dark green leaf foliages, high phenols and high chlorophyll content.

Evaluation of certain new insecticides as seed treatment and the pooled data of the three seasons (*Kharif*, 2011, 2012 and *Rabi*, 2011-12) indicated that all the treatments were found significantly superior over the untreated control in which highest per cent foliar damage (25.59%) was recorded. The pooled data indicated that the mean per cent foliar damage was least (2.69%) in the treatment imidacloprid 600FS followed by imidacloprid 70WS (3.70%), this might be due to its novel approach towards the pest and it has exhibited both antifeedant and repellent mode of action. The other promising treatments were thiamethoxam 70WS, thiamethoxam 35FS and imidacloprid 17.8SL with a mean of 4.41, 5.39 and 6.19 per cent foliar damage, respectively.

The evaluation of insecticides as foliar spray for the management of thrips and the pooled data of the three seasons (*Kharif*, 2011, 2012 and *Rabi*, 2011-12) revealed that thiacloprid 21.7SC, imidacloprid 200SL and monocrotophos 36WSC showed superiority over rest of the treatments in both the sprayings and on par with each other. Hence, it could be concluded that spraying of thiacloprid 21.7SC, imidacloprid 200SL and monocrotophos 36WSC could be recommended to the farmers for effective management of the thrips and enhanced yields in groundnut.
ABSTRACT

Experiment on life-table studies of brinjal shoot and fruit borer was conducted at Bt. lab of Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad. Observations were made on three generations of brinjal shoot and fruit borer. The maximum duration of egg, larva and pupa were observed to be 5, 18 and 11 days, respectively in all the three generations and mortality percentage during egg stage to a tune of 9-10 per cent, larval mortality 17-20 per cent and pupal mortality 26-29 per cent.

The number that survived from egg to adult emergence was ranging from 71-74 individuals in all the three generations. The net reproductive rate (R₀), mean length of generation (Tc) and innate capacity of increase (r₀) ranged from 131.03 to 138.58, 37.88 to 38.05 days and 0.1289 to 0.1302 females female⁻¹ day⁻¹, respectively. The finite rate of weekly multiplication rate and corrected generation time ranged from 1.1376 to 1.1391, 2.4653 to 2.4739 females female⁻¹ day⁻¹ and 37.82 to 37.98 days, respectively during three generations. Stable-age distribution studies of brinjal shoot and fruit borer revealed that egg stage was contributing highest per cent (58.64 to 58.98) for rₘ value compared to larval (37.65 to 38.01) and pupal stage (2.50 to 2.97) in all the three generations. The life expectancy of newly deposited eggs were ranging from 13.16 to 13.32 days while at the cessation of life cycle it was ranged from 1.80 to 1.91 days during three generations.

Spatial distribution pattern on brinjal shoot and fruit borer were carried out at Student farm, College of Agriculture, Rajendranagar, Hyderabad. The study was conducted by raising an unprotected brinjal crop raised during kharif, 2013-14. Spatial
distribution of brinjal shoot and fruit borer was aggregated type with a good probability of fit negative binominal distribution.

A field experiment was carried during kharif, 2013-14 at student farm, College of Agriculture, Rajendranagar, Hyderabad to study the efficacy of six insecticides viz., flubendiamide 480 SC at 48 g a.i ha$^{-1}$, thiacloprid 240 SC at 120 g a.i ha$^{-1}$, β-cyfluthrin + imidacloprid 300 OD at 30 g a.i ha$^{-1}$, thiodicarb 75 WP at 1000 g a.i ha$^{-1}$, spinosad 45 SC at 75 g a.i ha$^{-1}$ and profenophos 50 EC at 500 g a.i ha$^{-1}$ against brinjal shoot and fruit borer. Among all insecticidal treatments, spinosad 45 SC at 75 g a.i ha$^{-1}$ was adjudged as the best and effective treatment in checking shoot damage on number basis, fruit damage on number basis and fruit damage weight basis of 8.93, 19.36 and 18.70 per cent, respectively, followed by flubendiamide 480 SC at 48 g a.i ha$^{-1}$ (10.15, 20.24 and 20.04 per cent) and profenophos 50 EC at 500 g a.i ha$^{-1}$ (12.11, 21.32 and 20.91 per cent, respectively). The treatment thiodicarb at 75 WP at 1000 g a.i ha$^{-1}$ (12.88, 22.79 and 21.94, respectively), β-cyfluthrin + imidacloprid 300 OD at 30 g a.i ha$^{-1}$ (14.31, 25.49 and 23.18, respectively) and thiacloprid 240 SC at 120 g a.i ha$^{-1}$ (15.14, 28.77 and 24.17, respectively). The treatment spinosad 45 SC at 75 g a.i ha$^{-1}$ exhibited highest yield by recording 17.70 t ha$^{-1}$ followed by treatment like flubendiamide 480 SC at 48 g a.i ha$^{-1}$ (17.30 t ha$^{-1}$) and profenophos 500 EC at 500 g a.i ha$^{-1}$ (15.83 t ha$^{-1}$). Thiodicarb 75 WP at 1000 g a.i ha$^{-1}$ (14.83 t ha$^{-1}$), β-cyfluthrin+ imidacloprid 300 OD at 30 g a.i ha$^{-1}$ (14.29 t ha$^{-1}$) and thiacloprid 240 SC at 120 g a.i ha$^{-1}$ (12.75 t ha$^{-1}$).
ABSTRACT

Studies on host plant resistance in paddy to brown planthopper *Nilaparvata lugens* (Stal) was undertaken during August 2013 – May 2014 under glasshouse condition at DRR Rajendranagar, Hyderabad. The primary objective of evaluating rice genotypes was to identify the sources of resistance in paddy to BPH by screening the germplasm accessions using standard seed box technique.

The results of experiment showed that among 400 germplasm accessions four accessions (IC Nos. 578672, 578151, 464186 and 463837) were found to be resistant and seventeen accessions (IC Nos. 577478, 578145, 463851, 578665, 577482, 463828, 465106, 577741, 578144, 577663, 465109, 466428, 463887, 578137, 464128, 578017, 578413) were moderately resistant.

The mechanisms of resistance of selected rice germplasm accessions were examined using antixenosis mechanism judged by honeydew production by BPH; antibiosis mechanism by nymphal survival, ovicidal test and gain in body weight of BPH; tolerance by days to wilting of BPH infested plants. Also, the biochemical aspects of resistance viz., estimation of phenols, reducing sugars, ascorbic acid, nitrogen, phosphorus, potassium and protein content were analyzed.
The results indicated that the resistant and moderately resistant varieties showed lower quantity of honeydew excretion, lower % nympha survival, higher % unhatched eggs and more number of days to wilt.

The honeydew excretion and survival of nymphs and adults were lower in the accession 464186. Also the number of days to wilt and % unhatched eggs were higher which indicated that all the three mechanisms of resistance viz, non preference, antibiosis and tolerance were present in this accession. In case of the resistant accession 578151, the % unhatched eggs were highest while % nympha survival was lower suggesting antibiosis mechanism of resistance. The resistant accession 463837 exhibited anixenosis and antibiosis mechanisms as the quantity of honeydew excreted and % survival of nymphs was lower.

BPH fed rice plants were analyzed spectrophotometrically for quantitative changes in biochemical profile that occurs as plant’s defensive responses. The plant responded defensively upon infestation, resulting in low level of protein synthesis; production of higher amounts of phenolic compounds and reduced level of reducing sugars and ascorbic acid. The per cent reduction of P was less and K was much less upon BPH infestation compared to N content. Probably these factors alone or in combination might have a role in antibiosis and non preference.

ENTOMOLOGY

Author : RENUKA PITHANI
Title of the Thesis : YIELD LOSS DUE TO SUCKING PESTS AND MANAGEMENT OF EARLY SEASON SUCKING PESTS THROUGH STEM APPLICATION TECHNIQUE ON COTTON
Major Advisor : Dr. N. V. V. S. D. PRASAD
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D 9607

ABSTRACT

Studies on “Yield loss due to sucking pests and management of early season sucking pests through stem application technique on cotton” were taken up during kharif 2012 to determine the yield losses and management of sucking pests in cotton. Estimation of yield losses due to sucking pests viz., leafhoppers, aphids, thrips and whiteflies in Jaadoo and RCH-2 Bt cotton hybrids was done with two treatments under protected and unprotected conditions with 13 replications in paired plot technique.
Population of leafhoppers and thrips are high in RCH-2 Bt cotton hybrid where as aphids and whiteflies populations are high in Jaadoo. Among the two Bt cotton hybrids, jaadoo showed relative resistance to leafhoppers and thrips while RCH-2 showed susceptibility reaction towards leafhoppers.

Among the Bt cotton hybrids; Jaadoo recorded lowest yield loss (26.32%) and RCH2 recorded highest yield loss (48.89%) due to sucking pests.

Studies on management of early season sucking pests through stem application technique on L 761 cotton revealed that among the different insecticides tested, imidacloprid 1:10 was effective with higher per cent reduction of aphid population over control at 3 days after treatment. Monocrotophos 1:4 was effective in managing leafhoppers population. With reference to thrips and whiteflies, maximum reduction was recorded in Monocrotophos 1:2 treated plot. Monocrotophos 1:4 recorded maximum plant height and more leaf width & leaf length compared to other treatments.

Seed cotton yield ranged from 15.18 to 9.76 q/ha with highest yield recorded in monocrotophos 1:4 and which was on par with that of acephate 1:4 (14.27 q/ha), monocrotophos 1:3 (13.77 q/ha), imidacloprid 1:10 (12.81 q/ha), monocrotophos 1:2 (12.50 q/ha) and imidacloprid 1:15 (12.10 q/ha).

Monocrotophos 1:4 recorded highest per cent increase (55.53) over control while imidacloprid 1:20 least percent increase over control (7.17).

**ENTOMOLOGY**

**Author** : SACHIN RAMCHANDRA KHANDAGALE

**Title of the Thesis** : STUDIES ON INSECT PEST COMPLEX OF MAIZE (Zea mays Linn) IN DIFFERENT CROPPING SYSTEMS AND MANAGEMENT OF MAJOR INSECT PESTS

**Major Advisor** : Dr. K. MANJULA

**Degree** : M. Sc. (Ag.)

**College** : S.V. AGRICULTURAL COLLEGE, TIRUPATI

**Accession Number** : D 9619

**ABSTRACT**

A field trial was conducted to study the insect pest complex of maize (Zea mays Linn) in different cropping systems and management of major insect pests, at S.V. Agricultural College, Tirupati during kharif 2012. The cropping systems grown are maize
black gram, maize + greengram, maize + cowpea, maize + groundnut, maize + clusterbean, maize + fieldbean and pure crop.

Shoot bug (*Peregrinus maidis*) incidence was observed less in maize + fieldbean, maize + clusterbean and maize + groundnut intercropping systems. The population reached ETL at 75 DAS in sole maize and maize + cowpea intercrops. The other major sucking pests of maize noticed are leaf hoppers (*Pyrilla perpusilla* and *Proutista moesta*), aphid (*Rophalosiphum maidis*) and pod bug (*Riptortus pedestris*). Their counts were less in maize + clusterbean followed by maize + groundnut. In other systems, record of these pests was up to the ETL. *Helicoverpa armigera*, grasshoppers (*Cyrtacanthacris tatarica* and *Trilophidia annulata*), sugarcane leaf folder (*Marasmia trapezalis*) and green plant bug (*Nezara viridula*) population were found at minor level during crop growth period.

Among natural enemies of insects, coccinellids were abundant. In maize + fieldbean, overall natural enemy population was high but spiders were more in maize + clusterbean.

Seven insecticides were evaluated against sucking pests. Shoot bugs were significantly reduced by cartap hydrochloride 4G (0.8 kg a.i. ha^-1_), imidacloprid 17.8% SC (0.005 %) and rynaxypyr 18.5% EC (0.005 %), whereas leafhoppers were effectively controlled by imidacloprid 17.8% SC (0.005 %) and rynaxypyr 18.5% EC (0.005 %). All three granular insecticides i.e. carbofuran 3G (0.7 kg a.i. ha^-1_), fipronil 0.3G (0.06 kg a.i. ha^-1_) and cartap hydrochloride 4G (0.8 kg a.i. ha^-1_) have worked good against aphids. Among sprays, rynaxypyr 18.5% EC (0.005 %) was found effective for aphids. Maize + clusterbean, maize + fieldbean and maize + groundnut were proved economically profitable with benefit cost ratios of 1: 3.04, 1: 1.79 and 1: 0.82 respectively.

**ENTOMOLOGY**

Author : SAI CHARAN, M.

Title of the Thesis : RELATIVE INCIDENCE, SUCCESSION OF INSECT PESTS AND BIORATIONAL MANAGEMENT OF APHIDS IN CHRYSANTHEMUM (*Dendranthema grandiflora* Borkh).

Major Advisor : Dr. V. ANITHA

Degree : M. Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
ABSTRACT

Field experiments were carried out during kharif 2013-14 at Floricultural Research Station (FRS), ARI, Rajendranagar, Hyderabad wherein succession of insect pests, their correlation with weather parameters, relative incidence of insects like aphids and thrips on fifteen selected cultivars and biorational management of aphids, *Macrosiphoniella sanbornii* (Gillette) on chrysanthemum plants were studied.

Observations recorded on the seasonal insect pest incidence in chrysanthemum in the fixed plot at FRS and in roving surveys conducted at farmers field in Ranga Reddy district of Telangana state showed that leafminer, *Liriomyza trifolii* Burgess and aphids *Macrosiphoniella sanbornii* (Gillette) were found to affect the plants in the vegetative stage. Three species of thrips were observed during the reproductive stage of which *Frankliniella occidentalis* (Pergande) was the predominant species followed by *Frankliniella schultzei* (Trybom) and *Thrips palmi* Karny in the ratio of 63:28:9. Parasites and predator fauna collections during this period included *Cirrospilus ambiguus* Hansson & LaSalle, larval parasite on leafminer, predators, *Coccinella septumpunctata* (Linnaeus) and *Coccinella trifasciata* (Linnaeus) on aphids and the minute pirate bug (*Orius insidiosus* (Say)) on thrips and aphids.

Studies on insect pest succession in chrysanthemum cultivar ‘Silper’ in relation to weather revealed that the first appearance of leafminer (*L. trifolii*) was observed between 19-27 August (33rd standard week), ten days after transplantation which lasted for eight weeks and disappeared in the 40th standard week in October. Among abiotic factors minimum temperature, maximum relative humidity, minimum relative humidity had positive significant correlation whereas sunshine exerted negative significant impact on leaf miner incidence. The maximum temperature and rainfall showed positive non significant effect on the leafminer population buildup. The weather factors influenced upto 68.5 per cent in the building of leafminer population as indicated by co-efficient of determination.

The incidence of chrysanthemum aphid *M. sanbornii* was observed between 16-22 September (37th standard week) *i.e.* 5 weeks after transplantation of crop. The population gradually increased till 42nd standard week then suddenly declined due to heavy rainfall (31.77 mm) recorded for three consecutive days in October. The peak population of aphids was observed in 3rd standard week (62.03 aphids/plant) in second fortnight of January 2014. Among the weather parameters maximum temperature, minimum temperature, minimum relative humidity and evaporation showed a significant negative correlation. Maximum relative humidity and rainfall had shown negative non-significant expression over aphid population increase. Multiple regression analysis revealed all the weather parameters collectively accounted for the 64 per cent of the aphid load.

Three months after transplantation of chrysanthemum cuttings, first incidence of thrips was observed in first fortnight of November (45th standard week) during the reproductive stage of the crop. The peak incidence (78.3 thrips/10 plants) was observed
in the 2nd standard week in first fortnight of January. Maximum temperature, minimum temperature and sunshine hours exerted significant positive impact on the thrips population buildup. Maximum relative humidity and rainfall showed negatively non-significant correlation, whereas minimum relative humidity and evaporation exhibited negatively significant impact over thrips population. It was observed that the incidence of thrips was influenced by weather parameters to an extent of 71 per cent.

Fifteen germplasm accessions consisting of yellow, white and red flowered cultivars were assessed for aphid incidence. The overall mean population of aphids calculated from all the observations on the cultivars revealed that the genotype Red gold was least affected by aphids and recorded the lowest population of 19.10 aphids/apical shoot which was on par with Priya (19.93 aphids/ apical shoot). The genotypes IIHR-6, Kadapa local, Aparjitha recorded mean aphid population 20.95, 21.43 and 21.51/apical shoot which were on par with each other. The highest mean aphid population was recorded on PAU B 107 (31.35 aphids/ apical shoot) next higher infestation was found in Poonam (29.89 aphids/ apical shoot), closely followed by Raichur (29.06 aphids/ apical shoot) and Akitha (28.27 aphids/ apical shoot).

Among the five cultivars which recorded highest mean aphid population PAU-B-107, Ratlam selection, Akitha were white flowered; Poonam, and Raichur were yellow coloured cultivars. Similarly of the five cultivars which recorded lowest aphid population count, Redgold and Priya were red flower cultivars, IIHR-6, Kadapa local were white coloured and Aparjitha was the yellow coloured cultivar.

The overall mean thrips population calculated from all the observations on the cultivars revealed that the genotype Redstone recorded lowest thrips count 14.06/10 plants) closely followed by Kadapa local (14.80 thrips/10 plants) which were on par with each other. The next lower population of thrips was recorded on cultivars Akitha (19.59 thrips/10 plants), Redgold (20.91 thrips/10 plants) and Priya (20.98 thrips/10 plants) which were on par with each other. The maximum thrips population was found in Raichur (53.28) closely followed by Poonam (48.06 thrips/10 plants), CO-3 (46.71 thrips/10 plants) and Geethanjali (41.61 thrips/10 plants).

The top five cultivars which recorded highest thrips population were yellow flowered, and among the five cultivars which received least thrips count, four were red coloured and only one cultivar was white flowered.

Six different insecticides azadirachtin@5ml/l, karanjoil@2ml/l, verticillium alone@5g/l, verticillium followed by azadirachtin, verticillium followed by karanjoil and imidacloprid@0.4ml/l were evaluated against chrysanthemum aphid for their relative efficacy. Two sprays were given at 10 days interval. Effective reduction in population of aphids over untreated control was observed in plots treated with imidacloprid 17.8%SL treatment @ 0.4 ml/lit (92.31%). It was found that spray of verticillium @ 5g/lit followed by azadirachtin @ 5ml/lit (68.54%) and verticillium @ 5g/lit followed by karanj oil @ 2 ml/lit (67.34%) were significantly more effective than two consecutive sprays of verticillium @ 5g/lit (64.66%).
ENTOMOLOGY

Author : SANDHYA RANI CHORAGUDI
ABSTRACT

Studies on “Seasonal occurrence and management of spotted pod borer, *Maruca vitrata* (Geyer) (Pyralidae: Lepidoptera) on greengram” and experiments on seasonal incidence, survey in Khammam district for *Maruca* and its natural enemies and alternative hosts, field screening of hundred and ten genotypes and efficacy of certain leaf extracts and newer insecticides against *Maruca* were conducted at Agricultural Research Station, Madhira, Khammam district during the *rabi* and summer, 2009-10 and 2010-11.

Studies on the seasonal occurrence of *Maruca* during *rabi* and summer seasons revealed that, the initial incidence was observed during the last week of November to 1st week of December in *rabi* and last week of March during summer. *i.e.* at the bud initiation stage of the crop. Peak bud infestation (50.0%) was noticed in 48th standard week in *rabi* and 13th (16%) standard week in summer. The population and infestation gradually declined and reached minimum and the pest has disappeared by the third week of January in *rabi* and by the end of April in summer crop. All the weather variables in question were found to exert significant influence on *Maruca* infestation and they together contributed to the variation in number of larvae per plant by 70.52 and 53.48; bud infestation by 73.29 and 76.83; flower infestation by 38.52 and 73.85; webbing by 40.50 and 84.61 and pod damage by 89.60 and 55.05 per cent in *rabi* and summer seasons respectively.

Surveys conducted during *rabi* and summer seasons, revealed that in pulses ecosystem, coccinellid *Chilomenus sexmaculata* and the spiders, *Oxyopes* sp., *Oxyopes javanus*, *Tetragnatha javana*, *Thomisus* sp., *Chrysilla* sp., spiders in blackgram ecosystem; *Neoscona theisi*, *Telemonta diminata* (male and female), *Curba* sp., *Salticus* sp., *Chrysilla* sp., spiders in pigeonpea (redgram); *Oxyopes* sp., *Argiope anasuja* (Thorell) and *Peucetia viridana* spiders in greengram and also on *Abutilon* and *Gynandroposis* sp. weeds were observed on *Maruca* infested pulses. Predatism or parasitism was not observed in the field conditions. Among the various weeds in pulses ecosystem, three weeds namely, *Physalis minima*, *Abutilon* sp. and *Tephrosia* sp. (Papilionaceae) were found as alternative hosts, as they are hosting early instar larvae at flowering stage. Blackgram, cowpea, pigeonpea (redgram), groundnut and green-manure crops namely daincha and sunhemp, beans were cultivated hosts. Eight mandals namely,
Khammam Urban, Penubally, Chintakani, Thirumalayapalem, Kusumanchi, Yerrupalem, Bonakal and Kalluru recorded the highest Maruca infestation during both *rabi* and summer seasons.

Among the screened 110 greengram genotypes, LGG 538 and KM-9-128 with determinate growth habit, early duration, moderate avoidable losses showed tolerance and high yield, whereas LGG 544 and KM-9-121 were highly preferred by *Maruca* in *rabi* and summer seasons. Six genotypes, WGG 45, LGG 497, LGG 522, WGG 48, IPM-02-03 and LGG 477 were tolerant in *rabi* but susceptible in summer. Three genotypes, KM-9-136, LGG 527 and RMG 492 were tolerant in summer but susceptible in *rabi* with moderate avoidable losses. The susceptible genotypes KM-8-668, MGG 348 and tolerant LGG 538 were identified as high yielders in both seasons. Eight photosensitive genotypes were identified, as they showed only vegetative growth without any flowering in summer. The avoidable losses were higher in susceptible and lower in tolerant genotypes.

Management studies revealed that, metaflumizone 22% SC 0.044 per cent spray alone and in scheduling with leaf extracts at bud initiation stage and at 50% flowering stage of greengram was the most effective and significantly superior over all the other treatments, which was on par with chlorfenapyr 10% SC 0.015 per cent spray. Among the indigenous plant extracts, spray schedule with Neem leaf extract @ 5 per cent at bud initiation stage and Karanj leaf extract 5 per cent spray at 50% flowering stage showed significant results by reducing larval population, pod damage and safer to natural enemies.

The highest CBR (2.71) and yield of 1.86 kg/plot (1546 kg/ha) with an increase of 329 per cent yield over untreated check was recorded for the spray with Karanj leaf extract @ 5 per cent at bud initiation stage and metaflumizone 22% SC @ 0.044 at 50% flowering stage followed by the spray with Neem leaf extract @ 5 per cent at bud initiation stage and metaflumizone 22% SC @ 0.044 at 50% flowering stage with CBR 2.41 and 1.66 kg plot yield (1378 kg/ha) with an increase of 257 per cent yield over untreated check, Neem leaf extract @ 5 per cent at bud initiation stage and chlorfenapyr 10% SC 0.015 per cent at 50% flowering stage with CBR 2.16 and 1.38 kg/plot (1218 kg/ha) with an increase of 217 per cent yield over untreated check and single spray with metaflumizone 22% SC @ 0.044 at 50% flowering stage with CBR 2.04 and 1.35 kg/plot (1126 kg/ha) yield with an increase of 189 per cent yield over untreated check.
ENTOMOLOGY

Author : SIVA KUMAR, G.

Title of the Thesis : BIO-ECOLOGY AND MANAGEMENT OF POD FLY, *Melanagromyza obtusa* (Malloch) IN PIGEONPEA (*Cajanus cajan* L.)

Major Advisor : Dr. P. RAJENDRA PRASAD

Degree : M. Sc. (Ag.)

College : S.V. AGRICULTURAL COLLEGE, TIRUPATI

Accession Number : D 9618

ABSTRACT

The present studies on “Bio-Ecology and Management of Pod fly, *Melanagromyza obtusa* (Malloch) in Pigeonpea (*Cajanus cajan* L.)” were carried out at S.V. Agricultural College, Tirupati during *kharif* 2012-13.

The biology and seasonal incidence of pod fly, field screening of different pigeonpea cultivars and their morphological and biochemical parameters against pod fly and the efficacy of new insecticides against pod fly and economics of different insecticidal treatments were studied.

Pod fly, *Melanagromyza obtusa* was found to complete its life cycle, egg to adult ranged from 23 to 30 days with an average of 25.84 days in case of males and 28.31 days in case of females. The incubation period of egg was 2.33 days. The larval period lasted for 7.46 days and the average prepupal period and pupal period was about 0.71 days and 12.27 days, respectively. Adult longevity was 3.06 days in case of males where as 5.53 days in case of females.

Observations on the seasonal incidence of pod fly, *Melanagromyza obtusa* in relation to abiotic factors were carried out in two pigeonpea cultivars in each two different sowing dates during 2012-13. Peak incidence of maggot population was recorded in 4th standard week *i.e.*, fourth week of January and peak occurrence of pupae was recorded in 5th standard week *i.e.*, first week of February irrespective of the sowing date in both the cultivars (LRG 41 and TRG 38). Among the weather parameters morning relative humidity showed significant positive relationship with both maggot population...
and pupae in both the cultivars whereas, minimum temperature exhibited significant negative correlation with only maggot population in LRG 41 in two sowing dates.

In the two pigeonpea cultivars i.e., LRG 41 and TRG 38, late sown (August first fortnight) pigeonpea suffered much when compared to early sown (July second fortnight) crop against pod fly with respect to both maggots and pupae. Among the two cultivars TRG 38 suffered more compared to LRG 41 in both the sowing dates.

Screening of forty pigeonpea genotypes against pod fly revealed that mean number of maggot population varied significantly among the accessions and the cumulative incidence of maggot population per plant was least in ICP 14887 (3.93 maggots) followed by ICP 14770 (4.15 maggots) and BDN (4.33 maggots) whereas highest incidence was recorded in ICP 9150 (10.59 maggots) followed by ICP 12083 (9.53 maggots).

The pod and grain damage caused by pod fly among all the forty pigeonpea cultivars was significant and ranged from 24.67 (ICP 14887) to 88.67 per cent (ICP 9150) of pod damage and 15.12 (ICP 14887) to 45.56 per cent (ICP 9150) of grain damage. Among forty accessions screened against pod fly, no single cultivar was found to be highly resistant and the accessions ICP 14887, ICP 14770 and BDN 2 were moderately resistant and the cultivars ICP 9150, ICP 12083 and ICP 15225 were highly susceptible with respect to per cent pod damage.

Among morphological and biochemical constituents of pigeonpea pod length, pod width, protein content, total carbohydrates, reducing sugars and total free amino acids in the pod walls were positively correlated with per cent pod damage, whereas pod wall thickness, trichome density and phenol content exhibited significant negative correlation with per cent pod damage.

The relative efficacy of insecticides evaluated against pod fly revealed that monocrotophos 36 WSC @ 1.6 ml l-1 was on par with novaluron 10 EC @ 1 ml l-1 followed by quinalphos 25 EC @ 2 ml l-1 + DDVP 76 EC @ 1 ml l-1 found to be effective by recording high per cent reduction over control and less per cent pod damage. The treatments rynaxypyr 20 SC @ 0.3 ml l-1 and flubendiamide 480 SC @ 0.2 ml l-1 were found to be less effective against pod fly.

Highest grain yield was obtained from the treatment novaluron 10 EC @ 1 ml l-1 (1487.50 kg ha-1) followed by monocrotophos 36 WSC @ 1.6 ml l-1 (1445.83 kg ha-1) over control (565 kg ha-1), whereas highest cost benefit ratio of 1: 23.50 was obtained with monocrotophos 36 WSC @ 1.6 ml l-1 treatment followed by lambda cyhalothrin 2.5 EC @ 1 ml l-1 with 1: 22.17 and less cost benefit ratios were obtained from the treatments flubendiamide 480 SC @ 0.2 ml l-1 and rynaxypyr 20 SC @ 0.3 ml l-1 with 1: 0.69 and 1: 0.67, respectively.
ENTOMOLOGY

Author : SIVA LALITHA, P.
Title of the Thesis : COMPATIBILITY OF CERTAIN NEW INSECTICIDES AND FUNGICIDES AGAINST Spodoptera litura (Fabricius) (Noctuiidae: Lepidoptera)

Major Advisor : Dr. T. MADHUMATHI
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D 9608

ABSTRACT

The experiment “Compatibility of certain new insecticides and fungicides against Spodoptera litura (Fabricius) (Noctuiidae: Lepidoptera)” was conducted in the Department of Entomology, Agricultural College, Bapatla, Guntur district, Andhra Pradesh during 2011-13.

The compatibility of insecticides and fungicides were tested based on four parameters viz., bio - efficacy, physical compatibility, chemical compatibility and phytotoxicity test. Bio - efficacy of insecticides and fungicides against S. litura was tested by two methods viz., leaf disc impregnation method and topical application technique. Compatibility of insecticides and fungicides against Alternaria spp was tested by two methods viz., poison food technique and spore germination technique. In chemical compatibility the parameters like pH, EC were observed. Physical compatibility of insecticides, fungicides was conducted by emulsion stability test and specific gravity.
Emamectin benzoate 5 SG @ 0.5 g/l, chlorfenapyr 10 SC @ 1.5 ml/l alone and in combination with all the three fungicides *viz.*, carbendazim 50 WP @ 1.0 g/l, chlorothalonil 50 WP @ 2.0 g/l and hexaconazole 5 SC @ 2.0 ml/l was found to be superior which caused cent per cent mortality of third instar larvae of *S. litura* at 72 HAT in both the methods.

Hexaconazole 5 SC @ 2.0 ml/l alone and in combination with all the five insecticides *viz.*, emamectin benzoate 5 SG @ 0.5 g/l, chlorfenapyr 10 SC @ 1.5 ml/l, indoxacarb 14.5 SC @ 1.0 ml/l, flubendiamide 480 SC @ 0.3 ml/l and spinosad 45 SC @ 0.3 ml/l was found to be best which caused cent per cent growth inhibition of *Alternaria* over the control in poison food technique and cent per cent inhibition of spore germination of *Alternaria*.

There was no difference in the values of pH and EC in insecticide, fungicide combinations revealing good chemical compatibility.

There was no formation of sediment in the bottom and creamy layer at the top of the cylinder by combining the insecticides and fungicides and also there was no difference in the values of specific gravity in combination of insecticides and fungicides.

Phytotoxicity symptoms were not observed by spraying the insecticide and fungicide combinations at recommended concentrations. Slight phytotoxic symptoms were observed by spraying the high concentrations of insecticide, fungicide combinations but when the per cent injury was calculated it was below one per cent so it was taken as no phytotoxicity based on visual rating scale.
ABSTRACT

The survey on pesticide use pattern was carried out interviewing farmers growing tomato in open fields and poly houses based on the questionnaire prepared to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and use. Studies were undertaken to establish dissipation dynamics of
commonly used insecticides at recommended dose both in open field and poly house situations to assess the differences in rate of dissipation, and also to recommend Pre-Harvest Intervals based on MRLs established by CAC and FSSAI. Insecticides viz., dimethoate 30% EC @ 300 g a.i ha⁻¹, λ-cyhalothrin 5% EC @ 15 g a.i ha⁻¹, phosalone 35% EC @ 450 g a.i ha⁻¹, flubendiamide 20% WG, profenophos 50%EC @ 500 g a.i ha⁻¹ were sprayed and tomato samples collected at regular intervals analyzed for residues. Various decontamination methods were evaluated to assess the efficiency of method for removal of pesticide residues from tomato for food safety.

Education levels of poly house farmers are high compared to open field farmers, where 28.57% poly house farmers are college educated, while 33.33% open field farmers are illiterates. All farmers use nursery of 25 days and grow in <0.5 acre poly house in summer and rabi, and <1 acre open field during kharif. Awareness on pesticide related issues is varying among poly house and open field farmers with some commonality, where 35.71% poly house farmers know about recommended pesticides while only 16.67% open field farmers aware on this issue. However, in general, all farmers contact pesticide dealer for recommendations and some farmers prefer to contact scientists (38-43%). Most farmers are unaware about pesticide classification and toxicity symbols on packing. Farmers are aware about endosulfan ban, but only 28.57% poly house and 13.33% open field farmers know about ban of monocrotofos on vegetables. Very few farmers know about pesticide residues and related issues, but know washing helps to reduce contamination.

The dissipation pattern of insecticides varies in poly houses and open fields, where initial deposits are comparatively higher and dissipates slow in poly houses, however, all pesticides dissipates BDL in a week time except in case of profenofos. Dimethoate initial deposits (1.76 mg kg⁻¹) are less than FSSAI MRL of 2 mg kg⁻¹, hence a PHI of 1 day can be recommended. As no MRLs are available for lambda-cyhalothrin, PHI of 5 days to be recommended as residues dissipates BDL, though the initial residues are 0.18 mg kg⁻¹ and 0.13 mg kg⁻¹ in poly house and open fields, respectively, due to very less field dose. In case of phosalone, initial deposits of 4.55 mg kg⁻¹ recorded in poly house and hence a safe waiting period of 5 days should be recommended since FSSAI MRL is 1 mg kg⁻¹. Spray of flubendiamide at recommended dose results in 1.23 mg kg⁻¹ deposits which dissipated to BDL by 10th day in poly house. However, as the Codex MRL is 2 mg kg⁻¹, a PHI of 1 day is ideal for food safety. As per the Insecticide Act, 1969, profenofos is not recommended for use, but when sprayed at farmer”s dose on tomato, 3.25 mg kg⁻¹ and 1.51 mg kg⁻¹ initial deposits recorded in poly house and open field, respectively. Codex suggests MRL as 10 mg kg⁻¹, hence it can be concluded that profenofos application does not leave residues above MRL. Out of five insecticides tested in poly house, profenofos residues are found in tomatoes up to 15 days, while dimethoate and flubendiamide are detected up to 7 days, and lambda-cyhalothrin and phosalone dissipates faster and reach BDL by 7th day.

Among various decontamination methods tested, veggy wash found to be very effective in removing pesticide residues to an extent of 55-77% varying with type of pesticides, and common method i.e. 2% salt solution wash is also effective method for removing residues in the range of 40-59%.
ENTOMOLOGY

Author : SWATHI MOGALAPU

Title of the Thesis : DYNAMICS AND MANAGEMENT OF INSECT PESTS IN Bt COTTON AS INFLUENCED BY PLANT DENSITY

Major Advisor : Dr. G.M.V. PRASADA RAO

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, BAPATLA
ABSTRACT

The studies on “Dynamics and management of insect pests in Bt cotton as influenced by plant density” were conducted at research farm RARS, Lam, Guntur during kharif 2012 with an aim to study the influence of different plant densities on dynamics and management of insects of Bt cotton. The experiment was laid out in randomized block design with six plant densities replicated four times and test entry Tulasi BG-II was selected for this experiment.

In a study to ascertain the influence of plant densities on dynamics of insect pests of cotton, the incidence of sucking pests and natural enemies populations increased as the plant density increased from 11111 plants ha-1 to 66666 plants ha-1. The population of leafhoppers and aphids crossed ETL in all the treatments from 38 DAS to 52 DAS and 118 DAS to 125 DAS, respectively. Peak incidence of leafhoppers and aphids was observed at 45 DAS and 118 DAS, respectively. However, the leafhopper and aphid populations crossed ETL only in the treatments where plant densities were more than or equal to 22222 plants ha-1 at 60 DAS and 110 DAS, respectively. Negative relation was observed between the incidence of aphids and mealybugs in different plant densities from 118 DAS. The incidence of other sucking pests viz., thrips and whiteflies were below ETL throughout the crop growth period. The bollworm incidence was not observed during the entire crop period. The enhanced activity of natural enemies like spiders and coccinellid beetles was observed at higher plant densities.

In the study to know the influence of plant densities on the management of insect pests of Bt cotton, the sucking pest incidence was below ETL till 38 DAS due to effect of seed treatment with imidacloprid 70 WS @ 5 g kg-1 seed and from thereafter the leafhopper population levels were increased and crossed ETL at 45 DAS and 60 DAS. To manage the leafhoppers population in different plant densities two sprayings; one with acephate 75% SP @ 750 g a.i. ha-1 at 45 DAS and second with fipronil 5% SC @ 40 g a.i. ha-1 at 60 DAS were imposed on crop. Per cent reduction of leafhopper population over before spray was uniform in all the treatments and it was below 10%.

The seed cotton yields increased with the increase in plant density from 11111 plants ha-1 to 66666 plants ha-1 both under protected and unprotected conditions. The seed cotton yield ranged from 444 kg ha-1 to 2339 kg ha-1 under unprotected condition and 625 kg ha-1 to 2533 kg ha-1 under protected condition.
ENTOMOLOGY

Author : VASANTA BHANU, K.

Title of the Thesis : MECHANISMS OF RESISTANCE IN SELECTED RICE CULTURES AGAINST BROWN PLANTHOPPER,
Studies on the greenhouse and field (rabi 2010-11 and kharif 2011) screening of twenty eight advance rice cultures along with resistant check, Ptb 33 and susceptible check, TN1 to identify resistant cultures against the brown planthopper, *Nilaparvata lugens* (Stal) were conducted. The resultant resistant cultures were further tested to understand the mechanisms of resistance viz., antixenosis, antibiosis and tolerance in the laboratory. Studies were also conducted to study the functional response of adult green mirid bug on brown planthopper eggs and evaluation of certain newer insecticides against BPH was conducted for three successive seasons from kharif 2010 at Andhra Pradesh Rice Research Institute and Regional Agricultural research Station, Maruteru, Andhra Pradesh, India.

Based on the damage score against brown planthopper both in greenhouse and field as per the Standard Evaluation System (IRRI), one culture was highly resistant (MTU IJ 206-7-4-1), two cultures were resistant (MTU 1075 and RGL 7001) and nine cultures were moderately resistant (RGL 7002, MTU PLA 99-1-3-1-2, WGL 401, NLR 3090, WGL II 218-5-1, RDR 34, NLR 3093, NLR 20131 and BPT 2404). All the resistant cultures exhibited different mechanisms of resistance.

Antixenosis mechanism of resistance was assessed through studies on preferential settlement of nymphs on seedling, adult’s settlement for oviposition and feeding marks. Antibiosis was measured through various studies like nymphal survival, nymphal development period, growth index, feeding rate, population buildup and fecundity and hatchability. Tolerance was measured through three parameters viz., functional plant loss index, tolerance/antibiosis index and days to wilt.

Among the test cultures, MTU IJ 206-7-4-1 exhibited high level of antixenosis with low number of BPH nymphs and adults settled and more number of feeding marks. It also exhibited high level of antibiosis with prolonged nymphal development period, lower growth index, less area of honeydew excretion, low population buildup and less fecundity. Among the other rice cultures, WGL II 218-5-1 exhibited antibiosis by recording lower per cent of nymphal survival, lower growth index and higher per cent of macropterous adults.

The rice culture, MTU 1075 exhibited all the three mechanisms of resistance through more number of feeding marks, lower number eggs and high level of tolerance index. The antibiosis effects recorded in NLR 3093 and RGL 7002 was lower feeding
rate; in MTU PLA 99-1-3-1-2 were higher per cent of macropterous forms and lowest per cent of egg hatchability; in WGL 401 was low population build up and in RDR 34 was higher per cent of macropterous adults.

The rice culture, NLR 20131 exhibited high level of tolerance through lowest per cent of functional plant loss index while RGL 7001 and BPT 2404 exhibited high level of tolerance index.

The functional response of *C. lividipennis* adult female on BPH eggs was found to have the pattern of Holling’s type II model. The functional response parameters *viz*., the search rate (a) and the handling time (Th) were estimated by using the Rogers’ equation (0.318 and 0.0679 (days)) and Holling’s disc equation (0.283 and 0.0659 (days)) respectively.

Among the insecticide tested, dinotefuran 20 SG @ 40 g a.i./ha, imidaclorprid+ethiprole 80 WG @ 100 g a.i./ha and pymetrozine 50 WG @ 150 g a.i./ha were the most effective insecticides with highest per cent reduction of population over untreated control. The combination insecticides *viz*., rynaxypyr + thiamethoxam 40 WG @ 50 g a.i./ha and flubendiamide+buprofezin 4+20 SG @ 210 g a.i./ha were moderately effective against BPH. The grain yield were highest in buprofezin 25 SC @ 175 g a.i./ha treated plots and followed by imidaclorprid+ethiprole 80 WG @ 100 g a.i./ha and rynaxypyr + thiamethoxam 40 WG @ 50 g a.i./ha. All the insecticides tested were safer to natural enemies’ *viz*., spiders and green mirid bugs.
The present studies were carried out in the laboratory and greenhouse of the Department of Entomology and Students Farm, College of Agriculture, Rajendranagar during kharif and rabi, 2012-13 with an objective to evaluate physical compatibility, phytotoxic incompatibility and chemical compatibility of pesticide combinations against pests of cabbage.

(The physical compatibility of 6 insecticides viz., spinosad, indoxacarb, cartap hydrochloride, chlorfenapyr, flubendiamide, Bacillus thuringiensis and 2 fungicides viz., copper oxychloride and metalaxyl MZ and one bactericide, streptocycline were evaluated with jar compatibility test). Out of 18 combinations of insecticides and fungicides/bactericide, spinosad + copper oxychloride, cartap hydrochloride + copper oxychloride, spinosad + metalaxyl MZ and spinosad + streptocycline showed 10ml, 10ml, 10ml and 15ml of foaming, respectively and Bacillus thuringiensis + streptocycline showed 5ml of sedimentation. This foaming/sedimentation was lower than the prescribed limit (2ml/100ml or 20ml/l). The remaining 13 pesticide combinations showed neither foaming nor sedimentation indicating that all the 18 pesticide combinations were physically compatible.

The phytotoxic incompatibility due to combination of insecticides and fungicides/bactericide on cabbage showed no phytotoxic symptoms such as injury to the leaf tip, yellowing, wilting, necrosis, vein clearing, epinasty and hyponasty on the leaves.

The chemical compatibility of insecticide and fungicide/bactericide combination against cabbage leaf webber, Crocidolomia binotalis, cabbage aphid, Brevicoryne brassicae and the leaf spot, Alternaria brassicae under field conditions showed that all the 18 combinations reduced the incidence of leaf webber upto 5 DAS during both kharif and rabi seasons. The toxicity of spinosad + copper oxychloride increased with time upto
5 DAS and was on par with flubendiamide + copper oxychloride the later being relatively superior upto 2 DAS. The insecticides flubendiamide and spinosad in combination with all the fungicides/bactericide viz., copper oxychloride, metalaxyl MZ and streptocycline were highly effective in controlling the leaf webber population. Also the mixture of cartap hydrochloride + copper oxychloride was effective in controlling leaf webber in cabbage.

Similarly, the aphid incidence reduced upto 5 DAS in all the combinations during both kharif and rabi seasons and subsequently increased. Spinosad in combination with all the fungicides/bactericide viz., copper oxychloride, metalaxyl MZ and streptocycline were highly effective in reducing the population of aphids during both the seasons.

The per cent disease incidence (PDI) of Alternaria leaf spot reduced upto 5 DAS and thereafter slowly increased indicating that all the combination sprays were effective upto 5 DAS. Similar trend was noticed in per cent severity of disease also. Among the various insecticide and fungicide/bactericide combinations indoxacarb + metalaxyl MZ and cartap hydrochloride + metalaxyl MZ were highly effective in reducing the PDI and severity (%) of A. brassicae

Spinosad + metalaxyl MZ was most effective compared to other two spinosad combinations against cabbage leaf webber and aphids and also recorded highest yield. It was the next best combination after indoxacarb + metalaxyl MZ and cartap hydrochloride + metalaxyl MZ against A. brassicae. Cartap hydrochloride + copper oxychloride was effective combination against leaf webber and was the 4th best combination against aphids and A. brassicae and recorded >70% reduction over control and also recorded best yield. Hence, spinosad + metalaxyl MZ and cartap hydrochloride + copper oxychloride combinations could be recommended when there is the incidence of leaf webber, aphids and A. brassicae.

Flubendiamide in combination with fungicides/bactericide viz., copper oxychloride, metalaxyl MZ and streptocycline was effective against leaf webber. Flubendiamide + metalaxyl was the 5th best combination against A. brassicae and recorded ≥70% reduction over control. Cartap hydrochloride + metalaxyl MZ was most effective combination against A. brassicae and recorded >75% reduction of leaf webber. Indoxacarb + metalaxyl MZ was the first best combination against A. brassicae and recorded > 80% reduction of leaf webber over control. Hence Flubendiamide + metalaxyl, cartap hydrochloride + metalaxyl MZ and indoxacarb + metalaxyl MZ combinations could be recommended as they are effective against both leaf webber and A. brassicae.
ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Author : PRAVEEN SOLANKI
Title of the thesis : EFFECT OF SEWAGE SLUDGE ON MARIGOLD AND GOLDEN ROD
Major Advisor : Dr. BABY AKULA
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9523

ABSTRACT

Sewage sludge used in present study was analyzed in the laboratory following standard procedures before studying its effect on growth and yield quality in marigold and golden rod. The results revealed that the sewage sludge was moderately acidic in reaction with a pH of 5.81, EC of 5.48 dS m$^{-1}$, total organic carbon content of 25.76 per cent and with a sludge volume index (SVI) of 482.71 mL g$^{-1}$. Total N, P and K contents of sewage sludge were 3.29, 1.23 and 2.98 per cent, respectively. The triacid extractable zinc in sewage sludge was 27.72 mg kg$^{-1}$ while, the diacid extractable heavy metals viz., Cd, Co, Ni and Pb were 0.97, 0.37, 1.69 and 6.86 mg kg$^{-1}$, respectively and are within the permissible limits as per the standards of USEPA.

Pot culture experiments were conducted using medium textured slightly alkaline red soil to study the effect of sewage sludge on soil properties, crops growth, nutrients and heavy metals uptake, yield, quality of yield and other important parameters of marigold and golden rod. The present study entitled “Effect of Sewage Sludge on Marigold and Golden Rod” was carried out during kharif, 2013 at green house farm of the Department of Horticulture, College of Agriculture, ANGRAU, Rajendranagar, Hyderabad. The experiments were laid out in Completely Randomized Design (CRD) with three replications separately for each crop of marigold and golden rod. There were seven treatments consisting of T$_1$ (20% sewage sludge), T$_2$ (40% sewage sludge), T$_3$ (60% sewage sludge), T$_4$ (80% sewage sludge), T$_5$ (100% sewage sludge), T$_6$ (RDF - Inorganic N, P and K @ 100, 100 and 100 kg ha$^{-1}$, respectively) and T$_7$ (Control, no sewage sludge) for both the marigold and golden rod crops. Inorganic N, P and K were supplied through urea, single super phosphate and muriate of potash, respectively as per recommended dose.

The volume of each pot was made up to 6 kg on weight basis with sewage sludge + soil as per treatment schedule. Necessary care was taken to protect the crops from pests and diseases. Two sets of pots were arranged for each treatment in each replication for both the marigold and golden rod. The first set of plants were collected from pots at mid
stage (45 DAT) and second set of plants were collected at harvesting stage (90 DAT) for necessary analysis. Plant parameters like plant height, number of leaves, number of branches, chlorophyll content, dry matter production, first bud appearance, days to 50% flowering, flower diameter, number of flowers and spikes per plant, total weight of flowers and spikes per plant, shelf life of flowers and spikes, weight of 100 flowers and spikes and carotene content of flowers and spikes were recorded at different growth stages of both marigold and golden rod. The plants samples were analyzed for N, P, K, Zn, Pb, Co, Ni and Cd uptake, while the flowers and spikes samples were analyzed for carotene content, Pb, Co, Ni and Cd uptake in both marigold and golden rod. Soil samples were analyzed for pH, EC, OC, N, P, K, Zn, Pb, Ni, Co and Cd.

There were significant variations in pH and EC of soil samples at all the stages among different treatments of sewage sludge. Significantly highest organic carbon was observed in 100% sewage sludge treatment (25.7%) followed by 80% sewage sludge (21.6%) similar to pH and EC. Availability of N, P, K, Zn, Pb, Co, Ni and Cd in soil at all stages of observation indicated that the availability of nutrients and concentration of heavy metals increased with increase in sewage sludge application rates and advancement in crop age. The available N, P and K content in soil exhibited high rating. The heavy metals viz., Pb, Ni, Co and Cd content in soil at all stages were within the maximum permissible limits as per WHO standards. Observation of potting mixture temperature showed that the temperature increased with increase in sewage sludge application rates.

Significantly maximum plant height, number of branches, number of leaves per plant and dry matter production were recorded in 100% sewage sludge in both the crops at all stages of observation. Significantly, though maximum number of flowers (51.7 plant\(^{-1}\)) and spikes (5.43 plant\(^{-1}\)) were obtained in 100% sewage sludge treatment (T\(_5\)), respectively in marigold and golden rod, maximum flower diameter in marigold (6.66 cm) and carotene content in both crops was observed in 80% sewage sludge treatment (T\(_4\)).

The uptake of major nutrients viz., N, P, K and Zn by plants of marigold and golden rod was linearly increased with increase in sewage sludge application rates. Significantly highest and lowest uptake of these nutrients was noticed, respectively in treatment of 100% sewage sludge application and Control (T\(_7\)).

The uptake of Pb and Co was beyond the maximum permissible limits in 80% sewage sludge and 100% sewage sludge in plants of both crops. But, cadmium uptake was beyond the maximum permissible limits only in 100% sewage sludge. In contrast, the uptake of Ni by plants of both crops was within the maximum permissible limits in all treatments.

Uptake of heavy metals viz., Pb, Ni, Co and Cd in flowers and spikes of both crops was within the maximum permissible limits in all treatments as per the WHO standards.

The above study indicates that, the application of sewage sludge is highly beneficial due to more availability of major nutrients, micronutrient and organic carbon
and enhanced growth, yield and quality of marigold flowers and golden rod spikes. However, further study is required to consolidate the results.
GENETICS AND PLANT BREEDING

Author: AHMAD SAMIM SAMIMY
Title of the Thesis: CHARACTER ASSOCIATION AND GENETIC DIVERGENCE IN BLACKGRAM (Vigna mungo (L.) HEPPER)
Major Advisor: Dr. KULDEEP SINGH DANGI
Degree: M. Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D9494

ABSTRACT

In the present investigation, fifty genotypes of blackgram were evaluated to study the genetic diversity present in the experimental material, the extent of association between the yield and its component characters and to estimate direct and indirect effects of various characters. The experiment was laid out in a randomized block design with three replications at college Farm, College of Agriculture, ANGRAU, Rajendranagar, Hyderabad during Kharif 2012.

Analysis of variance indicated the existence of significant differences among the genotypes for yield and its component characters. High GCV and PCV values were observed for plant height, number of primary branches per plant, number of pods per plant, and 100 seed weight. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of primary branches per plant, clusters per plant, number of pods per cluster, number of pods per plant and 100-seed weight indicating the role of additive genes in the inheritance of these traits. Hence these characters could be improved through simple phenotype selection.

The characters plant height, number of primary branches per plant, number of pods per cluster, number of pods per plant, pods length and 100 seed weight indicated significant positive association with seed yield. Therefore, possibility exist for simultaneous improvement of these characters along with seed yield.

The path coefficient analysis studies revealed that selection for number of pods per cluster, number of primary branches per plant, number of pods per plant and 100-seed weight would directly increase seed yield.
Based on the relative magnitude of $D^2$ results and principal component analysis, the genotypes showed considerable amount of genetic diversity and the genotypes were grouped into eight clusters in both the methods. The grouping of genotypes into clusters was at random indicating that geographical isolation might not be the only factor causing genetic diversity. Out of eleven characters studied, number of pods per plant contributed maximum (36%) towards divergence followed by 100-seed weight (35.10%) in $D^2$ analysis. The principal component analysis identified three principal components, which contributed (69.18%) of cumulative variance.

Based on $D^2$ values, crosses are proposed between the genotypes of clusters VII (MBG-1054) and cluster VIII (ACM-05-007), which had high cluster distance, for getting high seed weight, more number of pods per plant, early flowering and maturity, more number of pods per cluster and high seed yield per plant. Crossing between cluster VI (LBG-726) and VII (MBG-1054) appeared desirable for getting tall plants, long pods, more number of clusters per plant and more number of pods per plant which ultimately results in high yield. The principal component analysis revealed that crosses between cluster I (MBG-615), VIII (ACM-05-007) and cluster VII (MBG-1054), which had high inter cluster distance could be useful for getting early maturity, tall plants, more number of clusters per plant, long pods, and high seed weight which may leads to high seed yield per plant.
GENETICS AND PLANT BREEDING

Author : ANIL KUMAR ARROJU

Title of the Thesis : GENETIC ANALYSIS OF YIELD AND YIELD CONTRIBUTING CHARACTERS IN HYBRID RICE (Oryza sativa L.)

Major Advisor : Dr. FARZANA JABEEN

Degree : Ph.D.

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D9503

ABSTRACT

The present investigation entitled GENETIC ANALYSIS OF YIELD AND YIELD CONTRIBUTING CHARACTERS IN HYBRID RICE (Oryza sativa L.) was undertaken to study the combining ability, heterosis and stability of experimental hybrids for yield and yield attributing characters and to evaluate grain quality characters of the hybrids.

Based on the pedigree records 20 parents (14 identified restorer lines and six CMS lines) were selected which were having ideal characters of restorer and CMS lines, in addition to yield. The selected 14 restorer lines were crossed with six male sterile lines in line x tester mating design during kharif, 2009. The resulting 84 F1 hybrids along with 20 parents and six checks including three hybrid checks (DRRH-2, PA 6201 and KRH 2) and three varietal checks (Annada, IR 64 and Jaya) were sown during rabi, 2009-2010 at three different locations situated at three different agro-climatic regions of Andhra Pradesh viz., Regional Agricultural Research Station, Kunaram for Northern Telangana Zone, Regional Agricultural Research Station, Warangal for Central Telangana Zone and Regional Agricultural Research Station, Kampusagar for Southern Telangana Zone for studying combining ability, heterosis and stability.
The pooled analysis of variance revealed significant differences due to environments for all the characters indicating significant diversity among the environments. The mean sum of squares due to parents and crosses were significant for all the characters indicating the wider variability among the parents used and hybrids developed. Comparison of parents vs. crosses recorded significant for all the characters indicating presence of heterosis. Variances due to lines and testers were significant for most of the characters and interactions of lines x tester, parents x locations, (parents vs. crosses) x locations, crosses x locations, lines x locations, testers x locations and line x testers x locations were significant for most of the yield contributing traits. This indicates the existence of wide variability in the material under study and there is a good scope for identifying promising parents and hybrid combinations and improving the yield through yield contributing characters.

For the character grain yield per plant, line IR-68897A recorded significant positive gca effects at three locations and in pooled analysis and the line IR-79156A recorded significant gca effects at Warangal, Kunaram and in pooled analysis. The line IR-79128A recorded significant negative gca effects at all three locations and in pooled analysis and the line IR-58025A recorded significant negative gca effects at Kunaram, Kampsagar and in pooled analysis.

Among the testers, R-17, R-53 and R-56 recorded significant positive gca effects at all three locations and in pooled analysis. The testers, R-24, R-27, R-31, R-35 and R-36 recorded significant gca effects in any of the two locations out of three locations and in pooled analysis. The testers R-21 and R-25 recorded significant negative gca effects at all three locations and in pooled analysis. The testers R-7, R-32 and R-34 recorded significant gca effects in any of the two locations out of three locations and in pooled analysis.

Among 84 hybrids evaluated, 18 hybrids at Warangal, 22 hybrids at Kunaram, 22 hybrids at Kampsagar and 23 hybrids at pooled analysis recorded significant positive sca effects. The hybrids IR-58025A x R-53, IR-79128A x R-19, IR-79128A x R-56, IR-80555A x R-35 and IR-80555A x R-36 recorded significant positive sca effects at all three locations and in pooled analysis.

In pooled analysis, the hybrids exhibited a range of average heterosis and heterobeltiosis from -15.38 (IR-58025A x R-7) to 87.56 (IR-80555A x R-36) and -24.35 (IR-58025A x R-7) to 87.53 (IR-80555A x R-36), respectively and 52 hybrids recorded significant positive heterobeltiosis. Standard heterosis over PA-6201 and KRH-2 ranged from -32.54 (IR-80155A x R-21) to 31.89 (IR-79128A x R-56) and -38.29 (IR-80155A x R-21) to 20.67 (IR-79128A x R-56) respectively. 28 and 13 hybrids recorded significant positive heterosis over PA-6201 and KRH-2.

Among hybrids, only one hybrid IR-79156A X R-36 (22.67g) possessed significantly higher grain yield than the best check KRH-2 (20.69g) and recorded nearer to unit bi value, hence it is considered to be ideal and highly adaptable hybrid having average stability and expected to perform well in all the environments. Eleven hybrids
recorded significantly higher or on par yields and regression coefficient of more than one and hence are adaptable for favourable environments. The hybrids, IR-79128A X R-56 (24.97g), IR-80555A X R-35 (23.91g), IR-79128A X R-17 (23.46g), IR-68897A X R-53 (22.42g) and IR-80155A X R-19 (21.77g) recorded bi values of less than one and considered to be adaptable to poor environments.

Based on grain quality analysis of hybrids, five hybrids viz., IR 68897A x R56, IR 79156A x R53, IR 80555A x R19, IR 80155A x R53 and IR 80555A x R36 were identified as good grain quality hybrids with high per se performance and high heterosis for grain yield per plant.

GENETICS AND PLANT BREEDING

Author : ANUSHA, B.
Title of the Thesis : CHARACTERIZATION OF AKSHAYA (BPT 2231) RICE MUTANT POPULATION FOR BLAST RESISTANCE
Major Advisor : Dr. B. KRISHNA VENI
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D9600

ABSTRACT

The present investigation was carried out during kharif 2012 at Agricultural College Farm, Bapatla, with 24 mutagenic treatments of M4 generation on rice variety Akshaya (BPT 2231) to obtain information on variability, heritability and genetic advance for quantitative and qualitative characters in addition to phenotypic screening for blast resistance at Bapatla and DRR, Hyderabad and molecular characterization for blast resistant genes using SSR markers.

The results of phenotypic screening for blast resistance revealed that the treatments viz., T9 (20 Kr + 0.25% EMS), T17 (30 Kr) and T19 (40 Kr + 0.1% EMS)
exhibited immune reaction at Bapatla and Hyderabad. Most of the treatments showed moderately resistant reaction as that of the control while the mutant population of treatments viz., T1, T2, T7, T14, T15, T16 and T23 scored 8-9 and manifested highly susceptible reaction both at Bapatla and Hyderabad.

A total of thirty two microsatellite markers were used to reveal the genetic polymorphism in the immune treatments, among these only five markers viz., RM266, RM280, RM228, RM72 and RM23946 exhibited polymorphism and the number of alleles detected per loci ranged from 2 to 5. Based on the pattern of polymorphism with the markers tested, it may be concluded that the mutation might have occurred in the location between 35.1 Mb to 34.9 Mb on second chromosome and/or 34.5 Mb to 34.9 Mb on fourth chromosome which might have led to the resistant reaction against blast disease conferred by the mutant population of treatments T9, T17 and T19.

The gene profiling studies with the major blast resistant genes viz., Pi1, Pi9, Pi54, Pi2, Pib, Pita, Pi33 and Pita2 indicated that the resistance observed in the mutant lines is not due to the presence of these genes. Hence, the resistance observed in the mutant lines may be due to the presence of other than the above genes. To identify the genes responsible for blast resistance, these lines have to be crossed with the control and in the F2 generation, the genetics of resistance can be further studied to identify the gene (s) conferring the resistance.

The analysis of variance revealed significant differences among the twenty five treatments for all the characters except for amylose content. The variability studies indicated that the material developed in the present study possessed significant variability which provides sufficient basis for selection.

The results of variability parameters indicated higher estimates for phenotypic coefficient of variation when compared with the genotypic coefficient of variation, suggesting less environmental influence on the characters studied. Among the yield components, ear bearing tillers, number of fertile grains per panicle and grain yield per plant manifested moderate to high GCV, PCV coupled with high heritability and high genetic advance suggesting the predominance of additive type of gene action in controlling these traits and thus good response to selection can be attained in early segregating generations for improvement of these characters. Majority of the characters under study viz., plant height, days to 50 % flowering, panicle length, test weight, head rice recovery, kernel length after cooking and elongation ratio exhibited low GCV, PCV, moderate to high heritability coupled with low to moderate genetic advance as per cent of mean indicating the preponderance of both additive and non additive gene effects in their inheritance.

When compared with the check Akshaya, majority of the treatments manifested lesser plant height and earliness in flowering which is highly desirable for isolating semi dwarf and early maturing types suitable to different cropping patterns. The treatments T3 (10 Kr + 0.25% EMS), T10 (20 Kr + 0.3% EMS) and T21 (40 Kr + 0.3% EMS) exhibited moderate resistant reaction for blast disease in addition to high mean performance for ear
bearing tillers and number of fertile grains per panicle and high grain yield per plant. Besides high yield potential, the population from the above treatments also possess the desirable quality characteristics. Hence, it is possible to isolate moderate blast resistant genotypes with high yield potential coupled with good grain quality from further generations.

GENETICS AND PLANT BREEDING

Author : ASHOK KUMAR MEENA
Title of the Thesis : GENETIC DIVERGENCE IN ELITE LINES FOR YIELD AND QUALITY ATTRIBUTES IN RICE (Oryza sativa L.)
Major Advisor : Dr. J. SURESH
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9561

ABSTRACT
In the present investigation, thirty eight genotypes of rice were evaluated to study the genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the genotypes for yield and quality traits, and the extent of association between the yield and its component characters including the direct and indirect effects. The experiment was laid out in a randomized block design with two replications at rice section farm, Agricultural Research Institute, Rajendranagar, Hyderabad during kharif 2013.

Analysis of variance indicated high significant differences among the genotypes for all the traits under study. A perusal of genetic parameters revealed that phenotypic and genotypic coefficients of variation were high for thousand grain weight, followed by grain yield per plant, number of productive tillers per plant number of filled grains per panicle, head rice recovery and plant height.

The genetic divergence was high and the thirty eight genotypes of rice were grouped into 10 divergent clusters. Cluster I was the largest comprising of twenty nine genotypes and all other clusters II,III IV, V, VI, VII, VIII, IX and X were represented by single genotype indicating high degree of heterogeneity among the genotypes. The pattern of group constellations indicated significant variability among the genotypes.

The thousand grain weight, kernel length, grain yield per plant, plant height, L/B ratio contributed 85.34 per cent towards total divergence. Therefore, these characters should be given importance during hybridization and selection of segregating populations.

The cluster VIII is having highest mean value for grain yield per plant and thousand grain weight, cluster VII for number of filled grains per panicle and cluster X is having highest number of productive tillers per plant, head rice recovery, kernel breadth and cluster VI for hulling percentage, high milling percentage and cluster III having highest plant height, panicle length, II having highest kernel length and cluster IV having high L/B ratio. The genotypes RNR 19371, RNR 19420, MTU 1010, MTU 1001 and RNR 19368 from these clusters having high mean values may be directly used for adaptation or may be used as parents in future hybridization programme.

Character association studies revealed that the grain yield per plant showed significant positive association with days to 50 per cent flowering, number of productive tillers per plant, number of filled grains per panicle, kernel length, kernel breadth and positive association with thousand grain weight. This indicated that simultaneous selection of all these characters was important for yield improvement.

Path analysis revealed that numbers of productive tillers per plant, number of filled grains per panicle, kernel breadth, kernel L/B ratio and thousand grain weight are the most important characters which could be used as selection criteria for effective improvement on grain yield.
Therefore, it is suggested that preference should be given to these characters in the selection programme to isolate superior lines with genetic potentiality for higher yield in rice genotypes.

**GENETICS AND PLANT BREEDING**

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<td>Title of the Thesis</td>
<td>GENETIC ANALYSIS OF YIELD, PHYSIOLOGICAL AND YIELD ATTRIBUTES IN <em>RABÍ REDGRAM (Cajanas cajan (L.) MILLSP.)</em></td>
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<td>Major Advisor</td>
<td>Dr. L. PRASANTHI</td>
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The present investigation was undertaken in redgram (*Cajanus cajan* (L.) Millsp.) to study the variability, heritability and genetic advance as per cent of mean, character association, path coefficient analysis and polymorphism studies using Random Amplified Polymorphic DNA (RAPD) markers during *rabi*, 2012. The experiment was laid out in Randomized Block Design with three replications at the Regional Agricultural Research Station, Tirupati and observations were recorded on 16 characters viz., days to flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, pod length, number of pods per plant, number of seeds per pod, 100-seed weight, harvest index, Relative Water Content, Specific Leaf Area, SPAD Chlorophyll Meter Reading, protein content, phenol content, seed yield per plant.

Analysis of variance indicated the existence of significant differences among the genotypes for all the characters. Among the 15 genotypes LRG-41 and ICP-15580 showed high mean performance for seed yield. Analysis of genetic parameters revealed higher phenotypic and genotypic coefficient of variation, heritability, genetic advance as per cent of mean for secondary branches per plant, pods per plant and seed yield per plant, indicating that simple selection could have relevance for grain yield improvement.

Correlation studies indicated that the characters pods per plant, harvest index, plant height, secondary branches per plant, days to flowering, days to maturity and primary branches per plant had significant positive correlation with seed yield per plant. Path coefficient analysis revealed high positive direct influence of pods per plant, harvest index and also days to flowering has positive indirect effects on seed yield via all the characters except pod length, RWC, SCMR, protein content. Pods per plant had positive indirect effects on seed yield via all the characters except pod length, 100-seed weight and SCMR where as harvest index also had positive indirect effects on seed yield via all the characters except 100-seed weight. Hence, selection for pods per plant and harvest index is suggested for the improvement of seed yield per plant in redgram.

The polymorphism studies using Random Amplified Polymorphic DNA (RAPD) marker analysis detected a high level of genetic variation among the 15 redgram genotypes. Based on diversity analysis using molecular markers hybridization programme may be initiated between the genotypes PRG-158, ICP-15225 and TRG-59 from cluster II and LRG-30 from cluster I in order to get transgressive segregants, since these genotypes showed maximum diversity among themselves besides high yielding performance at phenotypic level.
ABSTRACT

Rice (*Oryza sativa* L.) is the most important staple food grain of all cereal crops and feeds more than half of the world’s population. Advanced breeding lines are pre-released lines which include homozygous lines, mutant lines and the lines derived from biotechnology programmes contains valuable gene combinations. These constitute an important source of genetic variation for utilization in breeding of high yielding rice varieties and hybrids.

The present study was undertaken with an objective to assess the genetic diversity among advanced breeding lines (mutant lines - *M*₄ generation derived from Samba mahsuri variety, which showed earlier tolerance to yellow stem borer (YSB) infestation. The study was also intended to identify some allele specific markers (Molecular Ids). Out of the total 60 SSR markers distributed across 12 chromosomes, tested, 21 were found to be polymorphic and were used to assess the extent of genetic diversity among 42 mutant lines of samba mahsuri. A total of 44 alleles were detected across 42 mutant lines of samba mahsuri by 21 polymorphic SSR markers. The number of alleles generated per locus by each marker ranged from 2 to 3 with an average of 2.09 number of alleles per locus.

Polymorphism information content (PIC) values among the SSR loci tested ranged from 0.565 (RM562) detected on chromosome 1 to 0.816 (RM 26213) on chromosome 11 with an average of 0.685 per locus.

Cluster analysis performed by using UPGMA based on similarity co-efficient grouped 42 mutant lines into two major clusters with 37% dissimilarity. Cluster I consisted of 41 breeding lines which showed 35% dissimilarity and was further subdivided into IA and IB. IA and IB consisted of 40 lines and 1 mutant line, respectively with 26% dissimilarity comprised of 30 and 8 mutant lines. Cluster II consisted of 1 mutant line.
Out of 21 polymorphic SSR markers, four SSR markers were identified as allele specific markers, viz., RM485 on chromosome 2, RM6487 on chromosome 4, RM1359 on chromosome 4 and RM26998 on chromosome 11. The specific markers (Molecular Ids) identified in the present study will also be used for identification of particular mutants. The loci which undergone mutations in particular mutants needs to be associated with morphological characters like resistance reaction to the YSB (Yellow Stem Borer) to know clearly which loci corresponds to the altered phenotype. The hypothesis of EMS mutation which causes the point mutation in the genome was verified and evidenced from this study.
GENETICS AND PLANT BREEDING

Author : CHELPURI DURGARAJU
Title of the Thesis : MAPPING HOST-PLANT RESISTANCE QTL FOR DOWNY MILDEW PATHOGEN IN PEARL MILLET (Pennisetum glaucum [L.] R.Br.)
Major Advisor : Dr. K. KANAKA DURGA
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9555

ABSTRACT

The present study entitled “Mapping Host-Plant Resistance QTL for Downy Mildew Pathogen in Pearl Millet (Pennisetum glaucum [L.] R.Br.)” undertaken at ICRISAT - Patancheru was carried out for mapping the chromosomal regions harbouring QTL for downy mildew resistance by utilizing the F8 RIL population generated from a cross between ICMB 89111-P6 and ICMB 90111-P6.

Pearl millet downy mildew, caused by Sclerospora graminicola, is the most devastating disease of pearl millet causing huge losses to grain and straw in India. Sclerospora graminicola is known to be a highly variable pathogen because existence of sexual stages in its life cycle helps the pathogen to undergo rapid genetic recombination leading to the emergence of new pathotypes and races with high degree of spatial and temporal variation for virulence. Evolution of more virulent populations of S. graminicola in the recent past has resulted in the susceptibility of pearl millet accessions hitherto resistant to earlier pathotypes. As the host is a crop of poor and marginal areas, the use of resistant cultivars is the most appropriate, efficient, environmental friendly and economical means to control pearl millet downy mildew. However, the conventional breeding alone is tedious, time consuming and the progress is very low for understanding and manipulating quantitative traits, molecular markers are used as highly effective
research tools to uncover the genetic basis of complex traits such as pest/disease resistance.

Keeping in view the seriousness of the downy mildew problem, the present investigation was proposed to map resistance QTLs for diverse virulent isolates of *Sclerospora graminicola* [(Sg445 (Gujarat), Sg519 (Haryana), Sg526 (Rajasthan))] in a RIL mapping population of F₈ generation of 188 genotypes from the cross ICMB 89111-P6 × ICMB 90111-P6.

For the QTL mapping available 20 pairs of mapping population parental lines were screened against three above new isolates of downy mildew pathogen and ICMB 89111-P6, ICMB 90111-P6 which are recorded high contrast for downy mildew reaction in screening were selected for mapping of downy mildew resistance QTLs.

Selected mapping population parents are screened for polymorphism with 468 SSR primers and 118 SSR markers recorded polymorphism. From this 118, 88 polymorphic SSR marker loci were used for genotyping the 188 RILs. In genotyping about 62.6% (21) of polymorphic marker loci showed mendelian segregation ratio of 1:1, while 37.4% (13) of polymorphic marker loci showed segregation distortion.

A skeleton linkage map of seven linkage groups with a total map length of 725.5 cM (Haldane units) was constructed using data from 74 marker loci for 188 RILs using JoinMap at LOD threshold value of 5.0 and MapMaker/Exp version 3.0b and map was drawn using Map Chart 2.2. The map length of individual linkage groups ranged from a minimum of 32.1cM (LG3) to a maximum of 140.2 cM (LG1). The average inter marker distance was 9.8 cM, with an average density of 0.102 markers/cM. The total number of mapped loci per linkage group (LG) ranged from 5 on LG3 to 23 on LG1.

For QTL mapping the primary data of downy mildew incidence percentage was converted later into resistance percentage and used for QTL analysis which was performed by Composite Interval Mapping with Windows QTL Cartographer ver2.5 using a LOD of 2.5 as the threshold value at 0.05 significance levels and walk speed of 1cM with 1000 permutations for QTL significance. A total of seven different major disease resistant QTLs were identified from the F₈ RIL mapping population against the three isolates. Two QTLs each were identified on LG4 against Sg445, Sg519 and Sg526 and one QTL on LG6 against Sg519. The inheritance of these QTLs showed that male parent ICMB 90111-P6 was contributing the resistance alleles. The highest LOD score (30.86) for the QTL identified on LG4 against Sg445 and largest amount of observed phenotypic variation (78.59) was contributed by the QTL on LG4 against Sg519. These identified DMR QTLs can be transferred to genetic backgrounds of elite pearl millet hybrid lines through marker-assisted backcrossing programs. Flanking markers of the identified QTLs can facilitate foreground selection of resistant progenies during the backcrossing process, where as other marker loci can be used in reducing the length of the donor segments carried along with the introgressed downy mildew resistance genes through background selection.
In the present investigation, elite restorer lines were screened for the presence of proven Rf genes and the identified restorers were evaluated for their per se performance in different hybrid combinations and promising hybrids were identified.

During kharif, 2012, fifty-five restorers and 2 CMS lines (WA type) developed at Maruteru were evaluated for variability, genetic parameters and genetic divergence for nine yield and yield component traits at Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, West Godavari district, Andhra Pradesh. DNA was isolated from the leaf tissues collected from parental lines at tillering
stage and screened for the presence of proven \textit{Rf} genes using published SSR markers and molecular cluster analysis was performed. The 55 restorers were then crossed with two CMS lines in a line x tester design and the hybrids obtained were evaluated during \textit{rabi}, 2012-13.

The analysis of variance of parental lines revealed significant differences among the genotypes for all the nine characters studied. Genetic variability studies revealed high variability for the character, no. of filled grains panicle-1. High heritability coupled with high genetic advance was observed in case of ear bearing tillers plant-1, number of filled grains panicle-1, test weight and grain yield plant-1 suggesting the role of additive gene action in the inheritance of these traits.

The estimation of genetic divergence employing both Mahalanobis D2 statistic and molecular cluster analysis revealed the existence of considerable genetic diversity among the parental lines studied. High genetic variability was observed in the hybrids for number of filled grains per panicle, spikelet fertility and grain yield per plant. High heritability coupled with high genetic advance was observed in case of ear bearing tillers per plant, number of filled grains panicle-1, spikelet fertility, test weight and grain yield plant-1 suggesting the role of additive gene action in the inheritance of these traits and directional selection could be profitably applied on these traits.

The analysis of variance for combining ability showed significance of crosses for all the characters under study. The variance due to lines was significant for all the characters studied whereas testers showed significance for all the characters except plant height, number of grains per panicle and spikelet fertility. All the traits showed significance for line x tester interaction. The SCA variances were higher than GCA variances for all the characters indicating the predominance of non-additive gene action.

Among lines, TCNP 23 and RP 13 and APMS 6A in testers were identified as good general combiners for grain yield plant-1, based on \textit{gca} effects. Based on overall performance, the hybrids TC 11 (APMS 6A × RP 13), TC 7 (APMS 6A × RP 5), TC 1(APMS 6A × RP 2), TC 34 (APMS 10A × TCNP 23), TC 20 (APMS 10A × RP 18) and TC 69 (APMS 6A × TCNP 29) were identified as promising heterotic hybrids for grain yield per plant over higher yielding check, MTU 1121.

These hybrids may be further evaluated for grain quality traits and also for their stability by testing over more number of environments in different seasons before being commercially exploited.

Twenty three restorers were identified as best ones based on spikelet fertility of the hybrids. Four and five primers were found to distinguish the restorer checks (Swarna and BPT 5204) and CMS lines for \textit{Rf} \textit{3} and \textit{Rf} \textit{4} genes respectively. Leaving a few exceptions, all the identified restorers showed similar banding pattern with the restorer checks indicating the presence of \textit{Rf} \textit{3} and \textit{Rf} \textit{4} genes in those restorers.

The identified test crosses with good restoration ability may be evaluated in F2
generation for further confirmation of the presence of $R_f$ genes.

GENETICS AND PLANT BREEDING

Author : JAGADISH, N.
Title of the Thesis : GENETIC ANALYSIS OF PHYSIOLOGICAL AND DROUGHT TOLERANCE ATTRIBUTES IN KABULI CHICKPEA (Cicer arietinum L.)
Major Advisor : Dr. V. JAYALAKSHMI
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, MAHANANDI
Accession Number : D9571

ABSTRACT
‘Genetic analyses of physiological and drought tolerance attributes in kabuli chickpea (Cicer arietinum L.)’ were carried out utilising six parental genotypes and their 15 half diallel crosses at Regional Agricultural Research Station, Nandyal during rabi, 2012-13. Analysis of variance revealed the existence of appreciable significant differences among the genotypes for sixteen yield and drought tolerance attributes except for days to first flowering and days to first podding.

Studies on combining ability revealed significant gca and sca mean squares for all the fourteen traits studied indicating the influence of both additive and non-additive gene action. However, estimates of components of variance revealed predominance of non-additive gene action for days to 50 per cent flowering, days to maturity, number of branches per plant, SPAD chlorophyll meter reading (SCMR), specific leaf area (SLA), relative Water Content (RWC), root length, and root weight. Whereas, plant height, number of pods per plant, shoot biomass per plant, seed yield per plant, harvest index and 100 seed weight showed predominant additive gene action.

Parental genotypes MNK 1 for plant height, SCMR, root length, root weight and 100 seed weight; Vihar for number of branches per plant, number of pods per plant and shoot biomass per plant; KAK 2 for root length, number of pods per plant and harvest index; Phule G 05107 for plant height, SCMR, and 100 seed weight; NBeG 72 for SLA, number of pods per plant and seed yield per plant and ICCV 95333 for SLA were identified as good general combiners with high mean per se for respective characters. These parents were suggested for improving chickpea productivity and drought tolerance.

Based on the per se performance, sca effects and heterosis promising crosses for isolating early maturing lines (ICCV 95333 x NBeG 72, Vihar x NBeG 72 and ICCV 95333 x Phule G 05107); for enhancing physiological traits like SCMR, SLA, RWC, root length and root weight (Vihar x NBeG 72, ICCV 95333 x Phule G 05107, ICCV 95333 x NBeG 72, KAK 2 x MNK 1, KAK 2 x Phule G 05107, KAK 2 x NBeG 72, MNK 1 x Phule G 05107 and MNK 1 x NBeG 72); and yield and yield attributes (Vihar x KAK 2, Vihar x MNK 1, MNK 1 x Phule G 05107 and MNK 1 x NBeG 72) were identified and could be used for developing high yielding drought tolerant genotypes in chickpea breeding programmes. Promising high yielding lines with extra large or large seeds can be developed by exploiting three crosses (MNK 1 x NBeG 72, MNK 1 x Phule G 05107, Phule G 05107 x NBeG 72) which were superior for 100 seed weight.

Correlation and path analysis studies revealed that shoot biomass per plant and number of branches per plant were the most important traits contributing directly to the seed yield. Characters like days to first flowering, days to 50 per cent flowering, number of branches per plant, SCMR, SLA also influenced seed yield per plant indirectly through shoot biomass per plant. Though 100 seed weight exhibited negative correlation with seed yield per plant, its indirect influence via other traits is positive. Therefore, the association between number of pods per plant, 100 seed weight and shoot biomass per plant should be considered carefully while formulating selection criteria in chickpea crop improvement programmes. Path analysis revealed that physiological traits like SLA, SCMR and RWC which are related to photosynthesis efficiency and water use efficiency
had considerable indirect and positive effects via other traits. Incorporation of these physiological traits in breeding programmes will help in improving drought tolerance in high-yielding chickpea genotypes.
Degree: M. Sc. (Ag.)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D9563

ABSTRACT

A field experiment was conducted to estimate the genetic variability and genetic divergence in finger millet and to carry out yield component analysis through correlation and path analysis. Forty eight germplasm lines were sown in a randomized block design with three replications, during kharif 2013 at National Bureau of Plant Genetic Resources, Regional station, Rajendranagar, Hyderabad. The objective of the experiment was to identify divergent genotypes to use as donor parents in hybridization programmes.

On the basis of the mean performance of the genotypes among traits studied, the following were identified as promising lines for further crop improvement. Genotype 13570 could be used as a promising donor for grain yield per plant and grain yield per plot. Genotype 13426 recorded highest mean value for maximum no. of leaves and finger width. Genotype 13433 recorded highest plant height and main ear length. Genotype 13632 recorded highest ear width, 13650 maximum no. of productive tillers, 13712 highest finger length, 13675 maximum no. of basal tillers and 13555 maximum no. of leaves. The above mentioned genotypes will be useful for increasing the productivity.

The analysis of variance revealed significant differences among genotypes for all the characters. Studies of genetic variability revealed high phenotypic and genotypic coefficients of variation, heritability and genetic advance as per cent of mean for the traits viz., no. of basal tillers per plant, no. of productive tillers per plant, main ear width, grain yield per plant and grain yield per plot indicating simple selection can be practiced for improvement of these characters.

The phenotypic coefficient of variation indicating the effect of environment. High GCV and PCV values were observed for grain yield per plot followed by grain yield per plant, no. of basal tillers per plant, productive tillers per plant, main ear width and finger length. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, no. of basal tillers per plant, no. of productive tillers per plant, main ear length, main ear width, finger length, grain yield per plant and grain yield per plot. Thus, these traits are predominantly under the control of additive gene action and hence these characters can be improved by Selection.

The correlation analysis revealed that grain yield per plant showed positive significant association with no. of basal tillers, no. of leaves on the main tiller, productive tillers per plant, main ear length, finger width, total no. of fingers on the main ear, grain yield per plot and plant height.

Path coefficient analysis revealed that grain yield per plot exhibited highest positive direct effect on grain yield per plant, followed by finger width, plant height and
along with significant positive correlation for all the above mentioned characters. Therefore, it is emphasized to lay attention on traits like grain yield per plot, finger width and plant height in crop improvement programme of finger millet in future.

The D\textsubscript{2} analysis was carried out for eleven characters which partitioned the forty eight genotypes into eight clusters. Maximum divergence was observed between cluster VI and VIII, while minimum was between cluster I and V. The maximum intra cluster distance was shown by cluster VIII.

Higher grain yield per plant was recorded for clusters are VI, II and IV. Genotype included in cluster VI is having highest mean value for grain yield per plant, finger width and grain yield per plot. Cluster IV is having highest mean value for main ear width. The genotypes 13570, 13675 and 13528 (VI), 13569 and 13568 (II) were having high mean values for grain yield per plant may be directly used for adaptation or may be used as parents in future hybridization programme.

Among the 11 quantitative characters studied the most important character contributing to the divergence was grain yield per plant followed by main ear width, total no. of basal tillers per plant, total no. of fingers on the main ear, finger width, main ear length, plant height, no. of leaves on the main tiller, total productive tillers per plant, finger length and grain yield per plot. In order to select genetically diverse genotypes the material should be screened for the important traits viz., grain yield per plant, main ear width, total no. of basal tillers per plant, total no. of fingers on the main ear, main ear length and plant height.
ABSTRACT

The present study was carried out in kharif, 2011 at agricultural college farm, mahanandi in randomized block design with three replications and data were recorded on various yield and yield components to estimate variability, genetic parameter, character association and path analysis among 41 maize genotypes (Zea mays L.) for 15 yield and yield attributing characters.

Analysis of variance indicated the existence of significant genotypic differences for all the fifteen traits. Mean performance of 41 maize genotypes for 15 quantitative traits revealed that the genotypes CM 119, CM 131 and CM 208 were promising donors for grain yield per plant; CM 208, CM 131 and 3001 were promising donors for 100 grain weight; CM 210, 5111 and CM 131 were promising donors for number of grain rows per ear ; CM 131, 5204-1 and 5157 were promising donors for number of grains per row; CM 131, CM 208 and CM120 were promising donors for ear length; CM 131, CM 208 and CM 119 were promising donors for ear girth; CM118, CM 120 and 5222 were promising donors for shelling percentage; 5289, CM 118 and CM 120 were promising donors for harvest index; 5111, PC-23-2 and 5254 were promising donors for days to 50% brown husk; 5157, 5212 and PC-14-2 were promising donors for number of cobs per plant; CM 131, CM 211 and BML-7 were promising donors for ear height; PC-23-1, 5157 and BML-7 were promising donors for anthesis-silking interval; 5157, 5254 and 5158 were promising donors for days to 50% silking; 5158, 5254 and 5228 were promising donors for days to 50% tasseling; CM 131, BML-7 and CM 119 were promising donors for plant height.

Genotypic and phenotypic coefficients of variability were high for grain yield per plant followed by anthesis silking interval, ear height, number of grains per row, harvest index, plant height, 100 grain weight and number of cobs per plant. High heritability coupled with a high genetic advance was observed for 13 viz, grain yield per plant, harvest index, number of grains per row, ear height, plant height, number of cobs per plant, 100 grain weight and anthesis and silking interval indicating that these characters
are mainly under the influence of additive gene effects, as such, selection would be effective for improvement of these characters.

Correlation analysis revealed that number of grains per row followed by ear length, ear girth, plant height, 100-seed weight, number of grain rows per ear, ear height, harvest index and shelling percentage exhibited highly significant positive association with grain yield per plant. Based on *inter se* association studies among yield components, the characters *viz.*, number of grains per row, ear length, ear girth and 100-grain weight should be considered in formulating selection procedures for the improvement of elite genotypes for grain yield in maize, as these characters exhibited significant and strong positive association among themselves as well as with yield per plant.

Path coefficient analysis revealed that number of grains per row followed by 100 grain weight, ear length, shelling percentage, plant height, ear girth, harvest index, days to 50 % silking, anthesis-silking interval, number of grain rows per ear, days to 50 per cent brown husk exerted positive direct effects on grain yield. In contrast, the traits *viz.*, days to 50 per tasseling, number of cobs per plant and ear height exhibited negative direct effect on grain yield per plant.

Therefore, the traits number of grains per row, ear length, ear girth and 100-grain weight could be considered as the major yield contributing characters in maize and hence, emphasis should be made on these traits in the selection programme to evolve high yielding genotypes in maize.
GENETICS AND PLANT BREEDING

Author : NIRMALA, D.

Title of the Thesis : GENETIC DIVERSITY FOR PHYSIOLOGICAL AND PRODUCTIVITY TRAITS IN GROUNDNUT (Arachis hypogaea. L)

Major Advisor : Dr. V. JAYALAKSHMI

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, MAHANANDI

Accession Number : D9474

ABSTRACT

The present investigation was undertaken to assess the magnitude of genetic diversity and variability in thirty genotypes of groundnut and also to identify important physiological characters influencing groundnut yield and drought tolerance. The experimental material in the present study consisted of 30 genotypes developed at different centres of All India Coordinated Groundnut Improvement programme and were evaluated at College farm, Agricultural College, Mahanandi during kharif, 2011. Apart from yield attributes, important physiological traits like SPAD chlorophyll meter reading, specific leaf area, crop growth rate, and relative growth rate and harvest index were also included in the study.

Analysis of variance revealed the existence of significant differences among the genotypes for all the nineteen traits studied. The per se performance data revealed that the genotypes, K 1463, CAUG 1, K-1333, LGN 123 and R- 20001-2 are promising for yield and yield attributes and CTMG 7, CSMG 2006-6 and Bheema could be used as promising donors for physiological traits like SCMR and SLA.

Genetic divergence studies using Mahalanobis’s D2 statistic grouped 30 genotypes into 14 clusters. Based on inter cluster distances, clusters III & XII, V & XIII, XII & XIII and XIII & XIV were found as divergent. Hence, selection of superior genotypes from these clusters viz., CSMG 2006-6, CAUG 1, TCGS 150, LGN 123 and R-2001-2 for hybridization programme may result into good recombinants. Characters,
number of secondary branches per plant, CGR at 75 DAS to harvest, CGR at 30 DAS to 75 DAS and 100-seed weight contributed maximum towards genetic divergence in D2 analysis.

Correlation analysis revealed that the characters, weight of pods per plant, harvest index, shelling out turn, number of mature pods per plant, plant height, number of sound mature kernel, CGR at 75 DAS to harvest and RGR at 75 DAS to harvest are major component traits contributing to kernel weight per plant. Apart from strong correlation with kernel yield, characters like weight of pods per plant, number of mature pods per plant, number of sound mature kernel, shelling out turn, harvest index, SLA, CGR at 75 DAS to harvest and RGR at 75 DAS to harvest were interrelated among themselves. Thus, selection for any of these interrelated characters will lead to simultaneous improvement in rest of the characters and in turn kernel yield per plant.

Path coefficient analysis brought out high positive and direct effect of weight of pods per plant and shelling out turn with kernel weight per plant. Their indirect effects via, plant height, number of mature pods per plant, number of sound mature kernel, harvest index and CGR at 75 DAS to harvest were also high and hence these traits form major components of kernel weight per plant to emphasize selection.

Variability studies indicated high GCV, PCV, heritability and GAM for number of secondary branches per plant, CGR at 75 DAS to harvest, RGR at 75 DAS to harvest, number of sound mature kernel, number of mature pods per plant, plant height and number of immature pods per plant suggesting that improvement could be brought about by adopting straight or direct selection for these attributes.
GENETICS AND PLANT BREEDING

Author : NISHIT DEBBARMA
Title of the Thesis : STUDY OF GENETIC DIVERGENCE FOR GRAIN YIELD AND YIELD COMPONENTS IN FINGER MILLET (Eleusine coracana (L.) Gaertn)
Major Advisor : Dr. P.V. RAMA KUMAR
Degree : M. Sc. (Ag.)
College : AGRICULTURAL COLLEGE, BAPATLA
Accession Number : D9596

ABSTRACT

The present investigation was carried out during kharif 2012 at Agricultural College Farm, Bapatla with 60 genotypes of finger millet (Eleusine coracana (L.) Gaertn) to study variability, heritability, genetic advance as per cent of mean, genetic divergence, character association and the magnitude of direct and indirect effects of 10 yield component traits viz. days to 50% flowering, days to maturity, plant height (cm), number of productive tillers, number of fingers ear-1, finger length (cm), number of grains panicle-1, test weight, seed protein % with grain yield plant-1.

The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation, indicating the masking effect of the environment. Moderate to high variability and high heritability coupled with high genetic advance as per cent of men were observed for days to 50% flowering, days to maturity,
plant height, number of fingers ear-1, finger length, number of grains panicle-1, test weight, seed protein % and grain yield plant-1 indicating the predominance of additive gene action and hence, direct phenotypic selection may be useful for these traits.

Correlation and path analysis indicated that the traits like days to 50% flowering, days to maturity, test weight, number of fingers ear-1, number of grains panicle-1 and seed protein % may be utilized in selection to evolve high yielding varieties of finger millet.

The results of multivariate analysis indicated the presence of considerable genetic divergence among the 60 genotypes studied. The 60 genotypes were grouped into eight clusters in case of D2 analysis and also eight clusters through Ward’s minimum variance method. This analysis clearly indicated that the genetic diversity and geographical diversity were not related.

By Mahalanobis’ D2 statistic, it could be inferred that days to 50% flowering, days to maturity, number of fingers ear-1, test weight and seed protein % contributed maximum towards genetic divergence. Based on intra-and inter-cluster distance, it is suggested to make crosses between the genotypes of clusters III (GE-4798, GE-506, GE-2963, GE-1746, GPU-48, GE-3099, GE -3453 ) and VII (GE-2127) or III (GE-4798, GE-506, GE-2963, GE-1746, GPU-48, GE-3099, GE -3453 ) and VIII (GE-666) or III (GE-4798, GE-506, GE-2963, GE- 1746, GPU-48, GE-3099, GE -3453 ) and VI (GE-258) for evolving transgressive segregants for yield and yield components.

Principal component analysis identified four principal components (PCs), which contributed 74.71 per cent of cumulative variance. The significant factors which contributed maximum genetic divergence in PC1 were grain yield plant-1, number of grains panicle-1, days to 50% flowering, plant height, days to maturity and number of productive tillers.

Agglomerative cluster analysis revealed that wide genetic distance between the genotypes of clusters II (GE-258, GE-2127, GE-666) and VIII (GE-4798, GE-506, GE-2963, GE-3453) indicating their usefulness in the breeding programmes for finger millet yield improvement.

The genotypes GE-2127, GE-666, GPU-48, GE-4798, GE-506, GE-2963 and GE-3453 showed maximum inter-cluster distance in Mahalanobis’ D2 analysis, principal component analysis and cluster analysis. So they can be exploited for the development of heterotic hybrids in future breeding programmes.
GENETICS AND PLANT BREEDING

Author : PEDDA SWAMY, D.

Title of the Thesis : GENETIC VARIABILITY AND CHARACTER ASSOCIATION FOR YIELD AND YIELD ATTRIBUTES IN SORGHUM (Sorghum bicolor L. Moench)

Major Advisor : Dr. B. NARENDRA

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, MAHANANDI

Accession Number : D9572

ABSTRACT

The present study was carried out in sorghum during early rabi season (Popularly known as maghi season in Kurnool district), 2012-13 at Agricultural College, Mahanandi (ANGRAU) in simple lattice design with two replications and data were recorded on
various yield and yield components to estimate nature and magnitude of genetic variability, character association and path coefficient analysis among 81 sorghum genotypes for ten yield and yield attributing characters.

Analysis of variance indicated the existence of significant genotypic differences for all the ten traits. Mean performance of 81 sorghum genotypes for ten quantitative traits revealed that the genotypes IC 15466, IC 305920, IC 18039, IC 17941 and IC 343589 were promising donors for grain yield per plant; IC 343582, IC 15744, IC 29100, IC 23891 and IC 30838 were promising donors for panicle weight; IC 7679, IC 7987, IC 30838, IC 32349 and IC 7131 were promising donors for panicle length; IC 23891, IC 343582, IC 5919, IC 29100 and IC 29091 were promising donors for 1000-seed weight; IC 305920, IC 343554, IC 18039, IC 343589 and IC 343590 were promising donors for days to maturity; IC 15466, IC 305920, IC 18039, IC 17941 and IC 343589 were promising donors for days to 50 per cent flowering; IC 7679, IC 30838, IC 15931, IC 24139 and IC 28747 were promising donors for plant height (cm); IC 29100, IC 343554, IC 343573, IC 18039 and IC 343567 were promising donors for number of primaries per panicle; IC 343589, IC 343588, IC 343587, IC 343590 and IC 343591 were promising donors for stover yield per plant; IC 29565, IC 19859, IC 29100, IC 29519 and IC 14779 were promising donors for harvest index.

Genotypic and phenotypic coefficients of variability were high for grain yield per plant, panicle weight, stover yield per plant, harvest index, 1000-seed weight, panicle length and number of primaries per panicle. High heritability coupled with a high genetic advance as per cent of mean was observed for grain yield per plant, panicle weight, stover yield per plant, harvest index, 1000-seed weight, panicle length and plant height.

Character association studies indicated that the character grain yield per plant had positive and significant association with panicle weight followed by 1000-seed weight, harvest index, number of primaries per panicle, stover yield per plant, days to maturity, days to fifty per cent flowering and plant height, whereas grain yield per plant had negative and significant correlation with panicle length. Thus selection for above characters can increase the grain yield in sorghum as the characters highly correlated with grain yield per plant.

Path coefficient analysis revealed that panicle weight had the highest positive direct effect on grain yield per plant followed by harvest index, stover yield per plant and 1000-seed weight. Thus direct selection for more panicle weight, harvest index and 1000-seed weight can increase the grain yield in sorghum genotypes.

It is concluded that the characters panicle weight, 1000-seed weight and harvest index show high variability, high heritability and high genetic advance and these characters also show positive and direct effect on grain yield per plant. So selecting the genotypes having high panicle weight, 1000-seed weight and harvest index is prerequisite for improving the grain yield in sorghum genotypes.
Author : PRAVEEN, K.

Title of the Thesis : GERMLASM CHARACTERIZATION AND DATABASE DEVELOPMENT IN SUGARCANE (Saccharum spp.)

Major Advisor : Dr. M. HEMANTH KUMAR

Degree : M. Sc. (Ag.)
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D9640

ABSTRACT

The present investigation was carried out to characterize 131 genotypes including 127 germplasm lines and four checks of sugarcane using 27 characters furnished by PPV & FRA, Government of India for Distinctiveness, Uniformity and Stability (DUS) testing and 18 agronomic and quality characters at Agricultural Research Station, Perumallapalle. The 27 DUS descriptors were plant growth habit, leaf sheath hairiness, shape of ligule, shape of inner auricle, colour of dewlap, leaf blade curvature, leaf blade width, adherence of leaf sheath, internode colour (unexposed to sun), internode colour (exposed to sun), internode diameter, internode shape, internode zig zag alignment, internode growth crack (split), internode rind surface appearance, internode waxiness, shape of bud, size of bud (measured from base to tip of bud), bud groove, bud cushion, bud tip in relation to growth ring, prominence of growth ring (node swelling), width of root band (opposite to bud), internode cross-section, internode pithiness, number of millable canes per stool and cane height.

The agronomic and quality characters used were leaf sheath waxiness, leaf length, root zone colour (exposed), root zone colour (unexposed), number of root eyes, arrangement of root eye, growth ring colour, bud germ pore position, single cane weight (kg), percentage of flowering, sucrose %, brix %, CCS %, purity %, fibre %, CCS yield ha-1, cane yield ha-1 and juice extraction %. An exercise was made to group the 131 germplasm accessions for the most important morphological and agronomic characters. A large number of accessions were identified for each group of important characters. They may be utilized for direct commercial cultivation or may be used as parents in hybridization programmes for improvement of a combination of characters.

The genotypes 2003T129, 2005T16, 2005T50, 86V96, 2003T123, 95V74, 2006T36 and 2006T3 were found to possess all the characters that are considered for promotion of varieties for improving cane and CCS production. It was observed that the genotypes 85R186, 97R383, BO91, 93R113, 97R7, 83V288, 97R424, 2000A213, 2002V2, 94A73 and 2005T89 possess all the desirable characters that are suitable for cogeneration, pulp and paper making and can be considered as high biomass types useful for that purpose. The genotypes, 2006T3, 2005T50, 93A145, 97R272, Co1148, 87A298, 2005T52 and 2004T68 could be considered for production of ethanol as they possess all the characters contributing to high ethanol production.

Sugarcane Germplasm Database (SGDB) was developed for 45 descriptors on 131 germplasm accessions using MySQL 5.6 server, Dreamweaver web design tool, JAVA programming language and Apache Tomcat server. Selection of parents for improving two or more characters through hybridization can easily be made by using
search engines. The database can be used as a platform for the four sugarcane research stations of ANGRAU (ARS, Permullapalle; RARS, Anakapalle; SRS, Vuyuru and RSRSS, Rudrur) to exchange, share and discuss sugarcane characterization, conservation, utilization and documentation.

GENETICS AND PLANT BREEDING
ABSTRACT

In the present investigation, fifty genotypes of rice were evaluated to study the genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the genotypes for yield and the extent of association between the yield and its component characters including the direct and indirect effects. The experiment was laid out in a randomized block design with three replications at Directorate of Rice Research Farm, ICRISAT Campus, Patancheru, Hyderabad, during Rabi 2013-14.

Analysis of variance indicated the existence of significant genotypic differences among the genotypes for the yield, its components for all the characters. High GCV and PCV values were observed for number of filled grains per panicle, number of unfilled grains per panicle, grain yield per plant. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of tillers per plant, number of productive tillers per plant, number of filled grains per panicle, number of unfilled grains per panicle, 1000-grain weight and grain yield per plant. which indicated that these traits were controlled by additive type of gene action. The remaining traits were mostly under the influence of non-additive gene effects as they recorded low to moderate estimates of genetic advance.

Based on the relative magnitude of $D^2$ values, the genotypes were grouped into ten clusters. Cluster I was the largest comprising of eighteen genotypes followed by cluster II with fifteen genotypes, cluster IV with ten genotypes and cluster III, V, VI, VII, VIII, IX, X with one genotype each. The highest divergence occurred between cluster VI and cluster VIII (387.67) followed by cluster VIII and cluster X (387.16), cluster III and cluster VIII (321.26), while it was low between cluster V and cluster VII (21.35).

Based on the inter cluster distances, a hybridization between the genotypes (IC-70855) of cluster VI and cluster VIII (IC-145639), cluster VIII (IC-145639) and cluster X (IC-86143), cluster III (IC-67935) with cluster V (IC-145633), is suggested to generate promising segregants for grain yield and would produce encouraging results. The data on character means for ten clusters indicated that, cluster VIII is having highest mean value
for days to fifty percent flowering, plant height, panicle length, days to maturity, cluster IX number of unfilled grains per panicle and cluster X for number of tillers per plant, number of productive tillers per plant, number of filled grains per panicle, 1000 grain weight and grain yield per plant.

The maximum genetic divergence was contributed by days to fifty percent flowering was highest towards genetic divergence (41.22%) followed by Number of filled grains per panicle (30.61%), number of unfilled grains/panicle (9.80%), days to maturity (6.04%), 1000 grain weight (4.65%), plant height (3.27%), grain yield per plant (2.29%), number of productive tillers per plant (1.22%), number of tillers per plant (0.82%) panicle length (0.08%). Three characters viz. days to fifty percent flowering, number of filled grains per panicle accounts for more than 70% towards genetic divergence. Hence, these two characters are very important for selection indices.

Character association studies revealed that the characters grain yield per plant showed significant positive association with number of productive tiller per plant, number of tillers per plant, plant height, number of filled grains per panicle, 1000 grain weight, panicle length, This indicated that simultaneous selection of all these characters was important for yield improvement. Path analysis revealed that the traits viz., number of filled grains per panicle, 1000 grain weight, numbers of productive tillers per plant, number of filled grains per panicle, days to maturity and number of productive tillers per plant and number of tillers per plant, plant height were directly influencing the grain yield per plant.

A critical analysis of correlation and direct and indirect effects indicated that emphasis should be directed towards selection of parents having higher number of productive tillers per plant coupled with higher number of filled grains per panicle, 1000 grain weight, plant height, longer panicle length. As the yield component filled grains per panicle is intern dependent on panicle length and plant height, attention should be paid towards increasing the panicle length, maintaining optimum plant height. Thus, a plant with medium height, sturdy culm with increased panicle length, higher number of filled grains per panicle and productive tillers per plant would be more desirable for selection to realize higher yield.

Morphological characterization through DUS descriptors revealed that Out of total sixty two characters studied, 11 were found to monomorphic and 16 characters were dimorphic and remaining characters are polymorphic. The total of thirty three morphological characters (polymorphic) were most useful for varietal identification in selected rice genotypes.
GENETICS AND PLANT BREEDING

Author : RAJESH KUMAR, S.

Title of the Thesis : GENETIC ANALYSIS OF LATE LEAFSPOT RESISTANCE, POD YIELD AND ITS ATTRIBUTES IN GROUNDNUT (Arachis hypogaea L.)

Major Advisor : Dr. M. REDDI SEKHAR

Degree : M. Sc. (Ag.)

College : S.V. AGRICULTURAL COLLEGE, TIRUPATI

Accession Number : D9639

ABSTRACT

An investigation was undertaken on eight parents and 15 F2 crosses of groundnut in Dry land farm of S.V. Agricultural College, Tirupati during kharif, 2012 so as to identify the best cross combinations with high pod yield potential coupled with resistance to late leafspot.

The per se performance revealed that the F2 cross TCGS-888 × ICG13919 recorded the highest pod yield per plant whereas TG-47 × ICG-15234 registered the highest kernel yield per plant. Similarly, the F2 cross TPT-4 × ICG13919 recorded maximum number of mature pods per plant while, TCGS-888 × GPBD-4 recorded the highest test weight. The cross TG47 × ICG15234 recorded high shelling per cent while TG47 × ICG15234 displayed superiority for high harvest index. The F2 crosses viz., TG47 × ICG13919, TG47 × ICG15234 and TG47 × GPBD-4 were emerged out as superior crosses for number of leaves affected at 90 DAS and LLS score at 90 DAS with low mean values for the testers.

The analysis of genetic parameters revealed high estimates of variability among the F2 crosses for number of primary branches per plant, number of secondary branches per plant, number of mature pods per plant, test weight, pod yield per plant, kernel yield per plant, number of leaves affected at 60 DAS and 90 DAS, Late leafspot score at 60
DAS and 90 DAS. High heritability coupled with high genetic advance were recorded for all yield contributing characters except days to 50 percent flowering, days to maturity and shelling percent. The role of additive gene action seems to be significant in the inheritance of these traits.

The F2 segregation had a good fit to phenotype ratio of 15:1 ratio of Susceptible : Resistance plants in all the crosses. The study revealed that resistance to LLS disease is governed by two to three duplicate recessive genes. The resistant testers employed in this study could be utilized in breeding programme for transfer of LLS resistance into the elite cultivars of groundnut.

The transgressive segregants were recovered in 7 F2 populations while the remaining 8 F2 populations could not yielded transgressive segregants for number of mature pods per plant, pod yield per plant, kernel yield per plant and LLS score at 90 DAS.

A perusal of character association in selected five F2 populations (TCGS-888 x ICG-13919, TCGS-913 x ICG-15234, TPT-4 x ICG-13919, TG-47 x ICG-15234 and TCGS-913 x GPBD-4) indicated highly significant positive association of days to 50 per cent flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, number of mature pods per plant, test weight, shelling per cent, harvest index and kernel yield per plant with pod yield per plant in all the five crosses.

Path coefficient analysis revealed that kernel yield per plant showed highest positive direct effect on pod yield in the cross TPT-4 x ICG-13919 and TG-47 x ICG-15234. Similarly, number of mature pods per plant showed high positive direct effect on pod yield in the crosses TCGS-888 x ICG-13919, TCGS-913 x GPBD-4 and TCGS-913 x ICG-15234. Hence, due emphasis should be given on kernel yield per plant, number of mature pods per plant and harvest index in selection procedures for evolving superior genotypes with high pod yield in five F2 populations.
GENETICS AND PLANT BREEDING

Author : RAJITHA ATHOTA

Title of the Thesis : COMBINING ABILITY AND GENE ACTION IN MAIZE (Zea mays L.)

Major Advisor : Dr. D. RATNA BABU

Degree : M. Sc. (Ag.)

College : AGRICULTURAL COLLEGE, BAPATLA

Accession Number : D9599

ABSTRACT

The present investigation was carried out during kharif 2012 at Agricultural College Farm, Bapatla to study the variability, heritability, expected genetic advance, combining ability, heterosis, character association and path coefficient analysis involving eight parents (five lines, three testers), 15 F1s along with check in maize for characters viz., days to 50% tasseling, days to 50% silking, days to maturity, plant height (cm), cob length (cm), kernel rows per cob, 100-seed weight (g), grain protein content (%) and grain yield per plant (g).
Analysis of variance revealed significant differences among the genotypes for all the characters studied, indicating a high degree of variability in the material. The estimates of heritability and genetic advance as per cent of mean were high for the characters viz., 100-seed weight, grain yield per plant, cob length and plant height. High heritability coupled with moderate genetic advance as per cent of mean was observed for grain protein content and kernel rows per cob. High heritability coupled with low genetic advance as per cent of mean was observed for days to 50% tasseling and days to 50% silking. While low heritability coupled with low genetic advance as per cent of mean was observed for days to maturity.

The analysis of variance for combining ability revealed that lines, crosses and Line x Tester effects had significant amount of variability with in each of them for majority of the traits studied. The per cent contribution towards the total variance was maximum due to the interaction of lines and testers for the traits, grain yield per plant, 100-seed weight, days to 50% silking, grain protein content, days to 50% tasseling and days to maturity while contribution of lines alone was maximum towards the total variance for cob length, kernel rows per cob and plant height.

Out of the five lines tested in the present investigation, BM-421 and BM-256 recorded significant general combining ability effects in desirable direction for four (days to 50% tasseling, plant height, cob length and grain protein content) and three (days to 50% silking, kernel rows per cob and grain yield per plant) characters, respectively. While the tester, BM-143 recorded significant general combining effect for grain protein content. None of the 15 Line x Tester combinations recorded significant SCA effect for grain yield per plant. The cross BM-77 x BM-85 recorded significant SCA effect for plant height and grain protein content. While the crosses BM-3 x RNBL-4351 and BM-421 x BM-85 showed for 100-seed weight. The GCA effects of parents and SCA effects of their hybrid combinations indicated that the crosses with high SCA effects have resulted due to high x low, low x low and high x high GCA combinations. Therefore, one can afford to include some low general combiners also along with good general combiners in hybridization programmes.

Further, heterosis studies in general revealed that all the Line x Tester combinations registered significant positive heterosis over both mid and better parents for grain yield per plant. Out of the fifteen cross combinations, BM-256 x BM-85, BM-256 x BM-143, BM-3 x RNBL-4351, BM-421 x BM-85 recorded highest significant relative heterosis and heterobeltiosis for grain yield. Though the per se performance of the parents are relatively low, the above combinations are heterotic indicating better nicking ability of the lines and testers involved. Majority of lines and testers which yielded heterotic hybrids registered good general combining abilities as well. With this it is evident that lines with good GCA though having less per se may also yield heterotic combinations. This shows the importance of studying the combining ability effects of different lines to be used either in heterosis breeding or in combination and transgressive breeding.
The estimates of $sca$ and $gca$ variance also revealed the predominance of nonadditive gene action in the inheritance of days to 50% tasseling, days to 50% silking, 100-seed weight, grain protein content and grain yield per plant while both additive and non-additive gene actions were predominant for days to maturity and kernel rows per cob whereas additive gene action was predominant for cob length. These gene actions were further confirmed by the ratios of $gca$ variance to total genetic variance and the estimates of narrow sense heritability.

Genotypic correlations in general are higher than phenotypic correlations indicating that the apparent associations are largely due to genetic reasons. The traits cob length, 100-seed weight, kernel rows per cob, plant height and days to 50% tasseling were found to possess significant association in desirable direction with grain yield per plant at both genotypic and phenotypic levels. While path analysis studies revealed that cob length, 100-seed weight and kernel rows per cob showed true relationship by establishing significant positive association and high positive direct effect on grain yield per plant. From this it can be inferred that simultaneous improvement in grain yield per plant is possible through manifestation of cob length, 100-seed weight and kernel rows per cob.

GENETICS AND PLANT BREEDING

Author : RAJESH, K.
Title of the Thesis : GENETIC DIVERGENCE ANALYSIS IN PEARL MILLET GENOTYPES [Pennisetum glaucum (L.) R.Br.]
Major Advisor : Dr. T.DAYAKAR REDDY
Degree : M. Sc. (Ag.)
ABSTRACT

In the present investigation, fifty genotypes of bajra were evaluated to study the genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the genotypes for yield, and the extent of association between the yield and its component characters including direct and indirect effects. The experiment was laid out in a randomized block design with three replications at Regional Agricultural Research Station, Palem farm, Mahabubnagar during Kharif 2013.

Analysis of variance indicated the existence of significant genotypic differences among the genotypes for the yield and its component characters. The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the effect of the environment. Moderate GCV and PCV values were observed for plant height, panicle diameter, panicle length, productive tillers, 1000 grain weight, and fodder yield per plot. The values of genotypic and phenotypic coefficients of variation were low for days to 50% flowering, days to maturity. The other characters grain yield per plant and grain yield per plot exhibited moderate GCV high PCV. High heritability coupled with high genetic advance as percent of mean was observed for plant height, panicle diameter, panicle length, productive tillers, 1000-grain weight, grain yield per plant, grain yield per plot and fodder yield per plot indicating additive type of gene action in the inheritance of these characters and hence these characters could be improved through simple phenotype selection. The High estimates of heritability coupled with low genetic advance as percent of mean as well as moderate genetic advance as per cent of mean was observed for days to maturity and days to 50% flowering respectively indicated the presence of non-additive gene action.

The association of different traits indicated significant positive association for grain yield per plant with days to 50% flowering, days to maturity, plant height, productive tillers per plant, panicle length, panicle diameter, 1000-grain weight, grain yield per plot, fodder yield per plot and possibility of simultaneous improvement of these characters along with grain yield.

The path analysis indicated that selection for panicle diameter, days to 50% flowering, 1000-grain weight, productive tillers per plant, panicle length, plant height would directly increase grain yield.

Based on the D2 results, the genotypes showed considerable amount of genetic diversity and the genotypes were grouped into ten clusters. The grouping of genotypes into clusters was at random indicating that geographical isolation might not be the only factor causing genetic diversity. Out of ten characters studied, days to 50% flowering contributed maximum (28.08%) towards divergence followed 1000-grain weight (27.43%), panicle diameter (15.43%), productive tillers per plant (13.31%), plant height (8.33%) and panicle length (4.65%).
Based on D2 values, crosses are proposed between the genotypes of clusters 15467 of cluster IX and 15156 of cluster X had high cluster distance for improvement of high productive tillers, 1000-grain weight, early flowering and early maturity, and between 15156 of cluster X, cluster I (957, 15004, 1655, 15181, 1210, 1457 and 1023) for improvement of early flowering, productive tillers, panicle diameter and 1000-grain weight which ultimately results in high yield.

GENETICS AND PLANT BREEDING

Author : RAKESH ALLE
Title of the Thesis : HETEROESIS AND COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD CONTRIBUTING
CHARACTERS IN HORSEGRAM (*Macrotyloma uniflorum* [Lam.] Verdc.)

Major Advisor: Dr. V. HEMALATHA

Degree: M. Sc. (Ag.)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D9516

ABSTRACT

The present investigation “Heterosis and combining ability analysis for yield and yield contributing characters in horsegram (*Macrotyloma uniflorum* [Lam.] Verdc.), had been undertaken to carry out combining ability analysis, to estimate heterosis, to understand the nature of gene action, correlation and path analysis of yield and yield contributing characters. The experimental material for the present investigation comprised of twenty seven F1 crosses, their twelve parents and one check. The material was obtained from Regional Agricultural Research Station, Palem, ANGRAU. This material was evaluated during late kharif 2013. Each entry was sown in two rows of 5 m length with a uniform spacing of 45 x 15 cm in a Randomized Block Design (RBD), replicated thrice at College Farm, College of Agriculture, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad. The data was collected on days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, 100 seed weight (g) and seed yield per plant (g).

The characters studied. The study of analysis of variance for combining ability revealed the predominance of non-additive gene action for all the traits favouring the exploitation of heterosis breeding. High general combining ability effects for grain yield per plant and other yield component characters were noticed in the lines HGP-67, HGP-40 and HGP-44 and testers Palem-2 and AK-42. These parents had resulted in production of superior single crosses HGP-40 x AK-42, HGP-67 x Palem-2, HGP-44 x Palem-2 and HGP-80 x AK-42 for seed yield per plant. Hence, these crosses had potential application in the crop improvement programmes.

Estimates of heterosis, heterobeltiosis and standard heterosis were variable among crosses in desirable direction and some of them turned out to be best specific crosses.

The cross combinations HGP-67 x Palem-2, HGP-40 x AK-42, HGP-67 x AK-42, HGP-44 x Palem-2 and HGP-80 x AK-42 were top five crosses based on mean *per se* performance, *sca* effects and heterosis and these crosses had high seed yield and yield contributing characters.
Character association among yield and yield contributing characters revealed the positive association of seed yield per plant with 100 seed weight, number of pods per plant, number of clusters per plant, number of primary branches, number of pods per cluster, pod length, number of seeds per pod, plant height and days to 50 per cent flowering and negatively correlated with days to maturity. Path coefficient analysis had shown direct positive relationship of 100 seed weight, plant height, number of pods per plant and days to 50 per cent flowering with seed yield per plant.

The top five superior cross combinations identified in the present investigation HGP-67 x Palem-2, HGP-40 x AK-42, HGP-67 x AK-42, HGP-44 x Palem-2 and HGP-80 x AK-42 based on per se performance, heterosis and combining ability for seed yield and yield contributing characters. These crosses may be further tested before releasing as commercial hybrids.
The present investigation was undertaken in Pearl millet (Pennisetum glaucum L.) to study genetic variability, genetic divergence, character association and path analysis of drought tolerance and yield attributes. The experimental material consisted of fifteen ‘B’ lines and sixty one ‘R’ lines which were evaluated at Agricultural Research Station, Perumallapalle, Tirupati during kharif, 2012 under rainfed conditions. The entries were evaluated for different morpho-physiological characters related to drought tolerance along with yield and yield components.

Analysis of variance revealed the existence of significant differences among the genotypes for all the twenty four traits studied. The per se performance of genotypes indicated that 126 R and 162 R among ‘R’ lines while 12 B among ‘B’ lines recorded superiority for most of the traits. Hence, these lines could be recommended for commercial exploitation of novel recombinants.

From the studies of Temperature Induction Response (TIR) technique, out of 76 genotypes studied, four entries viz., 52 R, 150 R, 163 R, 164 R, 10 B and 15 B showed the highest thermotolerance in terms of 100 per cent seedlings survival and no reduction in root and shoot growth.

The estimates of GCV and PCV were high for root weight, green fodder yield per plant, root volume, dry fodder yield per plant, grain yield per plant, ear bearing tillers per hill, green fodder yield per plot, dry fodder yield per plot, grain yield per plot, relative injury, leaf area duration, number of grains per ear head, ear head length and plant height indicating the presence of genetic variability and less influence of environment on these traits. Thus, direct selection for these traits would result in further improvement of yield under rainfed condition. Moderate estimates of GCV and PCV were recorded for test
weight, harvest index, ear head girth and root spread. Hence, direct selection for these traits may be misleading if adopted for improvement programme through these traits.

The results of Mahalanobis’s D2 analysis revealed considerable variability among the 76 genotypes and were grouped into 12 clusters. Among twelve clusters formed, cluster I contained maximum number of 38 genotypes whereas Clusters, IV, VI, VII, VIII, IX, X, XI and XII comprised of only one genotype in each cluster. The inter-cluster distance was maximum between cluster VI (65 R) and XI (80 R) followed by between cluster XI (80 R) and XII (1 B). Selection of parents from such clusters for hybridization programmes would result in novel recombinants. Among twenty four characters, relative injury contributed maximum followed by SCMR, dry fodder yield per plot, root weight, root volume, leaf area duration, ear bearing tillers per hill and dry fodder yield per plant in decreasing order of contribution towards genetic divergence.

Correlation analysis revealed that among the yield components, viz., dry fodder yield, green fodder yield per plant and grain yield per plot while among physiological traits, root volume, root weight and leaf area duration exhibited highly significant positive association with grain yield per plant. Significant positive inter-se associations were observed among yield components viz., dry fodder yield per plant, green fodder yield per plot and green fodder yield per plant while among physiological traits, root volume, root weight, LAD, CSI, root spread, SCMR and RI as well as with grain yield per plant. Hence, these traits should be considered in formulating selection procedures for the improvement of elite genotypes for grain yield in pearl millet.

Path coefficient analysis revealed that among the yield components, test weight followed by dry fodder yield per plant, number of grains/ear head, ear bearing tillers per hill and green fodder yield per plant whereas among the physiological traits, root weight followed by harvest index, relative injury and root volume exerted high positive direct effects on grain yield. Therefore, the above traits could be considered as the major yield contributing characters in pearl millet and emphasis should be made on these traits in the selection programme to evolve high yielding genotypes in pearl millet.
GENETICS AND PLANT BREEDING

Author : SANDEEP, V.
Title of the Thesis : STUDIES ON GENETIC DIVERSITY IN INDIAN COWPEA (Vigna unguiculata (L.) Walp) GERMPLASM
Major Advisor : Dr. V. HEMALATHA
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9507

ABSTRACT

In the present investigation, fifty genotypes of cowpea collected from Karnataka, Kerala, UttarPradesh, Haryana, Rajasthan, Maharashtra, Gujarat and Tamil Nadu were evaluated to study the genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the genotypes for yield, and the extent of association between the yield and its component characters including direct and indirect effects. The experiment was laid out in a randomized block design with two replications at Regional Agricultural Research Station, Palem, Mahaboobnagar during kharif 2013.

Analysis of variance indicated the existence of significant genotypic differences among the genotypes for the yield and its component characters. The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the effect of the environment. High GCV and PCV values were observed for number of primary branches per plant, harvest index and moderate GCV and PCV values were observed for number of secondary branches, number of clusters, number of seeds per pod, seed yield, biological yield, while low GCV and PCV values were observed for days to 50 % flowering. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of primary branches, number of secondary branches, number of clusters, number of pods, number of seed per pod, 100-seed weight, seed yield per plant, biological yield
and harvest index indicating the role of additive genes in the inheritance of these traits and hence these characters could be improved through phenotype selection.

The association of different traits indicated significant positive association of number of primary branches, number of secondary branches, number of clusters, number of pods, number of seed per pod, 100-seed weight, biological yield and harvest index with seed yield and possibility of simultaneous improvement of these characters along with seed yield.

The path analysis indicated that selection for plant height, number of seeds per pod, pod length and biological yield per plant would directly increase seed yield because of their direct effects.

Based on the relative magnitude of D2 results, the genotypes showed considerable amount of genetic diversity and the genotypes were grouped into twelve clusters. The grouping of genotypes into clusters was at random indicating that geographical isolation might not be the only factor causing genetic diversity. Out of twelve characters studied, days to 50% flowering contributed maximum (25.22%) towards divergence followed by plant height (12.24%) and biological yield per plant (10.78%) in D2 analysis.

Study of clusters means for each of twelve characters revealed that cluster VI had high mean value for 100 seed weight (21.84), cluster VIII had high mean value for seed yield (49.64) and biological yield (206.24), cluster X had high mean value for pod length (28.70), number of seeds per pod (24.80) and low mean value for days to 50% flowering (40.50) and the cluster XII had high mean value for number of primary branches (5.30), number of secondary branches (15.70), number of clusters per plant (14.20), number of pods per plant (27.90), harvest index (43.67).

Based on D2 values, out of twelve clusters, cluster I was largest comprising of thirty genotypes followed by Cluster II with eight genotypes, cluster IV with three genotypes, and cluster III, V, VI, VII and VIII, IX, X, XI, XII were represented each by single genotype indicating high degree of heterogeneity among the genotypes. Maximum intra cluster distance was observed in cluster IV (38.06), followed by cluster II (37.08) and cluster I (32.49), indicating that some divergence still existed among the genotypes. Promising genotypes included in cluster IV that had maximum intra cluster distance are GC-3(1), Kanakamuni and IT-38956 which were highly divergent among themselves.

Genotypes VCP-09, KBC-5, ACM-27 and DC-15 are having higher mean values for different traits so, these genotypes can be exploited in breeding programme. Based on the pest reaction the genotypes ACM-37, ACM-38, Surabhi, CO-2 and Kanakamuni are showing resistance against Maruca testulalis. (Shivalingaswami and Balasubramanian 1992).
GENETICS AND PLANT BREEDING

Author : SILUVERU SANDEE
Title of the Thesis : GENETIC DIVERGENCE STUDIES IN MAIZE (Zea mays L.)
Major Advisor : Dr. M. BHARATHI
Degree : M. Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9558

ABSTRACT

In the present investigation, sixty inbreds of maize were evaluated to study the genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the genotypes for yield and the extent of association between the yield and its component characters including direct and indirect effects.

The experiment was laid out in a randomized block design with three replications at College Farm, College of Agriculture, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad during Kharif 2013. The data was recorded on days to 50% tasseling, days to 50% silking, days to maturity, plant height, ear height, ear length, ear
girth, number of kernel rows per ear, number of kernels per row, 100 seed weight, grain yield per plant and shelling percentage.

The Analysis of variance indicated the existence of significant differences among the genotypes for all the twelve characters studied. The genotypic coefficients of variation (GCV) for all the characters studied were lesser than the phenotypic coefficients of variation (PCV) indicating the effect of the environment. High GCV and PCV values were observed for grain yield per plant and ear height. The difference between the estimates of PCV and GCV were low for all the characters except shelling percentage thereby lesser role played by the environment in the expression of this character. The difference between the estimates of PCV and GCV was high for shelling percentage indicating the significant role played by the environment in the expression of these characters. High heritability coupled with high genetic advance as per cent of mean was observed for grain yield per plant, ear height, plant height, number of kernels per row, 100 seed weight and ear length indicating the role of additive genes in governing the inheritance of these traits which could be improved through simple selection.

Correlation studies revealed significant positive association of grain yield per plant with plant height, ear height, ear length, number of kernels per row, ear girth, 100 seed weight, and shelling percentage. Therefore these characters could be used as criteria for selection of genotypes with high grain yield. Path analysis at genotypic level, revealed that ear girth contributed maximum direct effect on grain yield per plant followed by days to 50% silking, ear height, shelling percentage, plant height, number of kernels per row, ear length, 100 seed weight, days to maturity, number of kernel rows per ear and days to 50% tasseling. Highest indirect effects of ear length, number of kernel rows per ear, ear height, plant height, number of kernels per row and 100 seed weight were showed on grain yield via ear girth.

Critical analysis of character association and path analysis connoted that the characters plant height, ear girth, ear height, ear length, number of kernels per row and 100 seed weight should be given importance to isolate superior lines with genetic potentiality for high grain yield.

Based on the relative magnitude of D2 analysis results and principal component analysis, the genotypes showed considerable amount of genetic diversity and the genotypes grouped into eight clusters in principal component analysis and nine clusters in D2 analysis. The grouping of genotypes into clusters was at random indicating that geographical isolation might not be the only factor causing genetic diversity. Out of the 12 characters studied, plant height (40.96%), grain yield per plant (18.19%), and days to 50% tasseling (13.27%) in D2 analysis and principal component analysis identified three principal components, which contributed 82.41% of cumulative variance.

The overall results of the study shows that crossing using the genotypes 3549 B-2-3-1, 3521 A-2-3-1, 1013, 1669-1, BH 4065-2-1, 1728-1-2, COMMANDO-3-3, BML 2, (BML 8 x CM 131)-2-3 and CM 118-1 from cluster III, CM 121 from cluster IV, CM 209 from cluster V and 5063 from cluster IX and making selections based on plant height
ear, height, ear length, 100 seed weight and days to maturity in the segregating generations would help in obtaining the genotypes with high grain yield.

Based on per se performance for grain yield and other important attributes it can be emphasized that the genotypes 1669-1, 3549 B-2-3-1, 3521 A-2-3-1, BH 4065-2-1 and Z-56-2-2 may be used in hybridization programmes after further evaluation.

GENETICS AND PLANT BREEDING

Author : SANTHOSH KUMAR NAIK, S.
Title of the Thesis : STUDIES ON GENETIC VARIABILITY FOR SEED YIELD AND TOLERANCE TO YELLOW MOSAIC VIRUS IN BLACKGRAM [Vigna mungo (L.) Hepper]
Major Advisor : Dr. N.V.NAIDU
Degree : M. Sc. (Ag.)
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D9637

ABSTRACT
The present investigation was carried out to study the genetic divergence, genetic parameters, character association and path coefficient analysis in forty four blackgram genotypes for twelve characters. The experiment was laid out in Randomized Block Design with two replications at the wet land farm, S.V. Agricultural College, Tirupati during kharif, 2012. The observations were recorded on twelve economically important characters.

Analysis of variance indicated the existence of significant genotypic differences for all the twelve characters. The genotypes namely LBG-772, WBG-26, PDBG-10, MASH-338, LBG-733, PU-31, PU-40, MASH-1-1, LBG-777, and IC-14691 exhibited high mean performance of seed yield and it’s components viz., clusters per plant, pods per plant, seeds per pod, pod length and resistance to yellow mosaic virus.

The D^2 analysis revealed the existence of considerable diversity among the genotypes of blackgram studied and were grouped into six clusters. The mode of distribution of genotypes from different eco-geographical regions into various clusters was at random indicating that geographical distribution and genetic diversity were not related to each other. The characters viz., days to 50% flowering, days to maturity, incidence of yellow mosaic virus and protein content contributed maximum towards genetic divergence. The maximum inter cluster D^2 value was recorded between cluster V and VI followed by cluster III and V. Hence, genotypes namely PDBG-10, MASH-338, MASH-1-1, LBG-772, IC-14691 from cluster III; LBG-767 and LBG-763 from cluster V and PU-1075, WBG-26, PU-31 and LBG-777 from cluster VI may be included in hybridization programme for obtaining superior and desirable recombinants.

A perusal of genetic parameters revealed that GCV, PCV, heritability (broad sense) and genetic advance as per cent of mean were high for incidence of yellow mosaic virus, seed yield per plant, number of pods per plant, plant height, protein content, number of clusters per plant and days to 50% flowering indicating that simple selection would be fruitful for the improvement of these traits.

A total of 44 genotypes of blackgram were screened against YMV disease to identify tolerant/resistant genotypes for YMV. In the present study 19 genotypes showed resistant (R) reaction. Eight genotypes showed moderately resistant reaction(MR). The remaining 17 genotypes showed susceptible reaction. Of them, nine are moderately susceptible (MS); five genotypes are susceptible (S) and three genotypes are highly susceptible (HS). Identification of resistant sources to YMV is a reliable option for controlling the viral disease. Hence, using the above resistant sources can be utilized in the breeding programme.

Association analysis revealed the significant and positive association of pods per plant and clusters per plant with seed yield per plant in blackgram. Seed yield per plant could be improved by increasing pods per plant and clusters per plant. Hence, direct selection based on these characters could be suggested for further improvement of seed yield. Path coefficient analysis revealed that pods per plant exerted maximum positive direct effect on seed yield per plant followed by pod length. Based on character association and path analysis pods per plant, clusters per plant and pod length may be
considered as the important yield contributing components as these traits exhibited highly significant and positive association with seed yield and also among themselves. Hence, simultaneous selection for these traits will be more rewarding to bring improvement in blackgram.
The present study was undertaken at ICRISAT-Patancheru to construct a skeleton genetic linkage map for a pearl millet mapping population of 295 RILs of cross, 81B-P13 and AIMP 92901-deriv-P03, to identify and map QTLs controlling downy mildew resistance (DMR) for new virulent downy mildew isolates from Gujarat, Rajasthan and Haryana.

Pearl millet downy mildew, caused by Sclerospora graminicola, is the most devastating disease of pearl millet causing huge grain and straw production losses in India. The allogamous and highly variable natures of both the host and pathogen are great hindrances to breeding for host plant resistance to this disease. Effective and economic control of this disease can be achieved by growing disease resistant varieties and hybrids. In order to develop disease resistant cultivars, it is important to have DMR QTLs mapped.

The available 20 pairs of mapping population parental lines were screened along with control entries 7042(S), 843B, 843-22B, ICMP 451 and IP 18292 against three isolates of DM pathogen population from Gujarat (Sg445), Haryana (Sg519) and Rajasthan (Sg526). 81B-P13 × AIMP 92901-S1-15-1-2-B-P03 RIL mapping population was selected for mapping of DMR QTLs on basis of high contrast for downy mildew resistance and susceptibility.

Mapping population of 295 RILs were used to isolate nuclear DNA that was genotyped for 80 polymorphic SSR, EST-SSR and STS marker loci. About 34% of polymorphic marker loci showed Mendelian segregation ratio of 1:1, while 66% of polymorphic marker loci showed segregation distortion.

A skeleton linkage map of seven linkage groups with a total map length of 536.8cM (Haldane units) was constructed using data from 39 marker loci for 295 RILs using MapMaker/Exp version 3.0b at LOD threshold value of 3.0 and map was drawn using Map Chart 2.2. Among all the linkage groups of the present study, linkage group 1 has the highest map length (146.6cM) followed by linkage group 2 (98.3cM). The linkage group 3 (6.6cM) has been recorded as the shortest among all seven linkage pearl millet groups in this study.

For QTL mapping, Composite interval mapping as implemented in QTL Cartographer version 2.5 at threshold likelihood ratio of 3.0 for declaration of QTL significance was employed. A total of four different major isolate specific resistant QTLs
were identified from three screens of the F7 RIL mapping population against pathogen populations from India. Two QTLs were identified on Linkage Group1 (LG1) against Sg445 and Sg526, one QTL on LG3 against Sg445 and another QTL on LG4 against Sg519. The inheritance of these QTLs showed AIMP 92901-deriv-P03 providing the resistance alleles. The highest LOD score for the QTL identified on LG4 was 41.0 with largest amount of observed phenotypic variation was contributed by the QTL on LG4 was 75.59.

At least one DMR QTL was detected and mapped for each of the three DM isolates. After validation, marker-assisted selection (MAS) can now be used for improving DMR of elite pearl millet hybrid parental lines using polymorphic flanking markers from donor parent AIMP 92901-deriv-P03.
GENETICS AND PLANT BREEDING

Author:
SHAIK JAVED AHMED

Title of the Thesis:
STUDIES ON STABILITY ANALYSIS OF RICE (Oryza sativa L.)

Major Advisor:
Dr. B. NARENDRA

Degree:
M. Sc. (Ag.)

College:
AGRICULTURAL COLLEGE, MAHANANDI

Accession Number:
D9476

ABSTRACT

The present investigation was carried out during Kharif 2011-12 with three dates of sowing at an interval of 30 days viz., first date of sowing i.e., June sowing, second date of sowing i.e., July sowing and third date of sowing i.e., August sowing. These three experiments were conducted at Agricultural College Farm, Mahanandi campus of Acharya N. G. Ranga Agricultural University in Randomized Block Design with three replications with an objective to study the variability and genetic parameters, stability analysis, character association, path co-efficient analysis and reaction of blast disease among 21 diverse genotypes of rice (Oryza sativa L.) for thirteen yield and yield components.

Analysis of variance indicated significant differences among the genotypes for all the traits in each of date of sowing as well as over the date of sowings. The genotypes viz., NLR 40024, RNR 2354 and NLR 145 under early sowing; WGL 32100, BPT 2231 and MTU 1010 for normal date of sowing, BPT 5204, NLR 40024 and JGL 3844 for late sowing; could be utilized in the breeding programme for yield improvement possessing all the desired per se performance for yield and yield components viz., number of productive tillers, panicle length, number of grains per panicle and test weight.

The estimates on genetic parameters revealed that the high GCV coupled with high heritability and high genetic advance were observed for number of ill filled grains per panicle, number filled grains per panicle, number of grains per panicle, number of productive tillers per plant and test weight in early sowing; number of ill filled grains per panicle and test weight in normal sowing; number of ill filled grains per panicle, number filled grains per panicle and number of grains per panicle in late sowing indicates the preponderance of additive gene action and such characters could be improved through selection in respective environments.
High heritability estimates was observed for all characters over three environments indicating less influence of environment. Both additive and nonadditive gene effects were implied for grain yield per plant among genotypes under experimentation. Hence, intermating of elite genotypes followed by selection may be rewarding for genetic enhancement of grain yield and its components with the present experimental material.

Stability analysis by Eberhart and Russell model (1966) revealed Genotype x Environment interactions for all the characters was significant implying differential response of genotypes under three environments for all characters. The linear component of genotype x environment interaction was highly significant than non linear component of genotype x environment interaction for most of the characters studied indicating the significant difference among the genotypes for linear response to environments behaviour of the genotypes could be predicted over environments more precisely.

Based on stability parameters, JGL 3855 expressed average stability suitable to all environments for grain yield per plant, NLR 40024 and JGL 3844 considered as high responsive genotypes specifically suitable to early and late sowings; WGL 32100 and MTU 1001 were considered as low responsive genotypes and are proposed specifically for normal sowing for grain yield per plant.

The genotypes JGL 3855, NDLR 7, NDLR 8 and RNR 2354 were considered as stable performer for most of the characters and can be recommended to any sowings because of their average performance. The genotypes NLR 40024, JGL 3844, JGL 3855, RNR 2354, JGL 11470 and MTU 1010 found as high responsive for most of the characters and can be recommended to early date of sowing because of their high performance. The genotypes MTU 1001, WGL 32100, WGL 23985 and NLR 145 found to be low responsive and can be recommended to delayed sowings because of their low performance.

Based on correlation studies, number of productive tillers per plant, total number of tillers per plant and harvest index was significantly correlated to yield per plant for all the three dates of sowing. Hence for Rice improvement programme, major thrust should be given on these traits in the respective environments.

On contrary, number of ill filled grains per panicle in early sowing, plant height, panicle length and number of grains per panicle in late sowing exhibited significant correlation with grain yield per plant. Therefore, simultaneous selection or in opposite direction may be done for these characters to have yield improvement in rice for respective conditions.

Path coefficient analysis revealed that positive direct effect on grain yield per plant was noticed for number of grains per panicle, harvest index, panicle length, number of productive tillers per plant and days to 50% flowering for all the environments.
Regarding reaction of blast disease, most of the genotypes had resistant reaction to blast except BPT 5204, which exhibited susceptible reaction in all environments.

Finally, number of productive tillers per plant, total number of tillers per plant and harvest index show high variability, high heritability and high genetic advance, as well as significantly positive correlation with grain yield per plant and positive and direct effect on grain yield per plant. So selecting such genotypes having these characters with high magnitude is prerequisite for improving the grain yield per plant in rice.
seed longevity. These genotypes are also having moderate to high total biomass per plant, harvest index, number of pods per plant and 100 seed weight.

The genotypic coefficients of variation for all characters studied were lesser than phenotypic coefficients of variation indicating the masking effects of the environment.

High PCV coupled with high GCV, observed for number of branches per plant, number of pod per plant, total biomass per plant (g) and seed yield per plant (g) indicating the presence of wider variability for these traits in the genotypes studied.

High heritability coupled with high genetic advance as percent of mean was observed for plant height (cm), branches per plant, number of pod per plant, number of seeds per pod, 100 seed weight (g), harvest index, total biomass per plant (g) and seed yield per plant (g) indicating the operation of additive gene action in the inheritance of these traits and improvement in these characters is possible through simple selection.

The results of multivariate analysis indicated the presence of considerable genetic divergence among the 60 genotypes studied. Out of 12 characters studied total biomass per plant followed by pods per plant and 100 seed weight contributed maximum towards divergence. The 60 soybean genotypes were grouped into 10 clusters with 37 genotypes in cluster I followed by 8 genotypes in cluster VI, 5 genotypes in cluster IV, 4 genotypes in cluster VIII and one genotype each in clusters II, III, V, VII, IX and X. Clustering pattern of genotypes did not follow geographical origin, suggesting that geographical isolation may not be the only factor causing genetic diversity. Based upon the divergence studies, crosses may be made between the genotype of clusters II, VI, and IX with the genotypes of clusters X which may lead to broad spectrum of favourable genetic variability for seed yield improvement in soybean and crosses may be made between clusters II, VI and IX with genotypes of cluster VIII. These crosses may give good segregants with high seed yield, better germination percentage and higher seed longevity.

The studies on association analysis and path analysis revealed that total biomass per plant, harvest index, pods per plant and seeds per pod are the characters having significant positive correlation and high positive direct effect on seed yield. Hence selection on these characters could bring improvement in seed yield of soybean crop.

The seed longevity studies indicated that the crossing between the genotypes with high germination percentage and germination percentage after accelerated ageing test (IC 1005, MAUS 558, AMS 9701, HIS-01, PI 60269, NRC 55 and AGS 185) and genotypes with high seed yield per plant (LSb18, TG x 814-14-B) and M-928) could results in superior segregant combinations for high seed yield and high seed longevity.

The present study revealed that major emphasis should be laid on selection for more biological yield per plant (g) coupled with more number of pods per plant, 100 high seed weight and harvest index (%) for realizing higher seed yield in soybean during rabi season.

Based on the present investigation results, it can be concluded that the genotypes with high seed yield and seed longevity should selected from different clusters and crossed so as
to improve seed yield and seed longevity. Hence crosses can be made between clusters VI (TG x 814-14 B), VIII (LSb 18, EC 242093, J-177 and EC 16213) and cluster VIII and IX with genotypes having high seed yield and seed longevity. Further selections should be done for high total biomass per plant, harvest index, number of pods per plant and number of seeds per pod in the segregating generations to improve seed yield and seed longevity in soybean.

GENETICS AND PLANT BREEDING

Author : SHANTHI PRIYA, M.
Title of the Thesis : BIOMETRICAL INVESTIGATIONS ON DIVERSIFIED USES IN SUGARCANE (SACCHARUM SPP.)
Major Advisor : DR. K. HARIPRASAD REDDY
Degree : Ph.D.
College : S.V. AGRICULTURAL COLLEGE, TIRUPATI
Accession Number : D9616

ABSTRACT

The present experiment entitled “Biometrical investigations on diversified uses in sugarcane (Saccharum spp.)” was carried out at Agricultural Research Station, Perumallapalle, Andhra Pradesh, from 2010 to 2012. Four hundred and twenty nine genotypes selected from seedling nursery based on phenotypic evaluation were planted in augmented block design. Seventy three genotypes selected from the first clonal stage
were evaluated for diversified uses viz., biomass per cane, fibre yield, theoretical yield of alcohol, commercial cane sugar (CCS) yield and cane yield in second clonal stage.

Considering the genetic parameters in second clonal stage, the characters viz., shoot population at 240 DAP, stalk length, number of millable canes, fibre content, brix, sucrose, CCS per cent, pol per cent cane, total sugars per cent, biomass per cane, fibre yield, CCS yield, theoretical yield of alcohol and cane yield showed high heritability coupled with high genetic advance as per cent of mean indicating that these characters were under the influence of additive gene effects and selection would be effective for the improvement of these characters.

Association studies and path analysis for diversified uses in second clonal stage revealed that single cane weight, fibre yield and number of millable canes at harvest were the major contributing characters to cane yield; cane yield and fibre content are the major contributing characters to fibre yield; selection based on stalk volume and single cane weight would be helpful for the improvement of biomass; total sugars per cent, pol per cent cane and CCS per cent were the major contributing characters to theoretical yield of alcohol; and the characters pol per cent cane, CCS per cent, cane yield, fibre yield, single cane weight and number of millable canes exhibited positive direct effects on CCS yield and the majority of the characters also exhibited high indirect positive effects on CCS yield via CCS per cent and pol per cent cane indicating that CCS percent and pol per cent cane are the major contributing characters to CCS yield in sugarcane.

The selection indices constructed with the inclusion of more than one character gave higher genetic advance and relative efficiency over straight selection for the five diversified uses viz., cane yield, biomass per cane, fibre yield, theoretical yield of alcohol and commercial cane sugar yield.

As sugar production scenario is changing, varietal needs have started changing. Based on the mean performance of the genotypes viz., 2010T-152 and 2010T-53 showing high performance for biomass, fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes viz., 2010T-146 and 2010T-84 showing higher performance for biomass, fibre yield, CCS yield and cane yield; the genotypes viz., 2010T-4, 2010T-103, 2010T-72 showing higher performance for fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes viz., 2010T-115, 2010T-387 and 2010T-285 showing higher performance for fibre yield, CCS yield and cane yield could be suggested for promotion as varieties for respective diversified uses.


On the basis of genetic divergence and mean performance of genotypes, the most promising cross combinations suggested for the development of varieties for diversified

GENETICS AND PLANT BREEDING

Author : SRIDHAR, M.

Title of the Thesis : HETEROSIS AND COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD COMPONENTS IN POPCORN (Zea mays var. everta Sturt.)

Major Advisor : Dr. K. MURALI KRISHNA

Degree : M. Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9557

ABSTRACT

The present investigation “Heterosis and combining ability analysis for yield and yield components in popcorn (Zea mays var. everta Sturt.)” had been undertaken to carry out the combining ability analysis and to estimate heterosis as well as to understand nature of gene action, correlation and path analysis of yield and yield contributing characters. Seven inbred lines crossed in Diallel mating design (method-II, model-I) during Rabi, 2012-13 at Maize Research Centre, Agriculture Research Institute, Rajendranagar, Hyderabad. The resulting 21 crosses along with parents and standard checks (Amber popcorn and BPCH-6) were evaluated in a Randomized Block Design replicated thrice, during Kharif, 2013 at Agricultural Research Station, Karimnagar, Andhra Pradesh. The data was collected on days to 50 per cent tasseling, days to 50 per cent silking, days to maturity, plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight, grain yield per plant and popping expansion ratio.

The analysis of variance revealed significant differences among the genotypes for all traits studied. Further, the study of analysis of variance for combining ability revealed the preponderance of non-additive gene action for all of the traits favoring the exploitation of heterosis breeding. In general, hybrids were tall, early and high yielding compared to the parents. The levels of heterosis were high in several crosses for grain yield per plant followed by ear length, ear girth, number of kernels per row, 100-kernel weight and number of kernel rows per ear.

High general combining ability effects for grain yield per plant were noticed in the inbred lines MRC PC-1, MRC PC-7 and MRC PC-5. These parents had resulted in the production of superior single crosses for grain yield per plant. Hence they had potential application in the crop improvement programmes for the development of hybrids and synthetics.

Estimates of heterosis, heterobeltiosis and standard heterosis were variable among crosses in desirable direction and some of them were turned out to be best specific crosses. The cross combinations MRC PC-1 x MRC PC-5, MRC PC-4 x MRC PC-7, MRC PC-1 x MRC PC-4 and MRC PC-3 x MRC PC-7 were found to be superior to both the checks for grain yield per plant and popping expansion ratio. These crosses also exhibited superior mean performances and significant positive Sca effects.

Character associations among grain yield per plant and yield contributing characters exhibited that plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight and popping expansion ratio had significant and positive correlations with grain yield.

Path coefficient analysis had shown that ear height, days to 50 per cent silking, number of kernels per row, number of kernel rows per ear and ear length had direct
positive effect, while days to 50 per cent tasseling, days to maturity, plant height, ear girth, 100-kernel weight and popping expansion ratio had direct negative relationship with grain yield per plant.

The hybrids MRC PC-4 x MRC PC-7, MRC PC-1 x MRC PC-4, MRC PC-3 x MRC PC-7 and MRC PC-1 x MRC PC-5 were found to be superior as they possessed higher per se, significant positive combining ability and standard heterosis for grain yield and most of the important yield contributing characters. These crosses may be advanced for isolation of homozygous inbred lines for use in breeding programmes or for the development of synthetics as in most of the crosses the parents involved are good general combiners or may be used as single cross hybrids after evaluation in multi location trails.

GENETICS AND PLANT BREEDING

Author : SRAVANTI, K.

Title of the Thesis : STUDIES ON COMBINING ABILITY AND HETEROSIS
FOR YIELD AND YIELD COMPONENTS THROUGH LINE X TESTER ANALYSIS IN MAIZE (Zea mays L.)

Major Advisor : Dr. I. SWARNALATHA DEVI

Degree : M. Sc. (Ag.).

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D9560

ABSTRACT

The present investigation had been undertaken in maize to carry out the combining ability analysis and to estimate heterosis as well as to understand nature of gene action, correlation and path analysis of yield and yield contributing characters. Nine inbred lines crossed with three testers in Line x Tester (L x T) design during Summer, 2012-13 and the resulting 27 crosses along with parents and standard checks DHM 117, 30V92 and 900M Gold were evaluated in a Randomized Block Design replicated thrice, during Kharif, 2013 at Seed Research and Technology Centre, Rajendranagar, Hyderabad. The data were collected on days to 50 per cent tasseling, days to 50 per cent silking, days to maturity, plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight, grain yield per plant and grain yield per plot.

The analysis of variance revealed significant differences among the genotypes for all traits studied. Further, the study of analysis of variance for combining ability revealed the preponderance of non-additive gene action for all of the traits favoring for the exploitation of heterosis breeding. In general, hybrids were tall, early and high yielding, compared to the parents. The levels of heterosis were high in several crosses for important traits like grain yield per plant followed by grain yield per plot, 100-kernel weight, ear height and ear length.

High general combining ability effects for grain yield per plant were noticed in the inbred lines BML 6, BML 7, CM 210 and testers Y52, Y18. These parents had resulted in the production of superior single crosses BML 6 x Y52, BML 7 x BML 11, CM 121 x Y18, CM 206 x BM 11 and CM 202 x Y18. Hence they had potential application in the crop improvement programmes for the development of hybrids and synthetics.

Estimates of heterosis, heterobeltiosis and standard heterosis were variable among crosses in desirable direction and some of them turned out to be best specific crosses. The cross combination BML 6 x Y52 for grain yield per plant was found to be superior to the checks DHM 117 (20.17 %), 30V92 (28.70 %) and 900M Gold (37.24 %).
Character associations among grain yield per plant and yield contributing characters exhibited that days to 50 per cent silking, plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight and grain yield per plot had significant and positive correlations with grain yield.

Path coefficient analysis had shown direct positive relationship of grain yield per plot, ear girth, number of kernels per row, days to maturity and ear height with grain yield. In the present investigation, plant height, number of kernel rows per ear, 100-kernel weight, ear length and days to 50 per cent tasseling exhibited direct negative relationship with grain yield per plant.

Apart from yield the other aspects considered for viability and large scale production of the improved hybrids were maturity of the hybrids, per se and synchronization of flowering of crosses in commercial seed production fields. The mean performance, heterosis and significant sca effects revealed the superiority of cross combination BML 6 x Y52 for grain yield and other important yield contributing characters. Keeping all aspects in view this cross may be further evaluated to consider for release and for further commercial cultivation.
Forty three genotypes of finger millet were studied during kharif 2012 at Agricultural College Farm, Bapatla to estimate genetic variability, heritability, character association, path coefficient analysis and to construct the best possible selection index for selection of superior genotypes.

Analysis of variance revealed significant differences among the 43 genotypes for all the eleven characters studied indicating a high degree of variability in the material. Phenotypic and genotypic coefficient of variation also indicated the presence of considerable amount of variability for majority of the characters studied.

The estimates of heritability and genetic advance as per cent of mean were high for the characters viz., seed calcium content, seed protein content, 1000-seed weight, finger length, productive tillers per plant, ear weight per plant and seed yield per plant. High heritability coupled with moderate genetic advance as per cent of mean was observed for days to 50% flowering and days to maturity. While moderate heritability coupled with moderate genetic advance as per cent of mean was observed for the characters viz., fingers per ear and plant height.

Genotypic correlations in general are higher than phenotypic correlations indicating that the apparent associations are largely due to genetic reasons. The traits, productive tillers per plant, fingers per ear, 1000-seed weight, finger length and ear weight per plant were found to possess significant positive association with seed yield per
plant at both genotypic and phenotypic levels. Further, path analysis revealed that productive tillers per plant, 1000-seed weight, fingers per ear and ear weight per plant also got high positive direct effect on seed yield per plant along with the strong significant positive association.

Considering the nature and magnitude of character associations and their direct and indirect effects, it can be inferred that productive tillers per plant, 1000-seed weight, fingers per ear and ear weight per plant could serve as important traits in any selection programme for selecting high yielding genotypes in finger millet.

Simultaneous selection taking all characters into consideration was carried out for all the forty three genotype of finger millet and found that IE-2884, Ratnagiri and Srichaitanya recorded higher selection index values in both the cases i.e., when the equal economic weights were assigned as well as when inverse of means are used as economic weights for calculation of selection index scores.

In the process of constructing the suitable selection index for selection of superior genotypes in finger millet, maximum estimates of genetic advance over seed yield per plant was obtained when all the eleven characters under study are included in the construction of selection index. Further, addition of characters one by one in the selection index constructs resulted in increasing trend of genetic advance values.

Restricted selection was carried out by restricting the selection for only ten out of eleven characters without affecting any change in the eleventh character. In all such eleven possible restriction selections the trait 1000-seed weight recorded highest estimate of genetic advance except when the same character is not considered for selection. This phenomenon was observed in both the cases i.e., when equal economic weights are used as well as when inverse of means are used as economic weights of the respective characters.

It can be concluded that the best possible construct of selection index for selection of superior genotypes in finger millet should include all the eleven characters which were considered for present investigation. Further, in the process of assigning economic weights to different traits for estimation of score or selection index values to different genotype as well as in estimation of genetic advance values of different characters it was found that both the ways of assigning the weights i.e., by taking equal economic weights as well as using inverse of means of respective characters as economic weights are equally effective and resulted in similar conclusions. Similar trend was found in the case of restricted selection as well.
GENETICS AND PLANT BREEDING

Author : SRUTHI, K.

Title of the Thesis : GENETICS AND MOLECULAR STUDIES OF STIGMA EXSERTION IN MAINTAINER LINES OF HYBRID RICE (Oryza sativa L.)

Major Advisor : Dr. K.B.ESWARI

Degree : M. Sc. (Ag.).

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D9514

ABSTRACT

In the present study, APMS-6B, a popularly used maintainer line with low stigma exsertion (14.95%) and BF-16B, another maintainer line with high stigma exsertion (80.25%) were selected as parents for hybridization. F₁ was developed by crossing low stigma exsertion parent and high stigma exsertion parent. F₁ was selfed to generate F₂. Four populations P₁ P₂ F₁ and F₂ were sown to perform phenotypic analysis for stigma exsertion. The observed data on phenotyping was subjected to χ² analysis to test their goodness of fit to appropriate mendelian ratios. F₁s were intermediate with 36.78 percent stigma exsertion rate. On phenotyping of 188 plants of F₂ population, the plants segregated into 75 low, 65 moderate and 48 high stigma exserted plants. Chi-square analysis showed that observed ratio was not confirmed the expected ratio of 1:2:1
and thus exerted stigma was appeared to be a quantitative trait. The frequency distribution of stigma exertion rate in the F₂ population showed a continuous variation and also signifying that stigma exertion trait controlled by polygenes.

Transgressive segregants were observed in F₂ population indicating that complementary action of the genes with additive effects that had been dispersed in the parents. The two parents were screened for parental polymorphism using 454 SSR markers, of which 118 markers exhibited polymorphism. Among these, three best polymorphic markers on each chromosome covering all 12 chromosomes were employed for selective genotyping.

One marker on each chromosome and two reported polymorphic markers used for genotyping the total 188 F₂ population. A co-segregation analysis with respect to marker (based on the amplification pattern of the marker) and trait phenotype revealed that three markers RM20060, RM5647 and RM4771 showed least recombination frequency and these three markers found to be linked to the stigma exertion trait.

GENETICS AND PLANT BREEDING

Author : SWAPNA KALAKURI
Title of the Thesis : CHARACTERIZATION AND GENETIC DIVERSITY STUDIES IN FARMERS’ VARIETIES OF RICE (Oryza sativa L.)
Major Advisor : Dr. FARZANA JABEEN
Degree : M. Sc. (Ag.).
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9493

ABSTRACT

In the present investigation, seventy five farmers’ varieties of rice were evaluated to study agro-morphological characterization, genetic diversity present in the experimental material for selection of the diverse parents, to estimate the genetic parameters among the varieties and the extent of association between the yield and yield contributing characters including the direct and indirect effects. The experiment was laid
out in a Randomized Block Design with three replications at Directorate of Rice Research Farm, ICRISAT campus, Patancheru, Hyderabad during Rabi, 2012.

Morphological characterization of varieties for twenty nine agro-morphological characters as per standard descriptors revealed that considerable variability for most of the morphological characters, indicating their utility in rice variety improvement programme.

Analysis of variance indicated the existence of significant genotypic differences among the varieties for all the characters. High PCV and GCV values were observed for number of filled grains per panicle followed by number of productive tillers per plant, grain yield per plant and total number of tillers per plant.

High heritability coupled with high genetic advance as per cent of mean was observed for time of heading, stem length, total number of tillers per plant, number of productive tillers per plant, panicle length, number of filled grains per panicle, 1000 grain weight, grain yield per plant and L/B ratio, which indicated that these traits were controlled by additive gene action. The remaining traits were mostly under the influence of non additive gene effects as they recorded low to moderate estimates of genetic advance.

Based on the relative magnitude of $D^2$ values, the varieties were grouped into eleven clusters. Cluster I was the largest one comprising of sixty four varieties followed by cluster IV with two varieties and cluster II, III, V, VI, VII, VIII, IX, X and XI with one variety each. The highest divergence occurred between cluster IX and cluster X (1101.06) followed by cluster II and cluster XI (996.88), cluster VII and cluster X (891.82) and cluster VI and cluster IX (880.00).

The data on character means for eleven clusters indicated that, cluster III with only one variety (Saria) exhibited highest cluster mean for the traits viz., grain yield per plant and decorticated grain width. Cluster IV with two varieties (Sitabhog and Sunakhadi) recorded highest mean value for total number of tillers per plant and number of productive tillers per plant. Cluster VIII possessed highest mean value time of heading and number of filled grains per panicle. Cluster VI with only one variety (Aganisali) exhibited highest cluster mean for the traits viz., stem length and panicle length.

The characters decorticated grain length (mm), time of heading, decorticated grain width (mm), L/B ratio, grain yield per plant and number of productive tillers per plant contributed maximum (90.17%) towards genetic divergence. Based on the inter cluster distances, crosses between the varieties (Kundo) of cluster IX and cluster X (Badkleshari), cluster II (Mahulata) and cluster XI (Govindabhoga), cluster VII (Kalajira) with cluster X (Badkleshari) and cluster VI (Aganisali) with cluster IX (Kundo), is suggested to generate promising segregants for grain yield. Divergence study through principal component analysis in the present study accounted for the total variance 91.17% by the first five vectors.
Character association studies revealed that the characters grain yield per plant showed significant positive association with number of filled grains per panicle, 1000 grain weight, number of productive tillers per plant, total number of tillers per plant, time of heading and decorticated grain length at both phenotypic and genotypic levels. This indicated that simultaneous selection of all these characters was important for yield improvement.

Critical analysis of the results by path analysis revealed that the traits number of filled grains per panicle, followed by L/B ratio, number of productive tillers per plant, decorticated grain width and 1000-grain weight were directly influencing the grain yield per plant. Hence, these traits were considered as important attributes in formulating selection criterion for achieving desired targets.
The present investigation was carried out during kharif, 2012-13 at wet land farm, Sri Venkateswara Agricultural College, Tirupati to study variability parameters, degree of association between yield and other yield and drought component traits and also to assess the direct and indirect contribution of each component character towards yield among the thirty one genotypes of mungbean. The data were collected on fifteen yield and physiological attributes. In addition to this, RAPD analysis was also carried out for twelve genotypes of mungbean (Vigna radiata (L.) Wilczek).

Analysis of variance indicated the existence of significant genotypic differences for all the traits under study. The genotypes IPM-02-19, RMG 492, WGG 2 and PM 110 showed high mean performance for yield. Similarly, the genotypes IPM-02-19, PUSA VISHAL, RMG 492 and LGG 528 showed better performance for the physiological parameters, SPAD chlorophyll meter reading and specific leaf area. The genotypes IPM-02-19 and RMG 492 performed well for both yield and drought tolerance traits.

The analysis of genetic parameters revealed higher GCV and PCV for the characters relative injury, seed yield per plant and number of pods per cluster. High heritability coupled with high genetic advance as per cent of mean was recorded for harvest index, number of seeds per pod, seed yield per plant, relative injury, chlorophyll stability index and specific leaf area. This shows that simple selection could be practiced for improving these traits.

Genetic diversity studies indicated the existence of significant diversity in thirty one mungbean genotypes and were grouped into seven clusters. The results revealed that the geographic diversity might not always be related to genetic diversity. The maximum contribution towards divergence was shown by seed yield per plant, harvest index, relative injury and chlorophyll stability index. In order to exploit transgressive segregants for better yield coupled with drought tolerance, the crosses between ASHA × TLM 7 (cluster IV × cluster VII), IPM-02-19 × COGG 974 (cluster III × cluster I) and TLM 7 × COGG 974 (cluster VII × cluster I) could be suggested.

Character association studies indicated the existence of significant and positive correlation of harvest index, days to maturity, SCMR, 100 seed weight, number of pods per plant, specific leaf area, number of seeds per pod and number of clusters per plant with seed yield per plant at both phenotypic and genotypic levels showing that increase in these traits would result in increase in the seed yield.

Path analysis revealed that harvest index, days to maturity, SCMR, number of pod per plant and number of seeds per pod and specific leaf area were the important
characters contributing to seed yield by exerting positive direct effects on it. Hence, these traits could be given due weightage during selection for improvement of seed yield and drought in mungbean.

The PEG studies revealed that the genotypes viz., ML 267, MH 565, MGG 350 and MGG 347 were found to be stress tolerant. Among these genotypes, ML 267 and MGG 347 showed better per se performance for yield and yield attributing traits. Hence these genotypes could be exploited for development of drought tolerance coupled with high yielding genotypes.

RAPD analysis detected a high level of genetic variation among the twelve mungbean genotypes. Based on diversity analysis using molecular markers hybridization may be initiated between the genotypes PUSA VISHAL (cluster II) × IPM-02-03 (cluster III), EC-396117 (cluster II) × IPM-02-03 (cluster III) and EC-396117 (cluster II) × MGG-295 (cluster III) in order to get transgressive segregants, since these genotypes showed maximum diversity among themselves besides high yield performance at phenotypic level.
The present investigation “Heterosis and combining ability studies for grain yield and its components in pearl millet [*Pennisetum glaucum* (L.) R.Br.]” had been undertaken to study combining ability and to estimate heterosis as well as to understand nature of gene action, correlation and path analysis of yield and its components. The material includes 4 lines were crossed with 10 testers in Line × Tester (L × T) mating design at regional agricultural research station during summer 2012-13. The parents (4 lines and 10 testers) and resultant 40 F1 crosses along with two checks evaluated at RARS, Palem during *kharif*, 2013 in Randomized Block Design with three replications. The data collected on days to 50 per cent flowering, days to maturity, plant height, productive tillers per plant, panicle length, panicle diameter, 1000 grain weight, grain yield per plant, grain yield per plot and fodder yield per plot.

The analysis of variance for combining ability revealed that genotypes exhibited highly significant differences among themselves for all the traits studied. The estimates of SCA variance were higher than GCA variance which depicts the ratio of GCA to SCA variances was less than unity. The ratio reveals the preponderance of non additive gene action which favours the exploitation of heterosis breeding.

High general combining ability effects for grain yield per plant was noticed in line 81A and testers 15156R, 15186R, 15501R and 15631R. These parents had resulted in the production of superior crosses 81A × 15631R, 98444A × 15156R and 88004A × 15156R. Hence general combining ability had significant importance in crop improvement programmes.

Based on the standard heterosis, four cross combinations 81A × 15631R, 98444A × 15156R, 88004A × 15156R and 88004A × 15050R were identified superior crosses over GHB-558 and PHB-3. These hybrids need further testing to know their stability before release as commercial hybrids.
The study of correlation among the yield components revealed positive association of grain yield per plant with plant height, productive tillers per plant, panicle length, panicle diameter, 1000 grain weight, grain yield per plot, fodder yield per plot and negatively correlated with days to 50 per cent flowering and days to maturity.

Based on the correlation and path analysis, main yield contributing characters in pearl millet are days to maturity, panicle length, panicle diameter and plant height.

The superior cross combinations 81A × 15631R, 98444A × 15156R, 88004A × 15156R, and 88004A × 15050R based on heterosis and combining ability for grain yield and yield component characters may be used as hybrids after evaluation in multi location trails.
GENETICS AND PLANT BREEDING

Author : UMARANI ERRABELLI
Title of the Thesis : EVALUATION OF LANDRACES OF RICE (Oryza sativa L.) FOR GENETIC DIVERSITY
Major Advisor : Dr. K. RADHIKA
Degree : M. Sc. (Ag.).
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9556

ABSTRACT

In the present investigation, seventy landraces of rice were evaluated to study the extent of genetic variability among these genotypes for agro-morphological and grain quality parameters, to estimate the genetic diversity using Mahalanobis D2 analysis for the selection of diverse parents and to study the extent of association among yield and its component traits and to determine the direct and indirect effects of these component characters on yield.

The experiment was conducted in a Randomized Block Design (RBD) with three replications during kharif 2013 and the data was recorded on 24 agro-morphological and grain quality traits. Characterization of the experimental material was carried out based on fourteen DUS characters. Among these characters, stem anthocyanin colouration of node was dimorphic, spikelet colour of stigma, stem length and panicle exsertion were trimorphic, basal leaf sheath colour, time of heading (50 % plants with panicles), flag leaf attitude (late observation), panicle length, decorticated grain length and shape were tetramorphic and lemma anthocyanin colouration of apex and amylose content showed five states of expression and based on decorticated grain colour highest number of groups i.e., six were made.

Analysis of variance indicated the existence of significant differences among the landraces under study for all the sixteen metric characters studied. Total number of grains per panicle exhibited highest PCV and GCV values followed by single plant yield,
whereas lowest PCV and GCV values were recorded for spikelet fertility. Among all the grain quality characters gel consistency expressed highest values of PCV and GCV. All the characters under study except spikelet fertility and panicle length exhibited high heritability coupled with high genetic advance as a per cent of mean, which indicated the preponderance of additive gene action in controlling these traits. Hence direct selection of these characters would be effective in improving the seed yield. Panicle length expressed high heritability coupled with moderate genetic advance as a per cent of mean, suggesting that the expression of this trait was mostly influenced by additive type of gene action. Hence its response to selection would be effective in improving the seed yield. Spikelet fertility exhibited high heritability coupled with low genetic advance as a per cent of mean indicating that the expression of this trait was under the control of non-additive type of gene action and its response to selection would be poor.

Based on the relative magnitude of D2 values, landraces of rice under study were distributed into nine clusters by using Tocher's method. Out of nine clusters, cluster I was the largest comprising of fifty landraces, followed by cluster III with eight, cluster VI with four and cluster VII with 3 landraces. Cluster II, IV, V, VIII and IX were monogenotypic clusters. The clustering pattern showed that the landraces originating from similar geographical regions were categorized into different clusters, indicating that geographical diversity and genetic diversity were not related. Total number of grains per panicle, decorticated grain length, 100-grain weight, amylose content, time of heading and stem length together contributed maximum (94.16 %) to the total genetic divergence.

Maximum inter cluster distance was exhibited between clusters VIII and IX followed by clusters V and IX, clusters VII and IX and clusters I and IX. The greater the distance between two clusters, the wider the genetic diversity among the genotypes of these clusters. Hence hybridization between the landraces from these clusters would produce high heterotic recombinants.

The cluster I was having highest mean value for productive tillers per plant, cluster II had highest mean values for single plant yield, 100 grain weight, decorticated grain width and amylose content, cluster V recorded maximum mean values for total number of grains per panicle, spikelet fertility and grain iron concentration, cluster VII showed maximum mean value for time of heading, cluster VIII had highest mean values for decorticated grain length, L/B ratio and gel consistency and cluster IX recorded highest mean values for stem length, panicle length, total number of grains per panicle and grain zinc concentration. The promising landraces from these clusters with high mean values for different traits may be directly used for adaptation or may be used as parents in future hybridization.

Character association studies revealed that single plant yield registered positive significant association with time of heading, stem length, panicle length, total number of grains per panicle and 100-grain weight indicating that these characters were important for yield improvement. Decorticated grain width and grain zinc concentration also exhibited positive significant association with single plant yield indicating that these
characters could also be considered to achieve better results for improving yield as well as grain quality.

A critical analysis of the results by path analysis revealed that number of productive tillers per plant exerted highest positive direct effect on grain yield followed by decorticated grain length, total number of grains per panicle, stem length, panicle length, 100-grain weight, decorticated grain width, grain zinc concentration and spikelet fertility. Hence, these traits must be considered as important attributes in formulating selection criteria for achieving desired targets in future breeding programmes.

GENETICS AND PLANT BREEDING

Author : VANDANA DEVULAPALLY
Title of the Thesis : STUDIES ON GENETIC DIVERGENCE IN MEDIUM DURATION RICE (Oryza sativa L.) GENOTYPES
Major Advisor : Dr.T.DAYAKAR REDDY
Degree : M. Sc. (Ag.).
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9506

ABSTRACT

In the present investigation, sixty four genotypes of rice were evaluated to study the genetic diversity pattern in the experimental material for selection of the diverse parents, to estimate the genetic variability parameters among the genotypes for yield and quality traits, and the extent of association between yield and its component characters including direct and indirect effects. The experiment was laid out in a randomized block design with two replications at Rice section farm, Agricultural Research Institute, Rajendranagar, Hyderabad during kharif 2013.

Analysis of variance indicated the existence of significant genotypic differences among the genotypes for yield, its components and grain quality traits for all the
characters. High GCV and PCV values were observed for number of filled grains per panicle, grain yield per plant and 1000 grain weight.

High heritability coupled with high genetic advance as per cent of mean was observed for number of productive tillers per plant, number of filled grains per panicle, 1000-grain weight, grain yield per plant, head rice recovery, kernel length, kernel breadth, L/B ratio, indicating that these traits were controlled by additive type of gene action. The remaining traits were mostly under the influence of non-additive gene effects as they recorded low to moderate estimates of genetic advance.

Based on the relative magnitude of D2 values, the genotypes were grouped into seven clusters. Cluster I was the largest comprising of twenty seven genotypes followed by cluster II with eighteen genotypes, cluster V with nine genotypes, cluster VI with seven genotypes and cluster III, IV and VII with one genotype each. The highest divergence occurred between cluster II and VI (28.73) followed by cluster III and VI (23.91) cluster V and VI (23.27) and cluster VI and VII (21.97).

Based on the inter cluster distances, hybridization between the genotypes (HKR 08-29) of cluster II and (CN 1340-201-15-BKNR 26-1-2 ) of cluster VI , (HUR 5-1) of cluster III and (CN 1340-201-15-BKNR 26-1-2) of cluster VI, (NLR 3091) of cluster V with cluster VI (CN 1340-201-15-BKNR 26-1-2) is expected to generate promising segregants for grain yield and quality traits.

The four characters days to 50 % flowering, head rice recovery, plant height and 1000 grain weight contributed maximum (86.42) towards genetic divergence. The data on character means for seven clusters indicated that, cluster IV with only one genotype (PAU 3842-44-2-2-2) exhibited highest cluster mean for four traits viz., no. of productive tillers per plant, L/B ratio, milling percentage and head rice recovery. Cluster VII with one genotype (NDLR 7) recorded highest mean value for 1000 grain weight, grain yield per plant. Cluster III with one genotype (HUR 5-1) possessed highest mean value for hulling percentage and kernel length. Cluster I possessed highest mean value for plant height, kernel breadth containing genotypes viz., TTB 404, UPR 3744-8-1-2.

Character association studies revealed that the characters grain yield per plant showed significant positive association with plant height, number of productive tillers per plant, number of filled grains per panicle, 1000 grain weight and kernel length and non significant positive association with panicle length and L/B ratio. This indicated that simultaneous selection of all these characters was important for yield improvement.

A critical analysis of the results by path analysis revealed that the traits such as 1000 grain weight followed by number of filled grains per panicle, number of productive tillers per plant, kernel length, and plant height were directly influencing the grain yield per plant. Hence, these traits were considered as important attributes in formulating selection criterion for achieving desired targets.
GENETICS AND PLANT BREEDING

Author : VENKATESWARA RAO, K.
Title of the Thesis : STABILITY ANALYSIS IN SESAME
(Sesamum indicum L.)
Major Advisor : Dr. A. APPALA SWAMY
Degree : M. Sc. (Ag.).
College : AGRICULTURAL COLLEGE, NAIRA
Accession Number : D9489

ABSTRACT

The present investigation was carried out during late Rabi, 2012-13 in three environments (different dates of sowing) i.e Environment 1 (E1) = 10-01-2013;
Environment 2 (E₂) = 25-01-2013; Environment 3 (E₃) = 10-02-2013 at the Agricultural college Farm, Naira, Andhra Pradesh with 30 genotypes of sesame (*Sesamum indicum* L.) in order to study the variability, heritability, genetic advance as per cent of mean, character association, magnitude of direct and indirect effects and stability analysis. The data were recorded on days to initial flowering, days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per plant, number of seeds per capsule, 1000 seed weight (g), oil content (%) and seed yield per plant (g).

The analysis of variance revealed significant differences among the genotypes for all the characters in all three environments indicating the presence of genetic variability in the studied material.

The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the interaction of genotypes with environment. High heritability coupled with high genetic advance was observed in number of branches per plant, number of seeds per capsule and seed yield per plant indicating the predominance of additive gene action and hence, direct phenotypic selection may be useful.

Character association and path coefficient analysis studies revealed that, number of branches per plant, number of capsules per plant and number of seeds per capsule showed significant positive association coupled with positive direct effects on seed yield per plant in all the environments indicating the use of these attributes in selection to evolve high seed yielding genotypes.

In pooled analysis of variance for stability the genotypes, environments, environment (linear) and pooled deviations showed significant differences for most of the characters studied, indicating divergent environments and the importance of non-linear component in the genotype-environment interaction.

According to Eberhart and Russell (1966) stability parameters (mean, regression and deviation from regression) the genotype IS-112-B was found to be stable for average environmental conditions (for days to initial flowering, days to 50% flowering and number of branches per plant) as well as for poor environmental conditions (for days to maturity, plant height, 1000 seed weight and seed yield per plant).

In AMMI analysis, the mean squares were significant for genotypes and environments for all the quantitative characters indicating significant differences among genotypes and environments. Among the environments, sowing on last week of January (environment-II) was found to most suitable for number of capsules per plant and seed yield per plant as indicated by high mean value of IPCA 1 and low value of IPCA 2. The genotypes SI-2174-1, S-0434, KMR-17, YLM-11 and YLM-111 recorded high mean but low interaction effects found to be adaptable for all environments for most of the characters.
According to AMMI’s stability values (ASV), the genotype IS-112-B was found to be stable for days to initial flowering, days to 50% flowering, days to maturity, number of branches per plant, oil content and seed yield per plant while the genotype IC-607-1-84 was found to be stable for number of capsules per plant, number of seeds per capsule, 1000 seed weight and seed yield per plant.

Based on the mean of ranks of all the ten stability parameters for all the quantitative characters, the genotypes IS-112-B was found to be most stable for days to initial flowering, days to 50% flowering, plant height, 1000 seed weight, oil content and seed yield per plant whereas the genotypes IS-112-B, S-0430, B-203 and IC-607-1-84 found to be stable based on overall rank of all the different stability parameters for all ten quantitative characters.

The Lewis stability factor, variance due to g x e, Wricke’s ecovalence and Shukla’s variance showed positive significant association with most of the stability parameter ranks for number of capsules per plant, number of seeds per capsule and seed yield per plant. The ranks of ASV values showed positive correlation with all the stability parameters indicated that selection of stable genotypes based on the ranks of ASV values was most appropriate.

Based on the comparative studies of the Eberhart and Russell (1966) stability parameters, AMMI’s stability values (ASV) and mean of ranks of different stability parameters for all the quantitative characters, the genotype IS-112-B, IC-96128 and IC-607-1-84 were found to be most stable for more than four quantitative characters.

In the present investigation, the following stable genotypes IS-112-B, IC-96128, IC-607-1-84, S-0430, B-203, KMR-17 and YLM-111 were found most promising by comparative study of different stability models and stability parameters, may serve as potential parental genotypes for future breeding programmes to develop desirable stable segregants for sesame crop improvement strategies.

GENETICS AND PLANT BREEDING

Author : VIJAYA KUMAR, N.
Title of the Thesis : “D2 ANALYSIS FOR SOME QUANTITATIVE TRAITS IN RABI SORGHUM (Sorghum bicolor L. Moench)”
Major Advisor : Dr. C.V. CHANDRA MOHAN REDDY
Degree : M. Sc. (Ag.).
The present study was carried out in rabi sorghum during rabi 2011-12 at Regional Agricultural Research Station, Nandyal (ANGRAU) in randomized block design with three replications and data were recorded on various yield and yield components to estimate nature and magnitude of genetic variability, genetic diversity, character association and path coefficient analysis among 25 rabi sorghum genotypes for 10 yield and yield attributing characters.

Analysis of variance indicated the existence of significant genotypic differences for all the ten traits. Mean performance of 25 rabi sorghum genotypes for ten quantitative traits revealed that the genotypes NTJ-3, CSV-23, CSV-17, M35-1 and NTJ-4 were promising donors for grain yield per plant; M35-1, CSV-23, NTJ-3, NTJ-4 and NTJ-2 were promising donors for panicle weight; CSV-17, C-43, GD-65028, NTJ-2 and M-35-1-19 were promising donors for panicle length; NTJ-4, N-33B2, NTJ-3, N-72B and N-48 were promising donors for 100-seed weight; CSV-17, CSV-23, GD-65028, ICSV-702 and M35-1 were promising donors for dead heart percentage; M35-1, CMS-1, 53AX3, Hagari and ICSV-702 were promising donors for days to 50 per cent flowering; CMS-1, NTJ-3, 53AX3, N-33B4 and N-33B2 were promising donors for plant height (cm); N-13, N-48, N-33B2, N-33B4 and CSV-23 were promising donors for number of primaries per panicle; KKLT-4, M35-1-19, NTJ-3, NTJ-4 and NTJ-1 were promising donors for stover yield per plant; CSV-23, NTJ-2, CSV-17, N-33B2 and PVK-801 were promising donors for harvest index.

Genotypic and phenotypic coefficients of variability were high for grain yield per plant, stover yield per plant, harvest index, panicle weight, panicle length, 100-seed weight and dead heart percentage. High heritability coupled with a high genetic advance was observed for grain yield per plant, stover yield per plant, panicle weight, panicle length, 100-seed weight, plant height, number of primaries per panicle, harvest index and dead heart percentage.

By using Mahalanobis’s D2 statistic 25 rabi sorghum genotypes were grouped into 10 clusters. Among the 10 clusters, cluster I was the largest with 13 genotypes followed by cluster II with 4 genotypes. Remaining clusters were solitary. Inter cluster D2 values ranged from 4.90 between clusters III and IV to 15.42 between cluster VI and VIII indicating wide genetic variability. Harvest index showed the highest contribution towards the genetic diversity followed by grain yield per plant, panicle length, stover yield per plant, 100-seed weight, plant height, number of primaries per panicle, panicle weight and dead heart percentage.
Character association studies indicated that the character grain yield per plant had positive and significant association with panicle weight followed by harvest index, 100-seed weight and panicle length, whereas grain yield per plant had negative and significant correlation with dead heart percentage. Thus selection for above characters can increase the grain yield in rabi sorghum as the characters highly correlated with grain yield per plant. Path coefficient analysis revealed that harvest index had the highest positive direct effect on grain yield per plant followed by stover yield per plant, panicle weight, 100-seed weight and plant height. Thus direct selection for more harvest index, panicle weight and 100-seed weight can increase the grain yield in rabi sorghum.

It is concluded that the characters panicle weight, panicle length, 100-seed weight and harvest index show high variability, high heritability and high genetic advance, these characters also show positive and direct effect on grain yield per plant. So selecting the genotypes having high panicle weight, panicle length, 100-seed weight and harvest index is pre-requisite for improving the grain yield in rabi sorghum.
ABSTRACT

The present investigation “study of combining ability and heterosis in sesame (Sesamum indicum L.)” involved crossing of 14 divergent sesame genotypes in half-diallel fashion to generate 91 F1s. The parents along with their F1s were evaluated for their stability of performance in four environments viz., Bapatla (kharif) and (rabi), Peddapuram (kharif) and (rabi). The data was recorded for nine quantitative characters viz., days to 50% flowering, plant height, number of primary branches, number of secondary branches, number of capsules per plant, number of seeds per capsule, 1000 seed weight, oil content and seed yield per plant.

Analysis of variance revealed highly significant mean sum of squares for all the traits in all the four environments studied as well as in pooled analysis. There was a narrow difference between phenotypic coefficient of variation and genotypic coefficient of variation for all the traits. High PCV and GCV coupled with high heritability and genetic advance as per cent of mean was observed for seed yield per plant suggesting prevalence of additive gene action making the character amenable to simple selection.

The correlation studies in different environments as well as in pooled analysis over environments established complementary relationship of plant height, number of primary branches, number of secondary branches, number of seeds per capsule and number of capsules per plant with seed yield per plant. High positive direct effect on seed yield per plant was exerted by number of capsules per plant, while days to 50% flowering alone was found to influence seed yield per plant in a negative direction in pooled analysis. Hence, in yield improvement programmes major emphasis may be given to number of capsules per plant with desirable duration without compromising for seed yield.

The estimated component of variance due to sca was higher than gca for all the nine characters in all the four environments studied as well as in pooled analysis. The ratio of general combining ability component of variance to specific combining ability component of variance was less than unity for all the nine characters studied indicating the preponderance of non-additive gene action. The parents involved in the promising crosses identified from pooled analysis based on heterobeltiosis (Madhavi x YLM 83,
YLM 103 x YLM 83 and YLM 100 x YLM 103 for oil content and YLM 11 x YLM 106, YLM 102 x YLM 108 and YLM 101 x YLM 83 for seed yield per plant) were high x low, low x high or low x low indicating additive x dominance, dominance x additive and dominance x dominance combinations of gene action.

Based on AMMI biplot technique the hybrids viz., YLM 66 x YLM 104, YLM 11 x YLM 107 and YLM 17 x YLM 66, showed little influence of environment because of relatively small distance from the coordinates to the abscissa and were considered as stable hybrids for seed yield per plant.

Based on AMMI analysis the crosses viz., YLM 66 x YLM 102 and YLM 11 x YLM 106 for seed yield, Gouri x YLM 100 for oil content and YLM 11 x YLM 106 and YLM 66 x YLM 107 for number of capsules per plant were found to be promising. These crosses may be further evaluated over large number of environments to ascertain their stability and for isolating desirable segregants.
The present investigation was undertaken to generate information on combining ability and heterosis in chickpea (*Cicer arietinum* L.) for important yield and drought tolerance attributes and also to ascertain nature and magnitude of character association among various productivity and drought tolerance attributes. The experimental material consisted of seven parents and twenty one F1 cross combinations was evaluated at Regional Agricultural Research Station, Nandyal during *rabi*, 2011-12.

Analysis of variance revealed the existence of significant differences among the genotypes for all the sixteen attributes studied. Studies on combining ability revealed significant *gca* and *sca* mean squares for all the traits studied indicating the influence of both additive and non-additive gene action. However, estimates of components of variance revealed predominance of non-additive gene action for days to first flowering, days to 50 per cent flowering, days to first poding, days to maturity, number of branches per plant, SPAD chlorophyll meter reading, root length, number of pods per plant, shoot biomass per plant, seed yield per plant, harvest index, chlorophyll ‘a’ content, chlorophyll ‘b’ content and total chlorophyll content; and predominant additive gene action for plant height and 100- seed weight.

Based on estimates of general combining ability and *per se* performance superior parents were suggested for improving chickpea productivity and drought tolerance. Promising parental genotypes are NBeG-3 for number of branches per plant, number of pods per plant, seed yield per plant, harvest index and chlorophyll ‘a’ content; JG-11 for days to first flowering, days to 50 per cent flowering, number of branches per plant,
SCMR, root length, number of pods per plant, chlorophyll ‘a’ content, chlorophyll ‘b’ content and total chlorophyll content; ICCV 05106 for number of pods per plant, MNK-1 for plant height and 100 seed weight and Vihar for shoot biomass per plant, chlorophyll ‘a’ content, chlorophyll ‘b’ content and total chlorophyll content. These parents can also be intercrossed in order to create large genetic variability and to isolate promising lines with desirable combination of yield and drought tolerance attributes.

Promising crosses for phenological traits (JG-11 x Vihar, ICCV 05106 x ICCV 95333, ICCV 05106 x KAK-2 and NBeG-3 x JG-11); physiological traits like SCMR, root length and leaf chlorophyll content (NBeG-3 x MNK-1, JG-11 x MNK-1, ICCV 95333 x KAK-2, ICCV 05106 x MNK-1, ICCV 05106 x KAK-2, ICCV 05106 x ICCV 95333 and ICCV 95333 x Vihar); and yield and yield attributes (NBeG-3 x JG-11, NBeG-3 x ICCV 95333, JG-11 x ICCV 05106, JG-11 x KAK-2, ICCV 05106 x Vihar, ICCV 95333 x KAK-2, ICCV 95333 x Vihar, NBeG-3 x Vihar and ICCV 05106 x ICCV 95333) identified in the study could be exploited in chickpea breeding programmes for developing high yielding chickpea genotypes with improved drought tolerance.

Shoot biomass per plant, harvest index, number of branches per plant and number of pods per plant were identified as major yield components which exhibited highly significant positive association with seed yield. Physiological characters viz., SCMR, chlorophyll ‘b’ content and total chlorophyll content exhibited highly significant positive inter se association with each other and also significant association with seed yield per plant. Hence, these traits can be included as selection criterion in breeding chickpea genotypes with high yield and enhanced drought tolerance.

Path coefficient analysis also brought out high positive direct effects of shoot biomass per plant and harvest index and moderate direct effects of chlorophyll ‘b’ content on seed yield per plant. High and positive indirect effect of SCMR and root length and moderately positive indirect effect of chlorophyll ‘b’ content via shoot biomass were also remarkable.
Sheath blight disease, caused by the pathogenic fungus *Rhizoctonia solani* Kuhn, which is one of the most prevalent rice diseases, results in severe yield losses worldwide. The fungus is soil borne in nature which survives either as sclerotia or mycelia in plant debris. Absolute resistance to *R. solani* is not available in any of the rice germplasm grown worldwide. However, it has been reported that resistance to *R. solani* is a typical quantitative trait controlled by polygenes in rice. The present investigation was attempted to identify sources of resistance to sheath blight and map the quantitative trait loci (QTLs) governing sheath blight resistance in the identified source(s). The screening for sheath blight resistance using typha bits method was performed in forty rice germplasm lines including 8 wild, 4 land races, 26 cultivated and 2 advanced breeding lines. A moderate level of resistance to this disease was identified in Tetep and ARC10531, a land race with the relative lesion height percentage of 21-30%. Molecular mapping of QTLs using Tetep as a source for moderate resistance has already been carried out by several research groups. Hence, ARC10531 was used in the present study. Two mapping populations namely, F<sub>2</sub> and BC<sub>1</sub>F<sub>2</sub> were developed from a cross between the cultivated rice variety, BPT5204 (susceptible) and a land race from Assam,ARC10531 (moderately resistant to sheath blight) and were used to map the QTLs governing sheath blight resistance. Parental polymorphism involving 500 SSR markers spanning all twelve chromosomes was carried out. Of the 500 SSR markers screened, seventy were found polymorphic among the parental lines.

The F<sub>2:3</sub> progenies of the cross ARC10531 and BPT-5204 (180 lines) was phenotyped for sheath blight during Kharif, 2012 following the standard method of screening in a hot and humid micro chamber. The frequency distribution curve of F<sub>2:3</sub> progenies for disease trait was continuous and near to normal distribution. The range of relative lesion height percentage was 21-75% with a mean of 38.59%.
Bulk Segregant Analysis (BSA) was carried out with these seventy polymorphic SSR primer pairs for parents (P₁, P₂), resistant bulk (RB), and susceptible bulk (SB) along with ten extreme individuals for disease reaction from F₂ population included in respective bulks, to identify the markers that might be closely linked to resistance loci. Two markers RM 205, present on chromosome 9 and RM 336, present on chromosome 7, clearly distinguished susceptible bulks from resistant bulks. QTL identification related to sheath blight resistance was sought using the software QTL cartographer v. 2.5 on LOD value 3.0. Using simple interval mapping analysis, a total of 14 QTLs were identified on chromosome 1, 6, 7, 8 and 9. Out of 14 QTLs identified by SIM, 11 QTLs on five different chromosomes were confirmed by employing composite interval mapping with phenotypic variance ranging from 8.40% to 21.76%. The two SSR markers RM 336 and RM 205 were found to be associated with major QTL qshb7.3 and qshb9.2 respectively. These two markers were confirmed in BC₁F₂ population using bulk segregant analysis approach. The chromosomal regions associated with sheath blight resistance identified in the present investigation were further analyzed for the presence of defense response genes. A hypothetical β 1-3 glucanase like gene was identified in silico from database RAP-DB using Rice TOGO browser within the identified QTL region qshb9.2 linked with marker RM 205. Alleles for the proposed candidate gene (β 1-3 glucanase) from the resistant and susceptible parents can be sequenced and subjected to BLAST analysis to further understand the molecular basis of ShB resistance in rice.

Hence the present study has been successful in identification of a new moderately resistant source for sheath blight resistance in rice and in identifying the QTLs governing the disease resistance in this source. Future line of work would involve fine mapping of these QTLs and further attempts to pyramid the identified QTLs with other already reported major QTLs to increase the level of resistance to sheath blight disease of rice.
MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author : ZUBAIR AHMAD MIR
Title of the thesis : ASSOCIATION ANALYSIS FOR FUSARIUM WILT RESISTANCE IN CASTOR
Major Advisor : Dr. SENTHILVEL SENAPATHY
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9525

ABSTRACT

Castor is an economically important oilseed crop grown historically in India and various countries. Wilt disease caused by *Fusarium oxysporum* f.sp. *ricini* is a major problem in all castor growing areas of India leading to heavy yield loss. Being a soil-borne pathogen, chemical control is difficult and non-economical. Cultivation of wilt resistant cultivars has proved to be an effective strategy to minimize the loss. However, breeding for wilt resistance has been challenging due to complex inheritance and pathogen variability. A breeding programme for disease resistance requires simple, rapid and reliable procedure for routine screening of progenies. Conventional screening procedures for evaluating wilt resistance in castor are cumbersome and often misleading. Marker-assisted selection is a modern tool, which has been effective for selecting diverse disease resistance genes in crop breeding.

Hence, this study was proposed to identify molecular markers associated with wilt resistance through association mapping approach to assist the castor breeding efforts. A subset of 96 germplasm accessions (cultivated and wild forms) was randomly taken from the core set of castor germplasm maintained at the Directorate of Oilseeds Research (DOR), Hyderabad. The level of genetic diversity and population structure in the genotype panel was assessed using castor genomic SSR markers. Out of 75 SSRs used,
49 were polymorphic producing two to six alleles with a polymorphism information content (PIC) value of 0.02 to 0.73 (mean: 0.32). The expected heterozygosity (gene diversity) ranged from 0.021 to 0.768 with mean of 0.374 indicating a reasonable level of genetic diversity in the genotype panel. The pairwise dissimilarity index (simple matching coefficient) based on allelic data from 49 SSR markers ranged from 0.065 to 0.651 with a mean of 0.372. The neighbor joining tree depicting the genetic relationship of 96 castor accessions showed no distinct clusters or groups. A model based clustering method as implemented in STRUCTURE software also indicated no sub-population in the panel, making it an ideal material for linkage disequilibrium (LD) based association analysis. All 96 castor genotypes along with standard checks viz., JI35 (susceptible) and 48-1 (resistant) were evaluated for their reaction to artificial inoculation of *F. oxysporum* f.sp. *ricini* using pot culture and the number of days taken by each genotype to wilt was scored as a measure of resistance. A total of nine genotypes was removed from the study due to inconsistent disease reaction or germination problems. Out of the remaining 87 genotypes, 25 were susceptible (reaction similar to JI35), 28 were moderately resistant (reaction in between JI35 and 48-1), 17 were resistant (reaction similar to 48-1) and 17 were highly resistant (reaction better than 48-1). The SSR genotypic data and the phenotypic data (days to wilt) of 87 genotypes were used for association analysis using TASSEL2.1 software. Since most genotypes in the panel had no or very low kinship values and there was no clear cut population structure, only general linear model (GLM) without Q matrix was used to identify the marker-trait association. Out of 49 markers tested, one marker, RCM9109 showed significant (p = 0.0026) association with the trait (days to wilt), which explained 19.88 per cent of total phenotypic variation. This marker may be used in the breeding programme after sufficient validation in a larger set of germplasm accessions/segregating lines.
ABSTRACT

MTU 1010 (Cottondora Sannalu), is one of the popular rice varieties released by Andhra Pradesh Rice Research Institute (APRRI), Maruteru. It is a short duration, high yielding; long slender rice variety occupied maximum area in India particularly during Rabi season. It is susceptible to bacterial blight (BB) disease, which is endemic to many rice growing areas in India and is also susceptible to blast disease. The present investigation was attempted to introgress BB and blast resistance genes into MTU 1010 using marker assisted backcross breeding method. Improved Samba Mahsuri (ISM) or B95-1 was used as a donor for bacterial blight resistance genes, \( xa13 \) and \( Xa21 \), while NLR 145 (Swarnamukhi) was used as donor for blast resistance \( Pi-kh \) (renamed as \( Pi54 \)) gene. Donor parents were validated for the target genes by using \( xa13 \)-promo (functional marker) for \( xa13 \) gene, pTA248 (STS marker) for \( Xa21 \) gene and RM206 (SSR marker), \( Pi54 \) MA\( S \) (functional marker) for \( Pi54 \) gene and found that the resistant alleles were present in accordance with earlier reports. Recurrent parent and donor parents showed polymorphism for the selected target markers. Parental polymorphic study carried out between two donors and recurrent parent (MTU 1010) with 617 SSR markers. Out of 617 SSR markers, 82 markers showed polymorphism between MTU 1010 and ISM, while 83 were polymorphic between MTU 1010 and NLR 145. Fifty six markers in common showed polymorphism between recurrent parent and both the donor parents.

Two crosses \( \text{viz.} \), MTU 1010 x ISM and MTU 1010 x NLR 145 were made during Rabi 2009-10 and confirmed hybrid plants were used for producing BC1F1 generation. At each backcross generation foreground as well as background analysis was carried out to identify the plant carrying target genes in heterozygous condition with maximum recurrent parent genome. Inter cross was made between two BC2F1s of MTU 1010 x ISM (female) and MTU 1010 x NLR 145 (male) to obtain ICF1. Out of 320 ICF1 plants, four plants having required three gene combination, \( \text{viz.} \), \( xa13 \), \( Xa21 \) and \( Pi54 \) in
heterozygous condition were found. These four ICF1 plants were analysed to screen the recovery percent of recurrent parent genome by using parental polymorphic markers. ICF1-16th plant with recurrent parent genome (90%) was selected and selfed to produce ICF2 seed. A total of 880 F2 plants were screened and 11 triple gene homozygous plants identified. Phenotyping for BB was carried out at 55 days old seedling stage with DRR isolate. As compared to MTU 1010, BB gene introgressed plants (lines having \textit{xa13} and \textit{Xa21}) exhibited very small lesion lengths indicating a very high level of resistance. In addition, the lines containing either \textit{Xa21} alone or \textit{xa13} alone also exhibited limited lesion lengths. The „triple positive” ICF2 plants (possessing \textit{xa13}, \textit{Xa21} and \textit{Pi54} in homozygous condition) were screened with parental polymorphic SSR markers for selecting those „positive” plants possessing maximum recurrent parent genome. Highest value recorded in ICF2-16-59th (92%) plant. Chromosome wise analysis of the background showed complete recovery of chromosomes 3, 5, 6, 7, 9 and 10. Donor parent introgression was analysed using Graphical genotypes, in all individuals 1.0Mb region around the \textit{xa13} gene, 3.5 Mb region around the \textit{Xa21} and \textit{Pi54} gene was introgressed from the donor parents.

All the ICF2 pyramided lines selected through marker assisted selection, which are having \textit{xa13xa13Pi54Pi54}, \textit{Xa21Xa21Pi54Pi54} and triple positive \textit{xa13xa13Xa21Xa21Pi54Pi54} in homozygous condition were selfed and ICF3 families were screened for blast resistance at Agriculture Research Station, Nellore and APPRI, Maruteru which are hotspots for blast disease. The donor parent NLR145, which possessed \textit{Pi54} gene showed high level of resistance for rice blast with „3” disease score and the MTU 1010 showed a disease score „7” and all introgressed lines showed score between „1 and 3” (highly resistant). The families with three gene and two genes showed resistance to BB and blast (14 lines) were analysed for agro-morphological characters along with parent MTU 1010 was planted in RBD design. Replication data was subjected to statistical analysis by using window stat software for obtaining the CV, CD and ANOVA. ICF3-16-59 line showed statistically on par with respect to yield and yield related characters when compared with MTU 1010 besides showing resistance to both BB and blast. In this present study, ICF3-16-235 line showed significant yield superiority over MTU 1010 coupled with BB and blast resistance can be backcrossed once with MTU 1010 to further improve the recurrent parent genome recovery as it is carrying 82% of recurrent parent background.
PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author : NAGALAKSHMI, S.
Title of the thesis : MOLECULAR DETECTION OF MYCOTOXIN CONTAMINATION IN MAIZE (Zea mays L.) USING RAPID MULTIPLEX qPCR METHOD
Major Advisor : Dr.K.MANORAMA
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9469

ABSTRACT

Maize (Zea mays L.) is the most important staple food crop in the world. According to FAO, 25% of the world’s food crops are affected by mycotoxins. The major mycotoxin producing fungi are Aspergillus, Fusarium and Pencillium. Aflatoxins, fumonisins, trichothecenes, ochratoxins, cyclopiazonic acid, patulin, deoxynivalenol, zearalenone, citrinin, gliotoxin and sterigmatocystin are some of the important mycotoxins. Mycotoxin detection is important for quality control, especially while exporting food grains. Timely detection will help to alleviate consumption of afflicted food grains by population and susceptibility to health problems associated with their consumption. Detection systems like High Performance Liquid Chromatography (HPLC) are time consuming. Molecular detection methods using PCR can replace conventional methods due to their precision as well as speed.

Mycotoxin producing gene fragments in fungal strains were amplified using PCR and realtime PCR along with Bioanalyzer in an attempt to develop a rapid assay for mycotoxin detection. As many as 130 samples of maize were collected from various storage areas like godowns, wholesale and retail shops and farmers’ fields in major maize
growing districts in Andhra Pradesh (A.P). Fungal DNA was extracted using DNA extraction kits. DNA from fungus contaminated maize samples was extracted by the CTAB method. Forward and reverse primers were designed by identifying homologous regions from original gene sequences (obtained from GENBANK) of the three genes, *aflQ*, *Tri13*-DON and *pks* gene, which are key genes involved in the production of three mycotoxins *viz.*, aflatoxin, deoxynivalenol (DON) and ochratoxin respectively. Sequences from different species of fungi were aligned using megalign software from DNASTAR Lasergene 8.0 version, and homologous regions were identified. Primer 3.0 software was used for designing primers from these homologous regions. Using these three sets of primers, a 166 base pair fragment of the *aflQ* gene was amplified from DNA of *Aspergillus parasiticus* and *Aspergillus flavus*, a 200 bp fragment of ochratoxin producing polyketide synthase gene (*pks*) was amplified from DNA of *Aspergillus ochraceus*, and a 250 bp fragment of *Tri13*-DON (deoxynivalenol) gene was amplified from DNA of *Fusarium culmorum*. PCR and realtime PCR assays were conducted to detect the presence of the genes encoding the production of three mycotoxins, *viz.*, aflatoxin, deoxynivalenol (DON) and ochratoxin.

Results showed that out of 130 maize samples tested for the detection of the genes producing aflatoxin, ochratoxin and DON, 29 samples were positive for the aflatoxin producing *aflQ* gene. *Tri13*-DON gene amplification was observed in 13 samples and *pks* gene was detected in 11 samples. The fragments were resolved on the DNA 1000 LabchipR, for generating data of fragment sizes. Combination of PCR with the Bioanalyzer was advantageous compared to traditional agarose gel electrophoresis and staining methods, in terms of precision of the bands and band sizes. Amplification of these gene fragments was also achieved using RT-PCR with probes SYBRGreen, with Ct values ranging from 20 to 25 for the three genes. Multiplex PCR was done for the three positive controls, but only two of the gene fragments of *aflQ* and *Tri13*-DON were detected in one lane. Ochratoxin producing *pks* gene did not amplify in the multiplex PCR reaction. For individual samples, individual PCR reactions using separate sets of primers were conducted successfully for the detection of contamination. Multiplex PCR method did not detect gene amplification for two or three different mycotoxins simultaneously, as different maize samples were positive for different mycotoxins. No single sample among the 130 was positive for two or three mycotoxins. Grains were analysed for the presence of the three toxins by HPLC method and a comparison was made among both the methods. HPLC analysis indicated the presence of aflatoxin B1 in 27 of the 29 samples that were positive for aflatoxin gene fragment. Ochratoxin was detected in the 7 out of 11 samples and DON was detected in 12 samples out of 13 samples that were positive for the gene fragments of *Tri13*-DON using molecular techniques.
PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author : RAVI DEVARAKONDA
Title of the thesis : ASSESSMENT OF GENETIC DIVERSITY AND OUTCROSSING IN SAFFLOWER VARIETIES USING SSR MARKERS
Major Advisor : Dr. KADIRVEL PALCHAMY
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9534

ABSTRACT

Safflower (Carthamus tinctorius L.) is a member of Asteraceae family originated in the Middle Eastern region. The cultivated safflower is a diploid with 24 chromosomes and genome size of about 1.4 Gb. Understanding of genetic diversity in the safflower germplasm accessions is critical for conservation, maintenance and selection of appropriate accessions for use in breeding activities. In this study, genetic diversity and relatedness of 30 Mexican safflower varieties were compared with 30 public bred Indian cultivars using 50 SSR markers. The genetic diversity measures viz., allele number, major
allele frequency, observed heterozygosity (\(H_o\)), expected heterozygosity (\(H_e\)), polymorphism information content (PIC) and the population parameters viz., population structure, genetic admixture, analysis of molecular variance (AMOVA) and fixation index (\(Fst\)) were analyzed across 60 genotypes.

The allele number ranged from 1 to 10 with the mean of 2.7 per locus. The major allele frequency ranged from 0.386 to 1 with the mean of 0.74. The observed heterozygosity (\(H_o\)) ranged from 0 to 1 with the mean of 0.088. The expected heterozygosity (\(H_e\)) ranged from 0 to 0.768 with the mean of 0.332. The PIC values for each SSR primer pair ranged from 0 to 0.751 with the mean of 0.286. The low average number of alleles, high major allele frequency and low average PIC values across 60 accessions suggested that low level of SSR polymorphism in the safflower cultivars.

Neighbor joining (NJ) tree based on pair-wise simple matching coefficients clearly placed Indian and Mexican accessions in two distinct clusters. NJ tree also revealed several subgroups within Mexico and India groups. The model based STRUCTURE analysis also showed two subpopulations (K=2) clearly thus grouping the Indian and Mexican cultivars into distinct clusters. However, it was unclear to what extent the two varietal groups were genetically differentiated. Partitioning of variation through hierarchical AMOVA showed that about 40% of variation is explained between populations and 60% between individuals within population. The pair-wise \(Fst\) estimate between Mexico and India groups was 0.39639. These results indicated that both India and Mexico varietal groups are highly differentiated and a substantial genetic diversity exists between them, which can be used for generating new variability for improving agronomic traits in safflower breeding programmes.

In this study, an effort was also made to check outcrossing between nine safflower genotypes grown under honeybee excluded and protected net condition using SSR markers. Previously generated genotypic data of 60 genotypes were used to identify a single or a combination of SSR markers which could uniquely differentiate one genotype from the other. Five hundred plant progenies of the variety A1 (of the seeds collected from protected net field) grown in grow-out test (GOT) plot were genotyped using A1 specific SSR primer pair ct-266. The ct-266 allelic pattern of progenies was examined to check if any progeny that showed heterozygous allelic pattern (carrying A1 allele + allele from any parental genotype grown in the outcross block). It was observed that 496 progenies had the allelic pattern of A1. Only four progenies had allelic pattern that was different from A1; the pattern was not heterozygous but was similar to that of two parental genotypes; hence, these plants were considered as contaminants. Thus, the genotyping results showed that there was no evidence of outcrossing between A1 and other safflower genotypes under honeybee excluded protected net condition. Genotyping of 500 A1 progenies (of the seeds collected from open field) was also done using A1 specific SSR primer pair ct-266. All the 500 plants showed the allelic pattern of A1 suggesting that outcrossing did not happen between A1 and other genotypes even under
open field conditions. The results have strengthened the observations of safflower breeders that out-crossing may not happen in safflower in the absence of honeybees. However, the results are only indicative and not conclusive because of limited progeny size and genotypes used. Therefore, the findings need further validation using larger progeny across genotypes.
Groundnut Bud Necrosis Disease (GBND) caused by Groundnut Bud Necrosis Virus (GBNV) has been considered as one of the major virus diseases in Andhra Pradesh. Survey conducted in groundnut growing areas of Anantapur district during kharif and rabi 2013-14 and in Karimnagar and Warangal districts during rabi 2013-14 season revealed the natural occurrence of GBND in different manuals with an overall average incidence of 3.47 per cent. Higher incidence of GBND was observed in Anantapur (8.50 per cent) followed by Karimnagar (0.97 per cent) and Warangal (0.94 per cent) districts. Groundnut cultivar K-6 was grown extensively in all the districts surveyed. The infected groundnut leaf samples collected from Anantapur district tested positive when subjected to DAC-ELISA.

Of the 15 common weed species found in and around the surveyed groundnut fields, *Parthenium hysterophorus*, *Celosia argentea*, *Tridax procumbens*, *Achyranthus aspera* and *Cynodon dactylon* were more predominant and found in all the surveyed fields during rabi 2013-14 which may serve as reservoir weed hosts for GBND.

Evaluation of 40 groundnut genotypes for vector resistant sources under natural field conditions during late kharif 2013 revealed GBND incidence ranging from 2.57 to 22.71 percent compared to 4.04 per cent in ICGV 86031 (resistant check) and 25.45 per cent in JL 24 (susceptible check). Of the 40 genotypes tested, 8 genotypes were resistant with disease incidence of 2.57 - 4.99 per cent, 24 genotypes were moderately resistant (5.13 - 9.93 percent) and remaining 8 genotypes were moderately susceptible (10.21 - 22.71 per cent). The mean GBND severity in these genotypes under field conditions ranged from 1.99 to 4.32 compared to 2.33 in ICGV 86031 and 4.67 in JL 24. Further, resistance or susceptibility of genotypes was confirmed through DAC-ELISA.

Screening of groundnut genotypes inoculated with GBNV inoculums at 1:10 dilution under greenhouse conditions revealed mean disease incidence ranging from
64.71 to 100 percent compared to 72.22 per cent in resistant check and 94.44 per cent in susceptible check. All the genotypes were highly susceptible to GBNV at higher virus concentration (1:10 dilution). The mean disease incidence at lower virus concentration (1:100 dilution) ranged from 5.56 to 100 per cent compared to 26.67 in resistant check and 77.78 per cent in susceptible check, at 21 days after inoculation.

At low virus concentration, two genotypes (ICGV 00213, 06146) were moderately resistant (disease incidence of 5.56 and 7.14 per cent), four genotypes were moderately susceptible (11.11 - 25 per cent), 10 genotypes were susceptible (26.67 - 50 per cent) and remaining 24 genotypes were highly susceptible (52.94 - 100 per cent). None of the genotypes recorded highly resistant or resistant reaction.

The mean GBND severity in genotypes under greenhouse conditions, at 1:10 virus concentration, ranged from 2 to 5 compared to 4 in ICGV 86031 (resistant check) and 5 in JL24 (susceptible check). At 1:100 virus concentration, disease severity was slightly less, which ranged from 2 to 4 compared to 2 in ICGV 86031 (resistant check) and 4 in JL24 (susceptible check).

The genotype, ICGV 06146 showed resistance in field and moderate resistance in greenhouse screening by artificial inoculation. ICGV 00213 showed moderate resistance in both field and greenhouse screening. The genotypes, ICGV 07222, 03057 and ICGS 76 that showed moderate resistance in field, exhibited moderate susceptibility in greenhouse. Genotypes viz., ICGV 00187, 00191, 00202, 00203, 06100, 93260, 05155 and ICR 48 which showed moderate resistance in field were grouped under susceptible group in greenhouse. ICGV 07220 showed resistance in field and moderate susceptibility in greenhouse. These genotypes had Spanish bunch growth habit except ICGS 76 and ICR 48 which had Virginia bunch growth habit.

The present study revealed that the genotypes which were resistant or moderately resistant to the vector/disease under field conditions showed relative degree of susceptibility under high disease pressure in greenhouse conditions. The genotypes ICGV 06146, 00213, 07222, 03057 and ICGS 76 which were found promising with combined resistance to the vector and GBNV can be further evaluated over 2 - 3 seasons and genotypes with stable performance can be used in resistance breeding programme.
PLANT PATHOLOGY

Author : ANIL PAPPACHAN

Title of the thesis : VARIETAL SCREENING AND CHEMICAL MANAGEMENT OF LATE LEAF SPOT OF GROUNDNUT CAUSED BY Phaeoisariopsis personata (Berk & Curt)

Major Advisor : Dr. R. SARADA JAYALAKSHMI DEVI

Degree : M.Sc. (Ag.)

College : S.V. AGRICULTURAL COLLEGE, TIRUPATI

Accession Number : D 9615

ABSTRACT

Groundnut (Arachis hypogaea L.) is cultivated in India mainly as an oil seed crop. In India 60 % of groundnut is grown under rainfed conditions with total area about 4.19 mha (FAO, 2011). Several factors affect the yield under rainfed and irrigated situations, out of which foliar diseases like late leaf spot and rust play important role in reducing the productivity of groundnut significantly. Under favourable conditions late leaf spot alone is responsible for 25.3 per cent reduction in pod yield and 53.0 per cent reduction in haulm yield (Eswara Reddy and Venkateswara Rao, 1999).

Detailed experiments were carried out at “Department of Plant Pathology, S.V. Agricultural college, Tirupati” to screen varieties/lines against resistance to late leaf spot and to manage late leaf spot using chemicals. Study was also taken up on epidemiology to develop prediction models for forecasting, utilizing the effect of microclimate and meteorological parameters on the development of late leaf spot.

Out of the 46 varieties/lines screened, only three viz., GPBD-4, ICGV9114 and ICGV07022 were found to be resistant to late leaf spot. Most of the varieties/lines were moderately resistant to late leaf spot while 15 were susceptible to the disease.
Eleven fungicides were tested in the field against late leaf spot. All the fungicides significantly reduced per cent disease index over control. Out of the eleven fungicides tested in the field carbendazim (0.1 %), carbendazim + mancozeb (0.2 %), difenconazole (0.1 %) and tebuconazole (0.1 %) were found to be highly effective for the control of late leaf spot with corresponding increase in pod yield, haulm yield, 100 seed weight and shelling percentage.

The economics of disease management by fungicides revealed that two sprays of carbendazim (0.1%) recorded highest net return of Rs. 11.2 followed by carbendazim + mancozeb (0.2 %), tebuconazole (0.1%), hexaconazole (0.2%), propiconazole (0.1%) and chlorothalonil (0.2%) recorded net return of Rs. 6.1, 3.9, 3.1, 2.8 and 2.4, respectively for each rupee invested, for the fungicidal management operation.

Correlation analysis showed that minimum night temperature and morning relative humidity during crop growth period were the most important environmental factors that influenced the buildup of late leaf spot. Leaf spot progress was negatively correlated to maximum and minimum temperatures indicating that lower temperature was congenial for late leaf spot development. High morning relative humidity favoured the rapid progress of late leaf spot.

The rate of development of late leaf spot was fast in late sown crop. Area Under Disease Progress Curve (AUDPC) increased and both pod yield and haulm yield (kg ha\(^{-1}\)) decreased with delay in sowing time. Prediction models were developed for late leaf spot disease in groundnut based on parameters like maximum and minimum temperatures, morning and evening relative humidity. A high goodness of fit was noticed for all the linear regressions and provided evidence for an empirical relationship between intensity of late leaf spot and microclimatic parameters studied.
PLANT PATHOLOGY

Author : JALENDER, P.
Title of the thesis : STUDIES ON CUCUMBER MOSAIC VIRUS INFECTING TOMATO
Major Advisor : Dr. BHARATI N. BHAT
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9552

ABSTRACT

Tomato is under the constant threat of diseases and about 200 diseases are known to infect tomatoes worldwide. Among these, Cucumber mosaic virus (CMV) is most devastating disease, as it can completely destroy the crop. The characteristic field symptoms of CMV disease include stunting, yellowing, mottling of leaves, extreme filiformity or shoe stringing of leaf blades, depending on virus strain and the host.

Survey conducted in tomato growing areas of Ranga Reddy district during kharif 2013 and in Guntur district during rabi 2013-14 revealed natural occurrence of per cent disease incidence ranged from 6.9 to 15.7 among different mandals. Apparent disease incidence was more (18.0 per cent) in Sayyedguda village followed by Sanghiguda (16.3
per cent) and Shamshabad (14.2 per cent) villages of Shamshabad mandal. DAC-ELISA results indicated the presence of CMV incidence in all the three villages of Shamshabad mandal (with per cent incidence of 6.25 to 7.60) of Ranga Reddy district, while the remaining surveyed areas in both the districts were devoid of CMV incidence.

Electron micrographs obtained with leaf dip preparation revealed the presence of spherical particles of 28.5 nm diameter indicating the presence of CMV belonging to Cucumo virus group.

Host range studies conducted on 47 plant (29) and weed species (18) belonging to 13 families against CMV indicated that CMV infected 20 plant and 17 weed species, which was evident by the development of local/systemic symptoms. Local lesions were exhibited in most of the plant and weed species except in Capsicum annuum (Solanaceae), Parthenium hysterophorus (Asteraceae), Euphorbia hirta and E. geniculata (Euphorbiaceae). Systemic symptoms were developed only on Tagetes erecta, P. hysterophorus (Asteraceae) and Tridax procumbens, Amaranthus tricolor (Amaranthaceae), Cucumis sativus, Lagenaria siceraria, Luffa acutangula and Trichosanthes cucumerina (Cucurbitaceae), Lablab purpureus (Fabaceae), C. annuum, Nicotiana glutinosa, N. benthamiana, N. rustica and N. tabacum (Solanaceae).

The disease incidence of CMV ranged from 0 to 100 per cent in thirty tomato entries. The accessions viz., EC620389, EC251672 and EC625642 recorded zero per cent incidence of CMV. Eight genotypes viz., STH-801, EC514006, EC615014, EC615018, EC617056, EC617089, EC631430 and Pusa Ruby recorded less than 50% CMV incidence, while 19 genotypes viz., EC654284, KARS-425, Punjab Chauhara, US-1196, PSR-10693, EC617080, EC617083, EC617084, EC676742, BSBS-47, Marutham, SR-6525, STH-816, EC251790, EC514013, EC514134, EC617088, EC617076 and EC620388 recorded more than 50 per cent incidence.

DAC-ELISA results revealed that of all 31 genotypes including Arka Vikas were found positive to CMV, except EC620389 which was also symptomless. All symptomatic genotypes responded positively for CMV by DAC-ELISA. Though the genotypes, EC251790 and EC625642 did not exhibit any characteristic symptoms of CMV even after second inoculation, reacted positively against CMV antiserum with DAC-ELISA tests.

Disease severity index ranged from 0 to 38.8 among the screened tomato entries, as compared to 47.2 recorded in susceptible check Arka Vikas. Maximum disease severity (38.8) was recorded in EC617080. Three accessions, viz., EC251790, EC625642 and EC620389 were grouped under highly resistant category, while four accessions viz., EC514006, EC615014, EC654284 and EC631430 as resistant. Accessions EC615018, EC620388, BSBS-47, SR-6525, EC617088, EC617084, EC617089, EC676742, STH-801, EC251672, EC514013 and PSR-10693 recorded moderately resistant reaction with disease severity index ranging from 10.1 to 20.0.
Three accessions viz., EC251790, EC625642 and EC620389 recorded highly resistant reaction, of which EC251790 belongs to *Solanum peruvianum*, while the remaining two accessions belong to the cultivated *S. lycopersicum*. Of the four accessions (EC514006, EC615014, EC654284 and EC631430) that exhibited resistant reaction, EC514006 belongs to *S. lycopersicum* var *cerasiforme*, and the remaining accessions are the cultivated species of *S. lycopersicum*

**PLANT PATHOLOGY**

**Author** : SURESH BABU, CH.

**Title of the thesis** : EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) AGAINST *Aspergillus niger* AND *Sclerotium rolfsii* AND PLANT GROWTH IN GROUNDNUT (*Arachis hypogea* L.)

**Major Advisor** : Dr. V. KRISHNA RAO

**Degree** : M.Sc. (Ag.)

**College** : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

**Accession Number** : D 9485

**ABSTRACT**

Groundnut (*Arachis hypogea* L.) is the 13th most important food crop of the world and one of the principal oil seed crops grown in India, covering nearly half of the area
under oil seeds. It is the world’s 4th most important source of edible oil and 3rd most important source of vegetable protein. Groundnut seeds contain high quality of edible oil (50%) rich in easily digestible proteins (25%) and carbohydrates (20%). Being a legume, it is also valued for its N₂-fixing capacity through the root nodule bacteria and also forms an important member in many crop rotations. Diseases caused by various plant pathogens are one of the major limiting factors for lower pod yields in groundnut and many biotic and abiotic stresses accounts for low productivity of groundnut. The diseases caused by fungi; viz., Aspergillus niger, Sclerotium rolfsii, Rhizoctonia solani, Macrophomina phaseolina and Fusarium oxysporum are prevalent in almost all the parts of the country.

Plant growth promoting rhizobacteria (PGPR) naturally occurring soil bacteria are being considered as viable alternatives, keeping in view, their ability to colonize roots, enhance plant growth and activate plant defenses against microbial plant pathogens.

A preliminary field survey was conducted on the incidence of collar rot and stem rot caused by A. niger and S. rolfsii in major groundnut growing mandals of Warangal, Mahaboobnagar and Ananthapur districts of Andhra Pradesh to quantify the disease incidence levels as the results indicated that the collar rot incidence either alone or in combination with stem rot was observed from vegetative stage to pod formation stage of the groundnut crop. Out of three districts surveyed, the average maximum mean wilt incidence of 7.3 per cent was observed in Mahaboobnagar district followed by 5.8 per cent in Ananthapur district while least incidence of 5.1 per cent was observed in Warangal district.

The mean population levels of Aspergillus niger varied from 0.92 to 1.58 per cent with highest population in Mahaboobnagar district (1.58×10³ cfu/g soil) followed by Ananthapur district (1.41×10³ cfu/g soil) while the population was at the lowest of (0.92×10³ cfu/g soil) in Warangal district. The mean population levels of Sclerotium rolfsii varied from 1.48 to 1.67 per cent with highest population in Ananthapur district (1.67×10³ cfu/g soil) followed by Mahaboobnagar (1.61×10³ cfu/g soil) and lowest population was found in Warangal district (1.48×10³ cfu/g soil) of Andhra Pradesh. The mean wilt incidence was high (5.9%) during vegetative stage and the incidence decreased with the advancement of plant age i.e., peg penetration (5.1%) and pod formation stage of the crop (4.3%)

The rhizosphere mycoflora associated with the soil samples were collected from diseased and healthy groundnut ecosystem from Warangal, Mahaboobnagar and Ananthapur district of Andhra Pradesh. The most predominant mycoflora associated with rhizosphere ecosystem of groundnut plants was found to be Aspergillus niger followed by Trichoderma spp and certain bacterial isolates.

Among the two native bacterial biocontrol agents tested, Native bacterial isolate-2 and Native bacterial isolate-1 were found superior in inhibiting the growth by 67.4 and 78.64 per cent against A. niger and S. rolfsii respectively. Among fungal bio control agents Trichoderma sp. (native isolate – 2) was found superior in inhibiting the mycelial growth by 66.0 and 49.95 per cent of A. niger and S. rolfsii respectively. Similarly, among the commercial two bacterial and one fungal bio control agents tested against A. niger and S. rolfsii, P. fluorescens( DOR) was found superior in inhibiting the growth by
72.8 and 85.50 per cent followed by *B. subtilis* (SRI BIO) inhibiting the growth by 39.3 and 81.65 per cent and *T. viride* (DOR), with 70.4 and 51.07 per cent inhibition.

Among the three potential bacterial biocontrol agents tested against *T. viride*, *P. fluorescens* (DOR) was found superior in inhibiting the mycelial growth by 87.0 per cent followed by *B. subtilis* (SRIBIO) with 84.0 per cent inhibition, native bacterial isolate 2 showed the least with 8.20 percent of the inhibition.

All the tested potential PGPR isolates were compatible with thiram at recommended (0.25%) and half recommended (0.125%) dosages. Among these three biocontrol agents, *P. fluorescens* (DOR) and *B. subtilis* (SRIBIO) were compatible equally with 1.2 mm inhibition zone and 1.0 mm inhibition zones. Whereas the native bacterial isolate 2 showed less compatibility 1.0 mm at recommended and half recommended dosages of thiram than *P. fluorescens* (DOR) and *B. subtilis* (SRIBIO).

The potential PGPR antagonists *P. fluorescens*, *T. viride* and *Rhizobium* and standard fungicide thiram were further used for their efficacy under green house conditions with 17 treatments imposed.

Out of 17 treatments, treatment T15 i.e., combined seed treatment with *P. fluorescens*, *T. viride*, thiram and *Rhizobium* recorded highest seedling germination of 86.27 per cent with a 26.2 per cent increase over control. Similar treatment recorded minimum of 12.17 per cent rot incidence with 74.9 per cent decrease over control. Similar trend was noticed in terms of seed rot also where minimum incidence of 3.3 per cent was recorded with 89.3 per cent decrease over control.

Combined seed treatments with *P. fluorescens*, *T. viride*, thiram and *Rhizobium* resulted in high increase in dry weights of the root and shoot with 82.71, 80.88 per cent increase respectively. Root, shoot and plant total length increased significantly by all the treatments, from 11.50 to 14.90 cm root length, 24.0 to 30.33 cm shoot length and 37.66 to 46.0 cm plant total length respectively when compared to control 8.20 cm per plant for root, 22.33 cm per plant for shoot and 29.66 cm per plant for plant total length.

Nodule number and nodule dry weight ranged from 46 to 98 per plant with an average of 72 nodules per plant highest mean nodule number (97.33 per plant) and mean nodule dry weight (259.67 mg) were recorded in treatment T15.

All the treatments were found to be significantly superior in increasing pod and seed yield of groundnut. Among the treatments T15 i.e., combined seed treatment with *P. fluorescens*, *T. viride*, thiram and *Rhizobium* were found to be most effective in increasing pod and seed yield.
PLANT PATHOLOGY

Author : PAVANI MENDA

Title of the thesis : INTERACTION OF TRICHODERMA HARZIANUM WITH SOIL MYCOFLORA
ABSTRACT

Rhizosphere effect assessed in terms of Rhizosphere(R):Soil(S) ratio indicated that egg plant and cauliflower rhizospheres gave better support to soil mycoflora with higher R:S value compared to tomato rhizosphere.

Eighty isolates of soil mycoflora comprising twenty five genera were isolated from rhizosphere and bulk soils of egg plant, cauliflower and tomato nurseries. Thirty four isolates belonging to fourteen genera, viz., Aspergillus, Botryodiplodia, Chaetomium, Coniothyrium, Curvularia, Fusarium, Humicola, Macrophomina, Metarrhizium, Mortierella, Phoma, Rhizoctonia, Sordaria and Trichoderma were obtained from egg plant rhizosphere. Among the egg plant rhizosphere mycoflora, maximum cfu was obtained with Rhizoctonia (12×10³ cfu/g soil) on 10th day and by Macrophomina on 30th day (19×10³ cfu/g soil). Seven of these fourteen genera are known to be plant pathogens.

Twenty isolates belonging to eight genera, viz., Aspergillus, Cladosporium, Fusarium, Macrophomina, Naranus, Penicillium, Phoma and Verticillium were obtained from cauliflower rhizosphere. Among the cauliflower rhizosphere mycoflora, maximum cfu was obtained with Fusarium sp (25×10³ cfu/g soil) on 15th day followed by Naranus on 10th day (18×10³ cfu/g soil) and A. terreus on 30th day (18×10³ cfu/g soil). Six of the eight genera, viz., Aspergillus, Cladosporium, Fusarium, Macrophomina, Phoma and Verticillium obtained from cauliflower system are known plant pathogens.

Twenty six isolates belonging to ten genera, viz., Aspergillus, Fusarium, Helminthosporium, Macrophomina, Papulaspora, Phoma, Rhizoctonia, Rhizopus, Sordaria and Sphaeropsis were obtained from tomato rhizosphere. Among the tomato rhizosphere mycoflora, maximum cfu was obtained with A. niger (22 x 10³ cfu/g soil) on 15th day. Six of these ten genera are known plant pathogens.

A. niger, A. flavus, Fusarium, Macrophomina and Phoma were appeared on 10th day in all the three test crops’ rhizospheres indicating their better rhizosphere colonizing ability as primary colonizers. Native Trichoderma sp. could be isolated only in the rhizosphere of egg plant 20 days after sowing and hence regarded as a secondary colonizer which required stimulus from rhizosphere. Trichoderma population was found nil in the rhizospheres of tomato and cauliflower indicating that these crops could not stimulate native Trichoderma species.
Of the eighty interactions studied in vitro in dual culture using *Trichoderma harzianum* isolate, Th4 and individual soil fungus, 59 isolates (74% of total 80 isolates) were overgrown by Th4 in dual culture, 13 isolates (16%) could inhibit Th4 growth with a clear zone of inhibition and upon which Th4 could not overgrow, and only in 8 interactions (10%) Th4 attained static growth, i.e., neither zone of inhibition was formed nor overgrew by Th4. Genus wise analysis for genera with multiple isolates indicated that 73% isolates of Aspergillus, 80% isolates of *Fusarium*, 67% isolates of *Macrophomina*, 80% isolates of *Rhizoctonia*, 80% isolates of *Phoma*, 25% isolates of *Penicillium*, 100% isolates of *Chaetomium*, *Curvularia*, *Humicola*, and *Helminthosporium*, were overgrown by Th4. Zone of inhibition was recorded with 20% isolates of *Fusarium*, 25% isolates of *Macrophomina*, 75% isolates of *Penicillium*, 10% isolates of *Phoma* and 100% of *Sordaria*. Isolate *T. harzianum* Th4 attained static growth with 27% isolates of *Aspergillus*, 20% isolates of *Rhizoctonia*, 10% isolates of *Phoma* and 8% isolates of *Macrophomina* and 33% of *Trichoderma* isolates.

None of the eighty isolates had growth promotion due to the presence of *T. harzianum* Th4 in dual culture, which further indicated that *T. harzianum* Th4 did not help soil fungi to proliferate fast.

Three isolates were selected for further studies in soil system which included *Sordaria* (S2) with formation of zone of inhibition, *Mortierella* with overgrowth of *T. harzianum* (Th4) and *Macrophomina* (M11) with static interaction in dual culture and a known pathogen. Interaction effects were observed in terms of *Trichoderma* population in the presence or absence of pathogen *P. aphanidermatum* in natural or autoclaved soil system using soil cup method. Soil cup method revealed, *T. harzianum* Th4 population was higher in autoclaved soil (4.8 x 10^7 cfu/g soil) than in natural soil (2.0 x 10^7 cfu/g soil). Presence of *P. aphanidermatum* enhanced mean *T. harzianum* Th4 population compared to *P. aphanidermatum* unamended soil. The population was maximum in *Mortierella* amended treatments. Though *Sordaria* and *Macrophomina* were found antagonistic to *T. harzianum* Th4 in dual culture, *T. harzianum* Th4 population was enhanced in their presence along with *P. aphanidermatum*. Population of *T. harzianum* Th4 showed increasing trend in autoclaved or natural soil up to 10th day, there after population decreased. Presence of *Sordaria* or *Macrophomina* decreased Th4 population especially in pathogen unamended soil. *Mortierella* helped Th4 in increasing its population with or without *Pythium* in both natural and autoclaved soil system.

In pot culture soil application with *Sordaria* alone was found to give significantly better plant stand (28.3 plants/pot and 29.7 plants/pot out of 50 seeds sown) than *T. harzianum* Th4 applied pots with 64.1% and 69.3% disease control. Highest disease control was 81.4% obtained in *Mortierella* alone applied pots with 33 plants/50 seeds sown equivalent to 86.8% plant stand over absolute check. Thus the present study revealed biocontrol capability of *Sordaria* and *Mortierella* better than *T. harzianum* Th4. Soil application of *Macrophomina* alone gave 17 plants/50 seeds lowest among the treatment tested but was on par with Th4 seed treatment. This indicated that though *Macrophomina* was a known pathogen, in the presence of *Macrophomina*, effect of *P. aphanidermatum* was reduced (22.2% disease control).
Increased *T. harzianum* Th4 population did not increase disease control potential against tomato damping off caused by *P. aphanidermatum*. Instead increased *T. harzianum* Th4 population decreased the efficacy of fungi antagonistic to *P. aphanidermatum* such as *Sordaria* or *Mortierella*.
PLANT PATHOLOGY

Author : PRUTHVI BHARGAVI, M.L.
Title of the thesis : STUDIES ON EFFICACY OF BIOAGENTS BOTANICALS AND FUNGICIDES ON SEED MYCOFLORA AND SEED QUALITY OF BLACK GRAM
Major Advisor : Dr. B. RAJESWARI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9484

ABSTRACT

Black gram (Vigna mungo L. Hepper) is one of the premium pulse crop amongst all pulses and is also rich in phosphoric acid. Seed mycoflora known to affect the quality and quantity of seeds and also decreases seed germination and vigour of the seedlings, seed quality and causes seed rot, pre and post emergence seedling mortality and root rots. Seed borne fungal pathogens declines seed viability and vigour both in storage and field conditions and subsequently resulting in yield loss in field. Macrophomina phaseolina is one of the seed and soil borne disease causing significant yield loss of up to 25 per cent which decrease the quality and quantity of black gram seeds rendering the seeds unfit for consumption. Hence, detailed investigations were carried out to study the occurrence of seed mycoflora of black gram and to find out suitable detection method, in vitro and in vivo evaluation of bioagents, botanicals and fungicides against M. phaseolina of black gram was conducted at Department of Plant Pathology, College of Agriculture, Rajendranagar, Hyderabad during 2011 – 2012.

Sixty black gram seed samples of seven varieties viz., LBG 20, T 9, LBG 753, LBG 623, LBG 17 (Ranga Reddy), WBG 26 (Warangal), LBG 752, LBG 623, LBG 20 (Guntur), T 9, LBG 402 and LBG 623 (Krishna), T 9 and LBG 17 (Prakasam), LBG 20 (Srikakulum), East Godavari and West Godavari) collected from black gram growing locations were analysed by standard blotter and agar plate methods to detect the mycoflora associated with the black gram seed samples.

Seven fungi of six genera viz., Aspergillus flavus, Aspergillus niger, Alternaria alternata, Curvularia sp., Macrophomina phaseolina, Fusarium sp. and Rhizopus sp. were found associated with different black gram varieties. The occurrence of M. phaseolina was found predominant (32.1%), while incidence of Curvularia sp. was least (4.67%). The total percentage incidence of
mycoflora was high in var. WBG 26 collected from Warangal district (86%), while it was low in variety T 9 (3%) of Krishna district by blotter method. The total seed mycoflora ranged from 28.2 to 86% by blotter method. The occurrence of seed mycoflora was also similar in agar plate method. The frequency of predominant seed mycoflora viz., *M. phaseolina* was high in var. WBG 26 (25%) of Warangal district and least in var. T 9 (1%) of Krishna district. The total seed mycoflora ranged from 9 to 62.5%.

Out of two methods employed for detection of seed mycoflora, standard blotter was found superior over agar plate method.

Among the three methods tested to prove pathogenicity of *M. phaseolina* on black gram var. WBG 26, seed inoculation method was found superior in producing maximum seed rot and seedling blight (90%) over seedling symptom test (80%) and spray inoculation (70%).

*In vitro* evaluation of fungicides against test pathogen *M. phaseolina* indicated that captan and tebuconozole were found on par 99.7% and 99% over pyraclostrobin (80%). Botanical, neem oil was also effective in inhibiting the test pathogen by 40.4%. Bioagents, *Trichoderma harzianum* and *T. viride* were found to be superior in inhibiting the test pathogen by 99% and 71.2% respectively. The effective botanical (neem oil), bioagent (*T. harzianum*) and fungicide (captan) were further tested for their efficacy against test pathogen under glass house conditions. The results revealed that combined seed treatment with captan + neem oil + *T. harzianum* was found to be superior in not only increasing the plant biometrics (shoot length) and seedling emergence 64.5% and 93.65% respectively, but also resulted in reduction of pre and post emergence mortality by 89.6% and 89.4%, respectively in black gram.
Groundnut is one of the most important oilseed crops grown in Andhra Pradesh. The crop is affected by a variety of diseases, of which stem rot caused by *S. rolfsii* and collar rot affected by *Aspergillus niger* are very important and has become one of the major constraints, causing severe damage to the crop. Management of stem rot, collar rot diseases are difficult because of soil borne nature and the chemical methods are very expensive and will not be that good affect against the pathogen and also has a wide host range. In view of unsatisfactory control of soil borne pathogen by chemicals, considerable attention has been given on the other non-chemical means of plant disease control. This can be effectively managed by the integration of biological and conventional methods.
Compatibility of living organisms with modern inputs in plant protection like fungicides, insecticides is a pre-requisite for disease management. Hence, there is need to test the compatibility of fungicides and insecticides and their combinations with *Trichoderma* spp. against seed and soil borne diseases of groundnut.

Different microorganisms were isolated consistently from rhizosphere of groundnut cultivars in red soil of Mahanandi Farm by serial dilution plate method viz., *Trichoderma viride, Aspergillus flavus, A. niger, Fusarium spp, Rhizopus spp* and *S. rolfsii*. Among these isolates *Trichoderma viride* recorded maximum number of fungal colonies of $5 \times 10^3$.

*In vitro* screening of *Trichoderma* spp. against *S. rolfsii* by dual culture technique indicated that *Trichoderma* spp inhibited the growth of *S. rolfsii* by 54%. *In vitro* screening of *Trichoderma* spp against *Aspergillus niger* inhibited the growth by 25%.

Compatibility of *T. viride* against fungicides and insecticides were tested under *in vitro* conditions. Compatibility of *T. viride* was observed with mancozeb, tebuconazole, imidachloprid, mancozeb + imidachloprid, mancozeb + chlorpyriphos, mancozeb + imidachloprid + chlorpyriphos. Complete inhibition of *T. viride* was observed with tebuconazole + imidachloprid, tebuconazole + chlorpyriphos, tebuconazole + imidachloprid + chlorpyriphos.

Field experiment was conducted and the results revealed that seed treatment with combination of tebuconazole@1g/kg and *Trichoderma*@ 8g/kg were found significantly superior to all other treatments and improved the seed germination (91 %), low stem rot incidence at 100 DAS (52.6) and low late leaf spot PDI (25.3), low collar rot incidence (11.6), maximum initial plant population (301.7) and final plant population (256.6).

They also significantly improved plant biometrics viz. root weight (0.82g), number of nodules (166). Further the same treatment increased the yield and yield attributes like chlorophyll content (39.9), pod yield (1641.6 kg ha$^{-1}$), haulm yield (2800 kg ha$^{-1}$), low leaf drop (123.3 kg ha$^{-1}$), less pods left over in the soil (74.3 kg ha$^{-1}$), more number of pods per plant (30) and more test weight (30.7 g) than other treatments.
PLANT PATHOLOGY

Author : SURESH, V.
Title of the thesis : STUDIES ON MANGO GUMMOSIS WITH SPECIAL REFERENCE TO Lasiodiplodia theobromae (Pat.) Griffon & Moube
Major Advisor : Dr. B. VIDYA SAGAR
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9550

ABSTRACT

Mango (Mangifera indica L.) is one of the world’s most important and esteemed fruit of the tropical and subtropical world and is cultivated extensively as a commercial fruit crop in India.
Mango gummosis incited by *Lasiodiplodia theobromae* (Pat.) Griffon & Moube [synonym: *Botryodiplodia theobromae*] is becoming a serious problem in India on many popular varieties of mango particularly during monsoon and post-monsoon periods.

Survey was conducted to assess the incidence of gummosis in the major mango growing areas of Andhra Pradesh, *viz.*, Krishna, Khammam, Rangareddy and Medak during June to October, 2013. During the survey gummosis incidence was assessed and symptoms characteristic of the disease, *viz.*, gummosis, dieback, and vascular discoloration were noticed in the orchards surveyed. Among the four districts surveyed, maximum disease incidence (13.3 per cent) was recorded in the cultivar, Chinnarasamand least incidence was recorded in Baneshan (2.0 per cent) and kobbarimamidi (2.0 per cent) cultivars at Rekunta village of Krishna district.

Growth rate of *L. theobromae* on different solid media at different temperatures was studied. The radial growth of the mycelium was maximum (8.89 and 8.83) on PSA medium at 30 and 35°C followed by PDA (8.46) at 35°C. Least mycelial growth (6.3) was observed in MEA at 25°C. The maximum pycnidial production was observed on OMA followed by PDA at temperature above 30°C. Least pycnidial production was observed on MEA at all the temperatures tested. The fungal growth on various media was categorized as circular with sparse aerial mycelium, circular with moderate aerial mycelium and circular with abundant mycelium. The color of colony ranged from whitish grey to blackish grey.

The pathogen was isolated from infected host plant, purified and identified as *L. theobromae* and pathogenicity was proved by stem inoculation method. Morphological characters of *L. theobromae* were studied and following observations were made. Colonies were grey-brown to black with dense aerial mycelia on the PDA medium. Pycnidia were separate or aggregated, dark brown, thick or thin-walled. Conidiophores were hyaline, cylindrical to sub-Obpyriform, with oblong, straight and hyaline single celled conidial and initially. Gradually the conidial became dark brown and produced one septum with longitudinal striations; the size of conidia measured 22-29×11–15 μm.

Efficacy of nine fungicides was tested *in vitro* against *L. theobromae*, of which carbendazim, carbendazim + mancozeb and propiconazole were found superior at both 250 and 500 ppm concentrations with 100 per cent inhibition of the test pathogen. However, mancozeb and propineb were found effective only at 500 ppm concentration. Among the botanicals and *Trichoderma* isolates tested *in vitro*, Garlic bulb extract and *Trichoderma* isolates T9, T6, T3 and T2 were found effective against *L. theobromae*.

Screening of ten different mango cultivars against *L. theobromae* by stem inoculation method revealed that Chinnarasalu, Manjeera, Tellagulabi and Suvernarekha were susceptible to gummosis, while Baneshan, Alphonso, Imam Pasand and Pandurivarimamidi were moderately resistant. Among the cultivars screened, Suvernarekha was found highly susceptible to mango gummosis.
PLANT PATHOLOGY

Author : SUMALATHA NALLABEEMA
Title of the thesis : STUDIES ON BLIGHT OF TOMATO INCITED BY Rhizoctonia solani
Major Advisor : Dr. B. PUSHPAVATHI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
ABSTRACT

Tomato is one of the most important vegetable crop cultivated for its fleshy fruits. *Rhizoctonia solani* is the most important soilborne pathogen of tomato crop and in recent past it is known to cause blight symptoms on stems of tomato plants which has become a serious threat to tomato cultivation in Ranga Reddy district of Andhra pradesh.

The pathogen was isolated on PDA from blight effected tomato plants collected from farmers’ fields and was identified as *Rhizoctonia solani* based on its cultural and morphological characteristics. The culture of the fungus was greyish white in the beginning which later turned to black in color with cottony aerial mycelial growth. The hyphae produced branches mostly at right angles with constriction at the origin of branch and often formed a septum near the branch origin. The fungus produced microsclerotia of 0.8 - 1.0 mm in size in sixty days old cultures.

Of the three inoculation methods, root dip inoculation was found to be the best as it resulted in maximum per cent disease incidence (96.67) in a short period of incubation (two days). Symptoms produced due to soil infestation and root dip inoculation appeared as typical damping off symptoms with dark brown lesions at the collar region and yellowing of leaves which lead to death of seedlings. Whereas, in case of stem application the initial symptoms appeared as water soaked lesions on stems which later became oval to irregular light brown necrotic spots. Mature spots on stems appeared as large brown blighted portion with typical cracks on the bark. In advanced stages plant collapsed at infected portion leading to death of the plant.

Of the eleven tomato cultivars screened in vitro and glass house condition, Arka abha and PKM-1 were found significantly superior over other cultivars in terms of incidence of *Rhizoctonia solani*. Cultivar Arka vikas showed maximum susceptibility towards *Rhizoctonia* incidence and also poor growth parameters.

Among the sources of rhizosphere soil collected, significantly highest mean cfu count of mycoflora (27.70) and fluorescent pseudomonads (40.75) was observed in case of samples collected from weed plants followed by healthy tomato plants. The least mean cfu count of mycoflora (20.20) and fluorescent pseudomonads (21.31) was observed in samples collected from diseased plants. All the antagonistic isolates were tested for their efficacy against *R. solani* under in vitro condition. Among the mycoflora, the isolate M10 was found to be the potential antagonist and was identified as *Trichoderma viride*, whereas the effective pseudomonad isolate P1 was identified as *Pseudomonas fluorescens*.

Of the eight fungicides tested propiconazole, hexaconazole, tebuconazole, captan + hexaconazole and trifloxystrobin + tebuconazole showed cent per cent inhibition of the growth of the pathogen over control at all the dosages tested (recommended, 75% of
recommended, 50% of the recommended, 25% of recommended dosage). Of these chemicals, pyroclostrobin+metiram was found compatible with *Trichoderma viride*.

Among the IDM components tested, the treatment with potential antagonist + effective fungicide + tolerant cultivar showed lowest per cent disease incidence (18.67) when compared to all other treatments tried and found to be the most effective IDM strategy in reducing the incidence of *R. solani* on tomato.
Chickpea (*Cicer arietinum* L.) is one of the major grain legume pulse crops of India and other semi-arid regions of the World. Chickpea is severely affected by *Colletotrichum* blight caused by *Colletotrichum dematium* (Persoon) Grove. And *Colletotrichum capsici* (Sydow) Butler and Bisby. In some of the major chickpea growing areas of Kurnool, Prakasam and Anantapur districts of Andhra Pradesh during rabi 2009 and 2010 due to heavy unusual rains, the disease accounted for failure of the crop in many areas and led to re-sowing of crop in some areas. There is no research on *Colletotrichum* blight of chickpea in Andhra Pradesh as the disease occurred in severe form in recent years. Hence, studies were conducted in the present investigation on Colletotrichum blight of chickpea.

A total of seven isolates of *Colletotrichum* blight pathogen were collected from major chickpea growing areas of Kurnool, Anantapur, Prakasam, Kadapa and Nellore districts of Andhra Pradesh. Variability among seven isolates of *Colletotrichum capsici* causing blight in chickpea with respect to morphological and cultural characteristics was studied. Genetic diversity at molecular level among isolates was studied using molecular marker technique like RAPD. Management of pathogen by fungicides and bio-control agents was also studied.

The pathogen was isolated from infected plants showing the typical *Colletotrichum* blight symptoms, viz., brown necrotic lesions on basal stem, circular brown lesions on leaves, circular to enlarged brown lesions with acervuli in concentric rings on pods, blightning, wilting and drying of infected plants and purified by single spore isolation method. After confirming the pathogenicity, the isolates of the pathogen were identified as *Colletotrichum capsici* based on colony characteristics and spore measurements with the help of relevant monograph, illustrated books and CMI descriptions.

In disease severity tests, isolate Cb 2 exhibited the maximum PDI (52.00) followed by Cb 1 (41.33), while Cb 7 recorded the lowest PDI (12.67).
The maximum size of conidia (29.45×3.81μm) was observed in isolate Cb 1, while isolate Cb 4 showed minimum size (20.76×2.90μm). All the isolates produced falcate shaped conidia, while Cb 2 produced both falcate and fusiform shaped conidia. Isolate Cb 3 produced the longest (119.22μm) setae, while the isolate Cb 7 produced shortest (87.63μm) setae. The width of setae is highest in isolate Cb 3 (4.72 μm) and least in isolate Cb 4 (3.76μm).

Colour of the cultures was dark grey in isolates Cb 1, Cb 2, Cb 4 and Cb 6, whereas it was light grey in isolate Cb 3 and whitish in isolates Cb 5 and Cb 7. The isolate Cb 4 showed maximum radial growth (82.33 mm) followed by isolate, Cb 1 (81.00 mm), while least was recorded in isolate Cb 5 (65.13 mm). A large variation was recorded in the mycelial dry weight among the isolates which varied from 526.06 mg (Cb 5) to 648.41 mg (Cb 1). Excellent sporulation was observed in isolates Cb 1 and Cb 2, Good sporulation was observed in isolates Cb 4, Cb 6 and Cb 7, moderate sporulation was observed in Cb 5 and Cb 3 had shown poor sporulation.

RAPD data distinguished the isolates into two main clusters, i.e. Cluster I (Cb 1 and Cb 7), Cluster II, which is again divided into two sub clusters of Cluster IIA (Cb 3, Cb 4 and Cb 5) and Cluster IIB (Cb 2 and Cb 6). The clustering of different isolates by RAPD technique was similar with respect to geographical location, i.e., the isolates Cb 3, Cb 4 and Cb 5 collected from Anantapur district fall into one cluster i.e., cluster IIA. Apart from the above said character, remaining all characters like virulence, size of conidia, size of setae, colony colour, colony growth, colony diameter, sporulation and mycelia dry weight were not in agreement to the isolates grouped by RAPD technique.

Management of pathogen by fungicides and bio-control agents in pot culture experiment revealed that fungicide tebuconazole (0.1%) is more effective against the pathogen with less PDI of 17.33 and more disease reduction of 73.00 followed by difenconazole (0.1%), hexaconazole (0.2%), kresoxim methyl (0.1%). Mancozeb + cymoxanil (0.25%) recorded PDI of 48.33 and disease reduction of 42.00 which is least effective against pathogen. Among the bio-control agents tested Trichoderma koningii, (0.4%) with PDI and disease reduction of 25.33 and 65.00 respectively was more effective followed by Trichoderma harzianum (0.4%) with PDI and disease reduction of 28.67 and 61.67 respectively.
PLANT PATHOLOGY

Author : GUNA TULASI PALLA

Title of the thesis : VARIABILITY OF BIPOLARIS ORYZAE CAUSING BROWN SPOT OF RICE IN ANDHRA PRADESH AND MANAGEMENT OF THE DISEASE WITH FOLIAR APPLICATION OF MINERAL NUTRIENTS

Major Advisor : Dr. J. KRISHNA PRASADJI

Degree : M.Sc. (Ag.)

College : AGRICULTURE COLLEGE, BAPTLA

Accession Number : D 9584

ABSTRACT

Variability in isolates of Bipolaris oryzae, brown spot disease pathogen in rice, in Andhra Pradesh was investigated and the effect of certain mineral nutrients in the management of the disease was evaluated during 2010-11. Considerable variability among B. oryzae isolates obtained from six geographically distant rice growing locations of Andhra Pradesh was determined. Isolates differed marginally in colour and type of colony growth in culture. All the isolates exhibited a cottony growth and appeared whitish initially and turned dark brown with age on Czapek dox agar (CDA), potato dextrose agar (PDA) and rice leaf extract agar (RLE). Nlr and Sklm isolates showed slight variation with change in culture medium. Bpt isolate was the fastest while Mtu isolate was the slowest in radial growth. PDA supported better radial growth than CDA and RLE for most of the isolates with the exception of Mtu which showed better growth on RLE.

Isolates significantly differed in initiation and intensity of sporulation (13.7 – 40.7 days) with Bpt isolate as the earliest and Nlr isolate as the last. Spore production ranged between $13.83 \times 10^4$ /ml in Nlr isolate and $32.96 \times 10^4$ /ml in Mtu isolate. The fast growing Bpt isolate also produced a high number of spores $29.22 \times 10^4$ /ml which is an exception to the well known observations that the slow growing isolates produce higher number of spores than the fast growing isolates.
Spore dimensions of *B. oryzae* varied among isolates with the longest and widest spores in Khm isolate (101.2 × 15.6 μm) and the shortest and narrowest spores in Plm isolate (60.5 × 12.5 μm). Longer and wider spores were generally observed when the isolates were cultured on RLE and PDA than on CDA.

Culture filtrate of all isolates caused necrotic spots with a water soaked halo on leaves of rice genotypes indicating elaboration of a toxic principle in their culture filtrates. Largest spots were produced by culture filtrate of Plm isolate (2.7 mm) and the smallest spots were observed in inoculations with culture filtrate of Nlr isolate (2.1 mm). Rice genotypes showed differential sensitivity to culture filtrates of isolates indicating variation in genotype – isolate interaction. Longest mean spot size (3 mm) was observed in Nlr 3041 genotype and the smallest was in Bpt 2425 (1.9 mm).

Variations in incubation period (IP) and latent period (LP) with pathogen isolate and host genotype were observed when inoculated with spore suspensions of isolates in pot culture. Incubation period was the longest for Khm isolate (21.86 h) and the shortest for Bpt isolate (20.36 h). Rice genotypes too showed significant variation in IP ranging from 16.72 h (Nlr 145) to 23.06 h (Bpt 2425). Latent period for isolates in different rice genotypes varied between 82.58 h in Bpt isolate and 109.19 h in Nlr isolate.

Spray application of K2SO4, MnSO4, and ZnSO4 either alone or in combination with each other could significantly decrease the increase in brown spot severity than unsprayed check but this effect was significantly lesser than that observed in mannose treatment. An actual reduction in PDI than in previously recorded observation in any treatment was not observed indicating change in the apparent rate of infection (*r*). The mineral nutrient sprays had a rate reducing effect on the brown spot development which was evident from the lower *r*. Reduction in severity of brown spot was reflected in a reduction in yield loss (29 to 43%) and hence a higher yield in mineral nutrient applications which however, was less than that realized with mancozeb application. Among mineral nutrients K2SO4 was the most effective in reducing the yield loss by 43% Mineral nutrients may possibly have corrected the sub expressional nutrient deficiencies besides causing a reduction in disease and yield loss that ultimately led to higher yields.

Grain discolouration due primarily to *B. oryzae* was observed at harvest which increased with passage of storage period. Mineral nutrient applications could decrease grain discolouration than unsprayed check. Increase in grain discolouration with storage period was due to increase in contaminant storage fungi like *Curvularia* sp, *Fusarium* sp, *Aspergillus* sp and *Penicillium* sp.
ABSTRACT

Chickpea (*Cicer arietinum* L.) is one of the major legume pulse crop of India and other semi-arid regions of the World. Chickpea is severely affected by *Colletotrichum* blight caused by *Colletotrichum dematium* (Persoon) Grove. and *Colletotrichum capsici* (Sydow) Butler & Bisby., in Kurnool, Prakasam and Anantapur districts of Andhra Pradesh during *rabi* 2009 and 2010 due to heavy unusual rains which resulted in failure of the crop in many areas and led to re-sowing of crops in some areas. There is no research on *Colletotrichum* blight of chickpea in Andhra Pradesh as the disease occurred in severe form in recent years. Hence, studies were conducted in the present investigation on *Colletotrichum* blight of chickpea.

An intensive roving survey was conducted on *Colletotrichum* blight in major chickpea growing mandals of Kurnool, Anantapur, Prakasam districts and parts of Kadapa and Nellore districts during *rabi* 2011-12 and the results indicated that the disease incidence ranged from 0 to 90 per cent with maximum disease incidence of 76.5 per cent was observed in Nellore district followed by Prakasam district (41.8%) while...
minimum per cent disease incidence was recorded in Anantapur district (6.3%) followed by Kurnool district (7.2%).

The pathogen was isolated from infected plants from farmers’ fields of Nandyal region, Kurnool district showing the typical Colletotrichum blight symptoms viz., brown necrotic lesions on basal stem, circular brown lesions on leaves, circular to enlarged brown lesions with acervuli in concentric rings on pods, blighting, wilting and drying of infected plants. The pathogen was purified by single spore isolation method after confirming the pathogenicity and identified as Colletotrichum capsici by Indian type culture collection centre (ITCC), IARI, New Delhi and Agharkar Research Institute (ARI), Pune.

Sensitivity of C. capsici to different fungicides viz., mancozeb (0.25%), carbendazim (0.05% and 0.1%), SAAF (carbendazim + mancozeb) (0.2%), chlorothalonil (0.2% and 0.3%), hexaconazole (0.2%), thiophanate methyl (0.1%), copper oxy chloride (0.3%) and tebuconazole (0.1%) was assessed in poisoned food technique. Mancozeb, hexaconazole, tebuconazole were found to be effective which inhibited the growth of the pathogen completely (100%) whereas chlorothalonil (0.2%) and copper oxy chloride showed the least efficacy with inhibition of 69.7 and 67.1 per cent, respectively.

The bio-control agent T. koningii showed the highest rate of inhibition (85.7%) compared to T. viride (74.8%) in dual culture technique.

In integrated disease management, seed treatment with carbendazim @ 2g/kg + foliar spray with SAAF (12% carbendazim+ 63% mancozeb) @ 0.2% immediately after onset of disease + foliar spray with SAAF (12% carbendazim + 63% mancozeb) @ 0.2% 15 days after the first spray was found to be effective as it recorded the least PDI of 15.5 per cent, maximum plant height (20.7 cm), maximum shoot dry weight (7.1 g) and maximum root dry weight (0.24 g) while the treatment T2 (Seed treatment with Trichoderma viride @ 4 g/kg) was found to be the least effective with PDI of 38.8 per cent in pot culture studies.

In field experiment there was no incidence of disease due to prevailing weather parameters viz., rainfall (15.1 mm), mean relative humidity (77.6%), mean maximum temperature of 32.9°C and mean minimum temperature (21.9°C) recorded during the crop season at Nandyal region, Kurnool district.

Among 30 Chickpea genotypes (pre released cultures and varieties) screened against blight disease of Chickpea in pot culture none of them was found to be immune or resistant. All the genotypes showed intermediate to susceptible reaction to Colletotrichum blight. ICCV-37, JAKI-9218, JG-315, KAK-2, NBeG-1, NBeG-3, NBeG-20, NBeG-106, NBeG-147, NBeG-398, NBeG-399, NBeG-401 and VIHAR were showed intermediate reaction while NBeG-390, NBeG-108, NBeG-102, NBeG-49 and JG-62 showed susceptible reaction to Colletotrichum blight.
Disease was not recorded in the field experiment of screening genotypes (pre released cultures and varieties) against the pathogen as weather parameters recorded were uncongenial for the growth and multiplication of the pathogen.
Sarocladium oryzae causing sheath rot disease on rice was isolated and identified, and the effect of nutritional, environmental factors on growth and sporulation, survival and viability of the inoculum, interaction between S. oryzae and other foliar pathogens of rice, and the effect of bio-control agents and plant extracts on the growth, sporulation and spore germination was studied.

Among the six solid nutrient media used, best growth was observed on oat meal agar medium with the shortest incubation period. Least growth was observed on potato dextrose agar medium.

Among the three different liquid media tested, good growth of the fungus was recorded on Richard’s solution followed by Brown’s solution and potato dextrose broth. The optimum temperature for the growth and sporulation of the fungus was 25°C when the fungus was grown over a temperature range of 15 to 35°C. Maximum growth and sporulation occurred at relative humidity level of 90 per cent when tested over a range of 75 to 97 per cent relative humidity. Maximum growth of the fungus was recorded at pH 7 over a range of pH 3 to 9 tested.

The survival and viability of S. oryzae in rice boot leaf sheaths was higher when stored for 30 days in both sterilized and unsterilized leaf sheaths. Similar pattern was observed in the case of seed in both agar plate and blotter paper methods. The viability of fungus significantly showed reduction with increase in storage period, even though the fungus could be isolated after 120 days of storage. Survival and viability of S. oryzae in soil collected from infected field did not produce any colony of the fungus.

Bipolaris oryzae significantly inhibited the growth of S. oryzae followed by Rhizoctonia solani. Culture filtrate of B. oryzae and R. solani significantly inhibited the growth of the fungus.

Of the six leaf/bulb extracts used against S. oryzae, Allium cepa was the most effective in inhibiting the growth, sporulation and also spore germination. While Datura stramonium was the least effective in inhibiting growth and spore germination and Ocimum basilicum was least effective in inhibiting sporulation.

Among the five isolates of Trichoderma tested, Trichoderma harzianum was the most effective in inhibiting the growth of S. oryzae, while T. reesei was most effective in inhibiting sporulation and spore germination of S. oryzae.
SEED SCIENCE & TECHNOLOGY

Author : SUJATHA SIVANI, K.
Title of the thesis : MORPHOLOGICAL CHARACTERIZATION OF FINGER MILLET (Eleusine coracana L.)
Major Advisor : Dr. K. KESHAVULU
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9518

ABSTRACT

The present study was conducted to evaluate 50 finger millet genotypes for characterization, to assess genetic diversity and to assess genetic variation in finger millet genotypes. The material comprised of accessions and varieties sown in a Randomized Block Design (RBD) in three replications during Kharif 2013 at NBPG, Rajendra Nagar, Hyderabad and laboratory studies were conducted at Department of Seed Science and Technology, College of Agriculture, ANGRAU, Rajendra Nagar, Hyderabad.

The plant morphological characteristics viz., days to flowering, days to maturity, plant height, number of basal and productive tillers per plant, number of leaves on the main tiller, flag leaf traits, number of fingers and finger length and width, characters and seed and seedling traits viz., test weight, protein and calcium, germination (%), rate of germination, shoot and root length, seedling vigour indices and field emergence were useful for discrimination and characterization of genotypes as they exhibited variation. Genetic diversity analysis of these characters resulted in the grouping of these genotypes into clusters for plant, seed and seedling characters respectively thereby confirming their usefulness in discrimination of finger millet genotypes.

All the 50 finger millet genotypes were evaluated and characterized for plant qualitative and quantitative characters. The genotypes exhibited sufficient variation for majority of the characters based on GCV and PCV. High heritability coupled with high genetic advance was exhibited by number and length of fingers, plant height, number of basal and productive tillers per plant, number of leaves on the main tiller and flag leaf sheath indicated additive gene effect enabling the direct selection of trait. Similarly, all the seed and seedling characters also showed high GCV and PCV, high heritability and genetic advance which indicated their usefulness for crop improvement programmes.

Based on Mahalanobis D² analysis, the genotypes were grouped into 10 and 11 clusters for plant and seed and seedling characters respectively. Greater genetic divergence found between clusters for qualitative and quantitative plant and seed and
seedling characters could be exploited in the hybridization programmes. The characterization studies are useful in seed multiplication as well as DUS testing for protection of varieties.

Principal Component Analysis (PCA) confirmed the usefulness of the above traits for discrimination of finger millet genotypes. However plant characters were found more useful for discrimination of the genotypes. The results suggested that there was considerable variation and diversity for all the plant, seed and seedling qualitative and quantitative characters under study.
ABSTRACT

A field experiment was conducted on “E valuation of low flow drip irrigation in maize-sunflower cropping system” during both kharif and rabi seasons in the two successive years i.e., 2011-12 and 2012-13 at College Farm of College of Agriculture, Rajendranagar, Acharya N. G. Ranga Agricultural University. The experiment was laid out in Randomized Block Design (RBD) with three replications. Two irrigation regimes viz., 100 and 75 percent ETc and four discharge rates viz., 2.0, 1.6, 1.0 and 0.6 litre per hour (LPH) were adopted, thus a total of 8 treatments were imposed. Maize hybrid DeKalb and sunflower hybrid DRSH 1 were used for the study.

Irrigation scheduled at 100 percent ETc registered higher values of growth parameters viz., plant height, leaf area index and dry matter production as compared to irrigation scheduled at 75 percent ETc. In both irrigation regimes the plant growth parameters were linearly increased with decreasing drip discharge rate (from 2.0 LPH to 0.6 LPH) and highest values were recorded at 100 percent ETc with the discharge rate of 0.6 LPH treatment in maize and sunflower during both the years. The available nutrients (N, P2O5 and K2O) status after harvest of the maize and sunflower was increased from 75 percent ETc to 100 percent ETc and within the irrigation regimes the nutrient availability was increased from high discharge rate to low discharge rate during both the years. All the treatments scheduled at 100 percent ETc level registered significantly higher NPK contents and uptake by both st over / stalk and grain/ seed than the treatments scheduled at 75 percent ETc level at the same level of discharge during both the years. Irrigation scheduled at 100 percent ETc with the discharge rate 0.6 LPH resulted in higher nutrient concentrations and higher uptakes in both maize and sunflower during both the years. The NO3–N concentration was more at vertical plane of 0-15 cm and there after it decreased up to 45 cm depth in all the drip irrigation treatments after harvest of maize and sunflower in both the years. The highest NO3–N concentration was observed at 100 percent ETc for emitter discharge of 0.6 LP H in all the depths.
The grain/seed yield and Stover/stalk yields were increased with increasing irrigation amount and with decreasing drip discharge rate. The yields were increased from high discharge rate to low discharge rate at both the irrigation regimes in maize and sunflower during both the years. The highest grain yield of 12193.5 kg ha\(^{-1}\) in maize was recorded by applying the irrigation at 100 percent ETc with the discharge rate of 0.6 LPH and it was 7.83 percent more over the discharge rate of 2.0 LPH at the same irrigation regime. The highest seed yield of 2699.6 kg ha\(^{-1}\) in sunflower was recorded at 100 percent ETc with the low discharge rate (0.6 LPH) in sunflower and it was 12.87 percent more over the high discharge rate (2.0) LPH at the same irrigation regime. Similar grain yield was recorded at very low discharge rate of 0.6 LPH at 75 percent ETc and high discharge rate i.e., 2.0 LPH at 100 percent ETc. Hence, saving of 25% irrigation water can be achieved by decreasing discharge rate from 2.0 LPH to 0.6 LPH without reduction in grain yield in both the crops. Though the effect of volumes of discharge and irrigation regimes on oil content was not significant, the oil yield was linearly increased with increasing water application and with decreasing drip discharge rate in sunflower.

The nutrients (N, P and K) were used very effectively when drip irrigation applied with more water through the irrigation system at rates not exceeding the requirements of the plants. The nutrient partial factor productivity was increased from higher discharge rate to low discharge rate in both the irrigation regimes and the highest nutrient partial factor productivity of N, P and K was recorded at 100 percent ETc with the discharge rate of 0.6 LPH in both maize and sunflower. The water use efficiency (WUE) linearly increased by both decreasing discharge rates as well as by decreasing water application. The highest WUE was recorded at 75 percent ETc with the discharge rate of 0.6 LPH in both maize and sunflower. The positive response was observed by increasing irrigation and by decreasing discharge rate on gross returns, net returns and benefit cost ratio (B:C ratio) of both maize and sunflower. Drip irrigation at 100 percent ETc with the discharge rate 0.6 LPH showed higher B:C ratio of 2.27 and 1.55, higher net returns of Rs. 1,25,106.40 and 59,007.40 ha\(^{-1}\) for maize and sunflower, respectively. The B:C ratio and net returns were decreased with decreasing amount of water application and increase of drip discharge rate in both the crops.

Water distribution in soils is directly dependent on the discharge rate of emitter. The vertical component of wetted zone become larger and horizontal component smaller with lower discharge rate and the horizontal component of wetted zone become larger and vertical component smaller with higher discharge rate. The seasonal ETc was estimated from field water balance method and it was 427.73 mm in maize and 362.03 mm in sunflower. The crop coefficients were calculated for both maize and sunflower. In case of maize, Kc values of 0.303 and 0.446 (vegetative), 0.531 and 0.506 (crop development), 1.001 and 1.051 (mid-season), 0.780 and 0.774 (late season) were obtained during kharif 2011 and 2012, respectively. In case of sunflower, Kc values of 0.248 and 0.202 (germination and establishment stage), 0.523 and 0.526 (crop development stage), 0.913 and 0.928 (flowering stage), 0.851 and 0.844 (seed development stage) were obtained during rabi 2011-12 and 2012-13. The optimum water
use estimated for attaining maximum yield for maize was 423.91 mm in kharif and 237.0 mm in rabiseason for sunflower.

Drip irrigation applied at 100 percent ETc with discharge rate 0.6 LPH would be an ideal practice to achieve higher yield, income and water saving benefits as compared to high discharge rates in maize – sunflower cropping system.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : GOUTAMI, N.
Title of the thesis : NUTRIENT MANAGEMENT IN RICE-FALLOW SORGHUM
Major Advisor : Dr. P. PRASUNA RANI
Degree : M.Sc. (Ag.)
College : AGRICULTURE COLLEGE, BAPTLA
Accession Number : D 9579

ABSTRACT

A field experiment entitled “Nutrient management in rice - fallow sorghum” was conducted at Agricultural College Farm, Bapatla during 2012. The test soil was non-saline, sandy clay loam in texture with neutral reaction. The soil was low in available nitrogen, medium in phosphorus and high in potassium status. The available Cu, Mn and Fe were above their respective critical limits while Zn was deficient.

The experiment was laid out in RBD with thirteen treatments replicated thrice. The treatments comprised of T1- 90 kg N ha-1 ; T2- 120 kg N ha-1; T3- 150kg N ha-1 ; T4 - 90 kg N ha-1 + Bio-fertilizer consortium ; T5- 120 kg N ha-1 +Bio-fertilizer consortium ; T6-150 kg N ha-1 + Bio-fertilizer consortium; T7- 90kg N ha-1 + FYM ; T8- 120 kg N ha-1 + FYM ; T9- 150 kg N ha-1+ FYM ; T10-90 kg N ha-1 + FYM + Bio-fertilizer consortium; T11- 120 kg N ha-1 + FYM +Bio-fertilizer consortium; T12-150 kg N ha-1 + FYM + Bio-fertilizer consortium ; T13- Control. Well decomposed FYM @ 10 t ha-1 was applied one week before sowing. Bio-fertilizer consortium containing Azatobacter, PSB and PGPR each @ 5 kg ha-1 was applied one day before sowing. Nitrogen was applied in two splits as per the treatments in the form of urea.
Recommended dose of phosphorus and potassium were applied in the form of SSP and muriate of potash uniformly to all the treatments as per recommendation.

The influence of various treatments on growth parameters, yield attributes, yield, nutrient uptake and soil properties (physical, physico-chemical, available nutrients and biological) were determined by standard procedures at different stages.

Highest plant height, length of ear, 1000 grain weight and yield were recorded by the integrated treatment that received 150 kg N ha\(^{-1}\) + FYM + Biofertilizers followed by treatments supplied with 150 kg N ha\(^{-1}\) + FYM and 120 kg N ha\(^{-1}\) + FYM + Biofertilizers. An increase of 23, 19 and 4 per cent in grain sorghum yield was recorded by the treatments that received maximum inorganic nitrogen (150 kg N ha\(^{-1}\)) along with FYM and bio-fertilizers, with FYM and with bio-fertilizers, respectively over only inorganic treatment. All growth parameters, number of grains per ear, grain yield and Stover yield were markedly influenced by the levels of nitrogen and application of FYM and bio-fertilizers.

The nitrogen content of sorghum plants at flowering and harvest was markedly influenced by the treatments with highest N recorded in treatment supplied with 150 kg N ha\(^{-1}\) + FYM + Bio-fertilizers. The effect of treatments on other nutrients in plants was non-significant.

The uptake of macro and micronutrients at harvest was markedly influenced by the treatments with maximum values recorded by the treatment that received 150 kg N ha\(^{-1}\) + FYM + Bio-fertilizers which was at par with 150 kgN ha\(^{-1}\) + FYM and 120 kg N ha\(^{-1}\) + FYM + Bio-fertilizers.

The soil properties viz., bulk density, particle density, porosity, pH and EC were not markedly influenced by the imposed treatments, while significantly high organic carbon was recorded in FYM treated plots. There was a significant influence of the treatments on available nitrogen and phosphorus, but not on potassium. The available nitrogen content was markedly influenced by levels of nitrogen as well as components of integration at all the crop growth stages. Among micronutrients (Cu, Zn, Mn and Fe), the treatment influence was significant related to Fe only.

Application of inorganic, bio-fertilizers and FYM showed significant influence on biological activity of soil. Addition of inorganic in combination with organics and bio-fertilizers proved to be more efficient in improving the microbial population and enzyme activities (unease and dehydrogenises) significantly.
ABSTRACT

The present study entitled “Nutrient requirement and effect of Bt cotton on soil properties in Warangal district” was carried out during kharif, 2013. The study was mainly aimed at assessment of changes in properties of soils under Bt cotton cultivation and evaluation of nutrient requirements of Bt cotton vis-a-vis fertilizer practices in vogue. To meet the objectives, the study was made in two parts.
To identify the farmers’ nutrient management practices, a survey was carried out by collecting information from cotton cultivators in Warangal district during pre *kharif* season of 2013. Results revealed that farmers of this region apply very high doses of fertilizers to cotton. The average fertilizer dose adapted in Warangal district for *BT* cotton was 333-97-142-17 kg NPKS ha-1 as against recommended dose of 150-60-60. Seed cotton yield of farmers ranged from 21-35 q ha-1 with an average of 30 q ha-1.

Geo-referenced soil samples were collected from fields of farmers (15 samples from fields under *Bt* cotton for more than 8 years, 12 samples from fields under *BT* cotton for 2-5 years and 8 samples from non *Bt* cotton fields) and analyzed to study the impact of cultivation of *Bt* cotton. Results were clearly indicated that cultivation of *BT* cotton either for prolonged period (> 8 years) or short term (2-5 years) did not bring out any significant change in soil pH, EC, CEC and organic carbon content when compared to non *Bt* cotton cultivation. Except available phosphorus, the availability of nitrogen, potassium, sculpture and micronutrients did not show significant changes. Available phosphorus status was found to be significantly high in soils under >8 years of *BT* cotton.

Further, multiple years of cultivation of *Bt* cotton did not affect the functional bacterial population in rhizosphere soil. The population of total microbes, *Azotobacter* and *Pseudomonas* (PSB) remained statistically on par in both non *Bt* soils and in soils under *Bt* cotton soil for long time. With regard to soil enzymes, the activities of dehydrogenase and alkaline phosphatase were higher in soils under non *Bt* while urease activity higher in soils under *Bt* for long term. However, all these variations were insignificant and suggest that multiple years of *Bt* cotton cultivation pose little or no environmental risk.

To evaluate the nutrient requirement of *Bt* cotton *vis-a-vis* fertilizer practices in vogue, a field experiment was conducted at research farm of KVK, Malyal, Warangal district with 9 treatments viz., Control, Farmers practice (333-97-142-17 kg NPKS ha-1), Recommended dose of fertilizers (RDF-150-60-60 kg NPK ha-1), RDF + S @ 30 kg ha-1, Soil test based fertilizer application for an yield target of 25 q ha-1, 125% RDF, 125% RDF + S @ 30 kg ha-1, 150% RDF, 150% RDF + S @ 30 kg ha-1 in randomized block design with 3 replications.

Results revealed that at different growth stages, the higher plant height was recorded with farmers’ practice. Except control, all other treatments recorded higher number of monopodium and symposia branches than 100% RDF. Increasing doses of fertilizers from 100% to 150% RDF resulted in increased dry matter production, but very high doses of fertilizers as adopted by farmers resulted in lower and or par dry matter production as that of 100% RDF and other fertilizer doses. Incremental doses of fertilizers increased the number of bolls plant-1 but very high doses practiced by farmers did not help in increasing boll number.

Kapas yield was increased with increasing fertilizer dose from 100 to 150% but it was on par with the yield realized in 100% NPK (3616 kg ha-1) and soil test based fertilizer application treatments (3688 kg ha-1). Further, in farmers’ practice the yield(3582 kg ha-1) was even less and on par with that of 100% NPK. Inclusion of 30...
kg sulphur along with 100% RDF or with increased doses (125% or 150%) did not result in any additional yield increment. Kapas yield in soil test based fertilizer treatment (3688 kg ha-1) was higher than the targeted yield of 25 q ha-1. These results were suggested that need for revalidation of existing STCR equations for their use in Warangal district. Quality parameters like seed index, lint index and ginning out turn were not influenced by the fertilizer treatments.

Except in control, Nutrient removal at flowering and harvest stages was on par in all the fertilizer treatments and supply of additional or excess fertilizers did not help in uptake of more nutrients. Uptake of micronutrients (Zn, Cu, Mn and Fe) was higher in 100% RDF and was on par with that 100% RDF + 30 kg S ha-1.

Fertilizer doses tested in Bt cotton showed remarkable influence on soil properties both at flowering and harvesting stages. Activity of dehydrogenase was high at flowering stage when compared to harvest. DHA was lowest in control and increased with application of fertilizers. Higher dehydrogenase activity was recorded in soil test based fertilizer treatment and was on par with the DHA in 100% RDF with and without sulphur. Increasing doses of fertilizers showed a negative impact on activity of dehydrogenase, as evidenced by significantly lower DHA in farmers’ practice.

Urease activity was lowest in control and increased with application of fertilizers. Increasing RDF from 100 to 150% + S @ 30 kg ha-1 resulted in significant decrease in urease activity. Activity of phosphatases was highest in control both at flowering and at harvest. Increased doses from 100 to 150% significantly reduced the activity of these enzymes. Application of sulphur also showed inhibitory effect on acid phosphatase activity. Soil microbial population and microbial biomass carbon did not show significant variations.

Availability N was lowest in control and highest in farmers’ practice. Availability P and K were lowest in control and highest in soil test based fertilizer application and farmers practice. Available S content in soil was lowest in control and highest in 150% RDF + S @ 30 kg ha-1 treatment. Micronutrient status in soil at flowering and harvest stages was not significantly influenced by the fertilizer.

Economic analysis also indicated that application of very high doses of fertilizers did not help in getting higher net returns or higher benefit cost ratio. It is logical to resort of soil test based fertilizer application or to adopt the present recommendation of 150-60-60 kg NPK ha-1 for profitable cultivation of Bt cotton in Warangal district.
Author : SIVA JYOTHI, V.

Title of the thesis : PHOSPHORUS REQUIREMENT OF PADDY (Oryza Sativa L.) VAR. SAMBA MAHSURI (BPT-5204) GROWN IN HIGH SOIL AVAILABLE P VERTISOLS UNDER K.C.CANAL AYACUT
ABSTRACT

A field experiment entitled “Phosphorus requirement of paddy (Oryza sativa L.) var. samba mahsuri (BPT-5204) grown in high soil available P vertisols under K.C. Canal ayacut” was conducted during kharif 2011 at Regional Agricultural Research Station, Nandyal of Acharya N.G. Ranga Agricultural University. Use of excess and/or indiscriminate amounts of fertilizer P is leading to accumulation of available P in intensively cultivated areas. Hence, the present investigation was carried out to know whether it is possible to reduce currently recommended dose of P fertilizer to rice. The results indicated that it is possible to save fertilizer from the currently recommended dose of P even up to 100 per cent in high P accumulated soils without any compromise in rice yield. The experiment has twelve treatments each replicated three times in a randomized block design. The treatments include T1 : Absolute control (no manure or fertilizers), T2 : Farm yard manure @ 5 t ha-1, T3 : Green manure inset only, T4 : 100% RDP, T5 : 50% RDP, T6 : 25% RDP, T7 : No P, T8 : 50% RDP + FYM, T9 : 50% RDP + GM, T10 : 25% RDP + FYM, T11 : 25% RDP + GM and T12 : STBF.

The salient findings of the investigation are as follows. Organic sources (FYM and GM) were incorporated before transplanting. The crop growth characters (plant height, dry matter production and number of tillers/m-2), yield attribute (test weight), available nutrients (N, P and K) at all stages of crop growth, nutrient uptakes (N, P and K) at all stages of crop growth and yield (grain and straw) were significantly influenced by different treatments.

Application of organic and inorganic fertilizers alone and in combination to rice did not change the soil pH and EC. The treatment T9 (50% RDP + GM) produced tallest plants, highest total dry matter production and highest number of tillers/m-2. Growth characters were found to be lowest with T1 (absolute control) at all stages of crop growth. With regard to inorganic sources alone, the treatment T5 (50% RDP) and with regards to organic sources, the treatment T2 (FYM) showed highest plant height, dry matter production and tillers production at all stages of crop growth.

At all stages of observation, the highest available nitrogen and potassium were observed with FYM incorporation (T2), but highest available phosphorus was observed with green manure incorporation (T3). With regards to combination treatments, the treatment T8 (50% RDP+FYM) showed highest available nutrients like N, P and K. In
case of inorganic sources alone, the treatment T5 (50% RDP) showed highest available phosphorus at all.

The highest number of grains per panicle and filled grains per panicle was observed with the treatment T5 (50% RDP).

Among all the treatments studied, the concentration of nutrients (N, P, and K) in plant was found to decrease gradually as the crop advanced in its phenology and minimum was recorded at harvest. At harvest, grain recorded slightly more N and P than straw, but concentration of potassium in straw was more than grain.

With respect to organics alone, the treatment T3 (GM) recorded higher nitrogen and phosphorus concentration than T2 (FYM) while potassium concentration was greater in T2 (FYM) treatment than T3 (GM).

The treatment T9 (50% RDP + GM) recorded higher concentration (nitrogen and phosphorus) and uptake (nitrogen and phosphorus) at all stages of crop growth, except nitrogen concentration at panicle initiation stage.

Among inorganic sources alone, the treatment T5 (50% RDP) recorded higher phosphorus concentration and uptake at all stages of crop growth.

The highest gross and net returns as well as benefit-cost ratio were realized with the treatment T3 (green manure in situ only).

Among inorganic sources, highest gross returns, net returns and benefit-cost ratio was observed with 50 per cent RDP (T5).

Among combination treatments, highest gross returns, net returns and benefit-cost ratio was observed with treatment T9 (50% RDP + GM) followed by T8 (50% RDP + FYM), while the lowest gross returns was observed with absolute control (T1) and lowest net returns were observed with FYM (T2) which is due to high cost of FYM and lower yield.

Grain and straw yields were significantly influenced by different treatments. The higher yields were observed in the treatment T9 (50% RDP + GM). The plots which received organics and in organics alone were inferior as compared to the combination treatments.

The present investigation suggests application of 50% of RDP to paddy either alone or in combination with GM to achieve higher grain yield in high soil available P status vertisols of K.C. Canal ayacut.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author: SRILATHA, M.
Title of the thesis: CHANGES IN SOIL QUALITY, CROP PRODUCTIVITY AND SUSTAINABILITY IN RICE – RICE CROPPING SYSTEM UNDER LONG TERM FERTILIZER EXPERIMENTS
Major Advisor: Dr. P.CHANDRASEKHAR RAO
Degree: Ph. D.
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9504

ABSTRACT

A field experiment entitled “Changes in soil quality, crop productivity and sustainability in rice – rice cropping system under long term fertilizer experiments” was laid out in a field laid out in randomized block design with twelve treatments and four replications during kharif and rabi 2010-11 and 2011-12, at Regional Agricultural Research Station (RARS), Polasa, Jagtial, District Karimnagar, Andhra Pradesh in an Inceptisol (Ustochrept). The soil was slightly alkaline, non saline, high in organic carbon (0.79%) low in available nitrogen (107.6 kg ha$^{-1}$), medium in phosphorus (19.6 kg P ha$^{-1}$) and high in potassium (364 kg K ha$^{-1}$) while sulphur and micro nutrients were above critical levels. This experiment is a part of the ongoing experiments on All India Coordinated Research Project on Long Term Fertilizer Experiment initiated at RARS, Polasa, Jagtial during kharif 2000-01. The treatments comprised of T$_1$- 50%NPK, T$_2$- 100%NPK (120-60-40 kg NPK ha$^{-1}$), T$_3$- 150%NPK, T$_4$- 100% NPK + Hand weeding (HW), T$_5$- 100% NPK + ZnSo$_4$ @10 kg ha$^{-1}$ (in kharif), T$_6$-100% NP, T$_7$-100% N, T$_8$- 100% NPK + Farmyard manure @ 10 t ha$^{-1}$ (in kharif season only), T$_9$- 100% NPK-S, T$_{10}$- FYM @ 10t ha$^{-1}$ (in both kharif and rabi seasons), T$_{11}$- absolute control (No fertilizer and no manure) and T$_{12}$- Fallow.

The soil quality parameters were assessed by analyzing the post harvest soil for physico-chemical, chemical and biological properties with special reference to monitor the changes in soil enzyme activity during crop growth. The influence of long term fertilizer and manure application was evaluated for soil biological health by assaying soil urease, dehydrogenase and acid and alkaline phosphatase activities. Straw and grain
samples were analysed for their nutrient concentration with respect to N, P and K at harvest and nutrient uptake was computed.

The results of the experiment showed that the performance of rice crop improved significantly with integrated use of FYM along with recommended dose of fertilizers (120-60-40 kg NPK +FYM @ 10 t ha\(^{-1}\)) through inorganic fertilizers. Increase in levels of fertilizer dose caused a marginal non significant change in pH. The electrical conductivity of the soil decreased from initial value i.e. at the beginning (kharif 2000-01) 0.47 d S m\(^{-1}\) in all the treatments. The organic carbon increased from the initial (0.79%). Among the treatments application of FM @ 10 t ha\(^{-1}\) (1.07%) and 100% NPK+FYM (1.05%) recorded significantly higher organic carbon content. Organic carbon increased by 32.9 and 35.4 per cent in T\(_8\) (100 % NPK+FYM) and T\(_{10}\) (FYM) respectively over initial value.

Among the treatments, higher values of available nitrogen content were recorded with application of FYM @ 10 t ha\(^{-1}\) (229 kg ha\(^{-1}\)), 150% NPK (216 kg ha\(^{-1}\)), and 100% NPK + FYM (213 kg ha\(^{-1}\)) which were statistically on par with each other. There was an increase of 32.9% in available nitrogen with the treatment receiving 100% NPK +FYM over control. Available phosphorus increased from 19.6 kg ha\(^{-1}\) (initial level) to a significantly higher available P status with application of 100% NPK+FYM (41.7 kg P ha\(^{-1}\)) which was 112% higher over control. Higher available potassium content was observed (350 kg K ha\(^{-1}\)) when 150%NPK was applied.

The ammoniacal nitrogen content varied from 34.4 to 66.3 mg kg\(^{-1}\) in post harvest soils of rabi rice (pooled mean for two years). Highest ammoniacal nitrogen content (66.3 mg kg\(^{-1}\)) was recorded in the treatment receiving 100% NPK + FYM. The nitrate nitrogen content varied from 21.9 to 57.4 mg kg\(^{-1}\) in post harvest soils of rabi rice (pooled mean for two years). Highest nitrate nitrogen content (57.4 mg kg\(^{-1}\)) was recorded in the treatment receiving 100% NPK + FYM while the lowest was recorded with control (21.9 mg kg\(^{-1}\)). Among the inorganic nitrogen fractions, ammoniacal nitrogen fraction forms were higher compared to nitrate nitrogen forms in post harvest soils of rabi rice.

The fractions of inorganic – P viz., saloid, Al – P, Fe – P and Ca – P were significantly higher in the treatment 100% NPK + FYM with corresponding values of 7.0, 104, 44.2 and 447.6 mg kg\(^{-1}\). The lowest saloid, and Fe – P were observed in 100% N with corresponding values of 3.7 and 23.9 mg kg\(^{-1}\), while Al – P and Ca – P were recorded in control with corresponding values of 39.6 and 199.9 mg kg\(^{-1}\) respectively. Water soluble potassium in post harvest soils of rice varied from 27.8 (100% N) to 41.6 mg kg\(^{-1}\) (100% NPK + FYM). Exchangeable – K content varied from 34.4 (control) to 67.0 mg kg\(^{-1}\) (100% NPK + FYM). There was an increase in available potassium to the extent of 34 percent due to the combined application of 100 % NPK and FYM. The values of HNO\(_3\) extractable –K varied from 637.3 (100 % N) to 942.5 mg kg\(^{-1}\)(100% NPK + FYM).

Urease activity (mg NH\(_4^+\) released g\(^{-1}\) soil h\(^{-1}\)) increased with increase in crop age and exhibited maximum at flowering stage and thereafter activity decreased gradually towards maturity and stabilized at harvest. During kharif season high urease
activity of 4.31 (at 30 DAT), 8.52 (at 60DAT), 3.97 (90 DAT) and 3.30 (at harvest) and 3.46 (at 30 DT), 8.56 (at 60DAT), 6.54 (90 DAT) and 2.77 (at harvest) during rabi was recorded with the treatment 100\%NPK + FYM (pooled mean of two years).

Dehydrogenase activity (mg TPF produced g\(^{-1}\) soil d\(^{-1}\)) increased with increase in age of the crop and exhibited maximum at flowering and thereafter activity decreased gradually towards maturity and stabilized at harvest. During kharif high dehydrogenase activity of 2.42 (at 30 DT), 4.69 (at 60DAT), 3.66 (90 DAT) and 2.60 (at harvest) and 3.11 (at 30 DT), 7.62 (at 60DAT), 5.78 (90 DAT) and 2.63 (at harvest) during rabi were observed with 100\%NPK + FYM (pooled mean of two years).

Acid and alkaline phosphatase activities (µg PNP release d g\(^{-1}\) soil h\(^{-1}\)) (pooled mean values for two years) increased with increase in age of the crop and exhibited maximum at flowering and thereafter activity decreased gradually towards maturity and at harvest. During kharif season high acid phosphatase activity of 93.9, 127.6, 113.9 and 78.8 during kharif and 120.6, 206.1, 138.7 and 100.5 during rabi was recorded at 30, 60, 90 DAT and at harvest respectively with T\(_8\) (100\% NPK+FYM). Alkaline phosphatase activity also was higher in T\(_3\) (150\%NPK) with corresponding values of 105.6, 135.6, 121.9 and 89.2 during kharif season and 126.1, 177.4, 151.4 and 109.4 during rabi was recorded at 30, 60, 90 DAT and at harvest respectively.

Significantly higher humic and fulvic acid contents of 0.51 and 0.33 per cent were recorded with application of 100\% NPK+ FYM while lowest in 100\%N (0.35 and 0.24 per cent) respectively . Fulvic acid extracted from the treatment receiving 100\%NPK recorded higher total acidity (12.3 me g\(^{-1}\)), carboxylic (7.8 me g\(^{-1}\)) and phenolic –OH (4.5 me g\(^{-1}\)) groups than the corresponding humic acid total acidity (9.4 me g\(^{-1}\)), carboxylic (5.8 me g\(^{-1}\)) and phenolic –OH (3.6 me g\(^{-1}\)) respectively while lowest values were observed in fulvic (9.8, 6.2 and 3.6 me g\(^{-1}\)) and humic acid (7.7, 4.8 and 2.9 me g\(^{-1}\)) extracted from control plot respectively. The per cent contribution of carboxyl groups towards total acidity of fulvic acid (63.4) was higher than the corresponding humic acid (61.7) but reverse trend was observed in case of phenolic-OH groups.

Application of N, P and K either alone or in combination recorded significantly higher N uptake over control and total N uptake increased progressively with increased level of NPK application. Nitrogen uptake significantly increased with increase in level of NPK from 50 to 150 \%. During kharif (pooled values of two years) higher nitrogen uptake by crop was observed in 100 \% NPK +Hand weeding (141.7 kg ha\(^{-1}\)) which was on par with T\(_3\) (150\%NPK), T\(_5\) (100\%NPK+Zn) and T\(_9\) (100\%NPK- S) while lowest in control (66.1 kg ha\(^{-1}\)). During rabi (pooled mean values for two years) higher nitrogen uptake by crop was observed in 150 \% NPK (135.2 kg ha\(^{-1}\)) and lowest in control (66.1 kg ha\(^{-1}\)).

During kharif (pooled values of two years), the highest P uptake was obtained in the treatment receiving 150 \% NPK (37.19 kg ha\(^{-1}\)). Phosphorus uptake increased (pooled values of two years) with increase in level of NPK fertilizer. The increase was to the extent of 77.5, 85.8 and 89.4 \% with 50\%, 100\% and 150\% NPK over control during kharif respectively.
During rabi season (pooled values of two years), the highest P uptake was observed in 150%NPK (22.93 kg ha\(^{-1}\)) treatment which was on par with 100%NPK+FYM (21.17 kg ha\(^{-1}\)). The increase P uptake with increase in level of NPK fertilizer was 58.9, 92.3 and 128.3% with 50%, 100% and 150% NPK over control during rabi season respectively. Similar increase was also obtained with respect to potassium uptake during both seasons.

Application of 100% NPK + FYM @ 10 t ha\(^{-1}\) resulted in grain yield of 68.8 and 55.8 q ha\(^{-1}\) which were comparable with 150% NPK (71.73 and 61.06 q ha\(^{-1}\)) during kharif and rabi respectively. Individual application of nitrogen alone resulted in 18.3 and 23.1 per cent reduced yields as against 100% NPK in kharif and rabi respectively.

From the results obtained of long term fertilizer experiment it could further be concluded that the conjunctive use of organic manure along with recommended dose of fertilizers (100%NPK + FYM) results in consistently higher yields thus, indicating this particular treatment is the best for recommendation to the farmer for sustained productivity and improved soil quality.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : VENUGOPAL, G.
Title of the thesis : INFLUENCE OF LONG TERM NUTRIENT MANAGEMENT PRACTICES IN SORGHUM-SUNFLOWER CROPPING SYSTEM ON ENZYME ACTIVITY, NITROGEN, PHOSPHORUS AND POTASSIUM FRACTIONS AND SORGHUM PERFORMANCE IN AN ALFISOL
Major Advisor : Dr. S. HARISH KUMAR SHARMA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9533

ABSTRACT
Impact of long term continuous fertilization and manuring on the practices in sorghum-sunflower cropping system on enzyme activity, nutrient (NPK) fractions and sorghum performance in an Alfisol was studied by monitoring the long term fertilizer experiment on sorghum-sunflower cropping system at the research farm of Directorate of Oilseed Research in its 15th cropping cycle.

The soil is sandy loam in texture and at the initiation of the experiment in 1999 was slightly alkaline, non saline and medium in organic carbon content. The soil was medium in available nitrogen and available phosphorus and high in available potassium. The treatments and doses of fertilizers and manures were fixed at the initiation of the experiment and the same are being followed till now. Treatments consist of different combinations of nutrients, graded levels of NPK and integrated nutrient management by adding FYM or sunflower crop residues along with 100% NPK. Sorghum variety Rohini was grown in the study i.e., kharif 2013.

Application of FYM and CR along with 100% NPK proved beneficial in significantly enhancing the yield of the crop and nutrient uptake by the crop. With application of FYM @ 5 t ha\(^{-1}\) along with 100% NPK, the grain yield (32.69 q ha\(^{-1}\)) increased by 26.6% and with application of sunflower crop residues along with 100% NPK (30.52 q ha\(^{-1}\)), the grain yield increased by 18.6% over application of only 100% NPK (25.75 q ha\(^{-1}\)).

There was a considerable and significant increase in grain yield over control (3.73 q ha\(^{-1}\)) with 50% NPK (20.69 q ha\(^{-1}\)). There was further significant increase of 22.5% in grain yield with 100% NPK (25.75 q ha\(^{-1}\)) over 50% NPK. But, application of super optimal dose of NPK i.e., 150% NPK (25.59 q ha\(^{-1}\)) did not increase the yield over 100% NPK.

Continuous imbalance application with only nitrogen to every crop resulted in reduced yields compared to balanced nutrition. The grain yield with application of nitrogen alone (100% N, 7.89 q ha\(^{-1}\)) was on par with that in control (3.73 q ha\(^{-1}\)). Application of nitrogen along with phosphorus (NP, 27.45 q ha\(^{-1}\)) or along with phosphorus and potassium (NPK, 25.75 q ha\(^{-1}\)) increased the grain significantly over application of N alone. Nutrient uptake, in general, followed the trend similar to yields. Uptake of nitrogen, phosphorus and potassium by the crop significantly increased with application of the respective nutrient.

Treatment receiving 100% NPK recorded higher available nitrogen (206 kg ha\(^{-1}\)) than treatment receiving imbalanced fertilization with application of 100% N alone (155 kg ha\(^{-1}\)) or suboptimal level of NPK (186 kg ha\(^{-1}\)). Available phosphorus was maintained at the initial level in treatments that did not receive P application (i.e., control and only N treatments). In all the other treatments, which received organic manure and/or P fertilizers, there was a considerable buildup in available P content of soil. Increase in the available potassium content was recorded under integrated nutrient management and super optimal NPK compared to the initial value of 319 kg K ha\(^{-1}\) at the beginning of the experiment. Available potassium content decreased in the other treatments, even in the treatments that received optimum K (100% NPK). With application of FYM along with 100% NPK, significantly higher available phosphorus (55.2 kg P ha\(^{-1}\)), available potassium (453 kg K ha\(^{-1}\)), available zinc (1.6 mg kg\(^{-1}\)) and available Fe, Mn and Cu were recorded compared to 100% NPK (42.5 kg P ha\(^{-1}\), 286 kg K ha\(^{-1}\) and 1.4 mg Zn kg\(^{-1}\)).
Highest ammoniacal nitrogen content (28.0 mg kg\(^{-1}\)) was recorded in the treatment receiving 100% NPK+FYM followed by the treatment receiving NPK+CR (26.8 mg kg\(^{-1}\)) and 150% NPK (24.9 mg kg\(^{-1}\)). Similar results are recorded in nitrate nitrogen fraction also. Among the various inorganic P fractions, Ca – P was found to be the dominant P – fractions in the soil. The fractions of inorganic – P evaluated showed an appreciable build up with 100% NPK+FYM followed by 150% NPK. The contents of various inorganic forms of P (saloid – P, Al – P, Fe – P and Ca – P) were higher in P applied plots than those plots with no P application. Water soluble K, exchangeable K and non-exchangeable K increased significantly with application of FYM or crop residues along with 100% NPK and application of 150% NPK over 100% NPK.

Organic carbon content was higher in smaller size soil particles than larger particles. The organic carbon content under 150% NPK, NPK+CR and NPK+FYM was significantly higher than all the other treatments including 100% NPK in all the particle sizes. Organic carbon content also increased with increasing level of NPK in all the particle sizes.

The enzyme (urease, dehydrogenase and phosphatise) activity showed an increasing trend with the age of the crop till flowering stage and exhibited highest activity at flowering. There after the activity decreased towards maturity. The highest enzyme activity was recorded in the treatment of NPK+FYM and NPK+CR at all the stages which increased the activity significantly over that in 100% NPK.

Among the graded levels of NPK, super optimal dose of NPK recorded significantly higher enzyme activity than lower levels. The super optimal dose of fertilizer treatment (150% NPK) recorded lower activity of enzymes than manure treatments (NPK+FYM, NPK+CR). Optimum balanced application of nutrients (100% NPK) resulted in significant increase in enzyme activity over imbalanced fertilization (N, NP treatments).

From the present study, it can be concluded that balanced nutrition (application of phosphorus and potassium) proved better than imbalanced application (application of only nitrogen) and control in soil properties and yields. Application of FYM @ 5 t ha\(^{-1}\) or crop residues along with NPK i.e., integrated nutrient management (100% NPK+FYM) is best for higher yields and better soil health for sorghum.
ABSTRACT

A study on “TREND ANALYSIS OF SUGARCANE AREA, PRODUCTION AND PRODUCTIVITY IN ANDHRA PRADESH” has been undertaken to estimate the growth rates of sugarcane crop in three regions of Andhra Pradesh and fit the adequate trend equation for the future projections by 2015-16 AD.

The reference period of study was from 1971-72 to 2010-11 and was carried out region wise and Andhra Pradesh state as a whole.

The present investigation was carried out to examine the trends in area, production and productivity of sugarcane crop. Linear and compound growth rates were calculated for this purpose. Ten growth models were fitted to the area, production and productivity of sugarcane crop and the best-fitted model for future projection was chosen based upon the model with relatively high significant Adj $R^2$ and least Residual Mean Square (RMS). Besides, the important assumption of randomness of residuals was tested by using one sample Run test.

Results revealed that area, production and productivity of sugarcane in Andhra Pradesh marked significantly increasing trend with decreasing trend in production and productivity in last year during the study period. In case of Coastal Andhra region, upward trend in area, production and productivity were observed, whereas in case of Rayalaseema region, area, production and productivity marked significantly increasing trend but there was a decreasing growth in case of area and production in last years was observed and finally in Telangana region it was observed that there was a significantly increasing trend in area, production and productivity.
ABSTRACT

A study on “TEMPORAL VARIATIONS IN AREA, PRODUCTION AND PRODUCTIVITY OF WHEAT CROP IN UTTAR PRADESH IN INDIA” has been undertaken to estimate the growth rates of wheat crop in Uttar Pradesh in India and fit the adequate trend equations for the future projections by 2016 AD.

The reference period of study was from 1971-2010 and it was carried out in Uttar Pradesh.

Attempts have been made to examine the trends in area, production and productivity of Wheat crop in Uttar Pradesh. Linear and compound growth rates were calculated for this purpose. Ten growth models were fitted to the area, production and productivity of Wheat crop and best fitted model for future projection was chosen based upon Least Residual Mean Square (RMS) and significant Adj $R^2$. Besides and the important assumption of randomness of residuals was tested using one sample run test.

The study revealed that the growth rates of production were higher than the growth of area and productivity for the study period of wheat in India.

The study for India revealed that the area of wheat marked a significantly increasing trend during the study period but decrease in production and productivity and the same was observed in future projections by 2016AD.

The study for U.P. revealed that the growth rates of productivity were higher than the growth of area and production for the study period of Wheat in Uttar Pradesh.
The study revealed that the area, production and productivity of Wheat in U.P. marked a significantly increasing trend during the study period and the same was observed in future projections by 2016AD.

STATISTICS AND MATHEMATICS

Author : SAMBA SIVA, G.
Title of the thesis : A MULTIVARIATE APPROACH FOR STUDYING THE RAINFALL PATTERN INVISAKHAPATNAM DISTRICT
Major Advisor : Dr. V. SRINIVASA RAO
Degree : M.Sc. (Ag.)
College : AGRICULTURE COLLEGE, BAPTLA
Accession Number : D 9533

ABSTRACT

An attempt was made to study the pattern of rainfall in different mandals of Visakhapatnam district of Andhra Pradesh by using multivariate approaches based on cluster analysis and principle component analysis. The approach was applied to the rainfall data of 42 mandals based on 25 years covering from 1986-2010. The district exhibited variability in monthly and mandal wise rainfall. The application of these approaches identified rainfall patterns in the district. The application of hierarchical clustering techniques single linkage, completelinkage, average linkage and Ward’s minimum variance method all possesses unique characters, which contributed to large inter procedural differences and resultsobtained from these methods are unique. Maximum numbers of mandals (27) were coinciding in single linkage and average linkage methods of hierarchical cluster analysis.

Principle component analysis is a data reduction technique, which is used to identify a small set of variables, which accounts for a large proportion of the total variance in the original variables. The first eight principle components were accounted for 81.21 per cent and principle components with eigen values more than one were found to be statistically significant and contributed more than 74.22 per cent of variability in the 25 variables included in the rainfall analysis. Therainfall analysis in Visakhapatnam district indicated that multivariate approaches based on cluster analysis and principle component analysis effectively summarized the source of variability in the rainfall and
precisely identifies different rainfall patterns, which are likely to occur in different mandals.

The application of these approaches identified medium rainfall (862 mm-1162 mm) was the most frequent representative pattern of rainfall in majority mandals of Visakhapatnam district. The approaches can also be applied for identifying the rainfall patterns, which would help in planning suitable crop strategies on the basis of the availability of rainfall during the crop period.

STATISTICS AND MATHEMATICS

Author : SATHISH, G

Title of the thesis : A STATISTICAL ANALYSIS OF TEMPORAL VARIATIONS IN AREA, PRODUCTION AND PRODUCTIVITY OF CHILLI CROP IN THREE REGIONS OF ANDHRA PRADESH

Major Advisor : K. SUPRIYA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9505

ABSTRACT

A study on “A Statistical Analysis of Temporal Variations in Area, Production and Productivity of Chilli Crop in Three Regions of Andhra Pradesh” has been undertaken to estimate the growth rates of Chilli crop in three regions of Andhra Pradesh and to fit the adequate trend equations for the future projections by 2016 AD.

The reference period of study was from 1971-2010 and it was carried out in the three regions of Andhra Pradesh as a whole.

An attempts has been made to examine the trends in area, production and productivity of Chilli crop. Linear and compound growth rates were calculated for this purpose. Ten growth models were fitted to the area, production and productivity of Chilli crop and best- fitted model for future projection was chosen based upon least Residual
Mean Square (RMS) and significant $\text{Adj } R^2$. Besides, the important assumption of randomness of residuals was tested using one sample run test.

The results revealed that linear and compound growth rates of area, production and productivity of Chillies in Andhra Pradesh, Coastal Andhra, Rayalseema and Telangana were observed to be in significantly increasing trend during the study period. Area was in deceasing trend where as production and productivity were in increasing pattern in all the regions of Andhra Pradesh individually and as a whole. The cubic function was found to be best fitted for all the aspects of the regions under test as they had least Residual Mean Square (RMS), significant Adj $R^2$ mean while satisfied the randomness of residuals except for the production of Andhra Pradesh, to which quadratic function was found to be suitable.

### STATISTICS AND MATHEMATICS

**Author**

: SRINIVAS, G

**Title of the thesis**

: COMPARITIVE PERFORMANCE OF TIME SERIES MODELS IN RELATION TO CROPS IN NORTH COASTAL ZONE

**Major Advisor**

: Dr. V. SRINIVASA RAO

**Degree**

: M.Sc. (Ag.)

**College**

: AGRICULTURE COLLEGE, BAPTLA

**Accession Number**

: D 9582

### ABSTRACT

The present study entitled “Comparative performance of time series models in relation to crops in North coastal zone of Andhra Pradesh” has been undertaken to estimate the future trends of the selected important crops viz., Paddy, Maize, Jowar, Groundnut and Sugarcane to fit the adequate model for the future projections by 2020 AD. The study was carried for North coastal zone of Andhra Pradesh using time series data from 1971 to 2011. Different time series models viz., linear, exponential smoothing, ARIMA, ARCH and GARCH models were fitted to the area, production and productivity
of selected crops and the best-fitted model was chosen based on least Mean Absolute Percent Error (MAPE) value and highest R2 value for future projections.

The area, production and productivity of the major crops in the North coastal zone of Andhra Pradesh were projected up to 2020 AD. For the paddy crop, the area was stable during the study period and it will be same for the future also. But the production and productivity will be in an increasing trend. For the maize crop there was not much variation in the area but there was migre change in the production and productivity. For the Jowar crop the area, production was tremendously decreased during the study period and from 1999 onwards the productivity was an increasing trend due to hybrid varieties. The groundnut crop revealed that the area, production was in decreasing trend but productivity was in slight increasing trend. For the sugarcane crop the ARIMA model forecasted that the area, production and productivity will be stable up to 2020 AD.
Natural fibres are the essential alternative in the ever expanding horizon of textile fibres. These fibers are becoming indispensable at present due to increase in concern for eco-friendly products. There are myriad of eco friendly fabrics whose benefits go beyond their positive social and environmental footprint. The growing trend of eco-friendly fabrics, however, reduces the carbon footprint of both the textile industry and the consumer. In fact eco-friendly products have become a fashion statement. The goal of the latest developments in modern technology is mainly concerned with the quality of life with respect to people’s mental and physical health. Technological interventions led to the development of new eco friendly textile material and among them are bamboo and its charcoal. The advances in applications of NT to improve textile properties offer high economic value for the growth of textile industry as it is one of the largest consumer-oriented industries with a significant impact on national economy. Bamboo is a natural renewable source that has a number of benefits. Bamboo charcoal fiber is a new kind of fiber developed utilizing the inputs from nanotechnology.

Five different species of bamboo Phyllastachys pubescens, Phyllastachys aurea, Dendarcalamus strictus, Bambusa bamboos, Bambusa vulgaris were selected and pyrolysed. Based on the availability and higher micropore structure bamboo variety P.aurea was selected for making charcoal fiber. Charcoal was first made into powder was later grounded in ball miller at different timings of 2hr, 4hr, 6hr, 10hr, 17hr, and 22hr to make nano size particles. In this study 10 nm bamboo charcoal nano powder obtained after22 hrs ball milling. XRD patterns of charcoal nano powder showed weak peak diffraction due to its amorphous graphite structure. CHNS analysis proved that the carbon was the major element present with a least amount of nitrogen and no sulphur.

Polyester and charcoal powder were compounded in a twin screw extruder which were later melt spun, crimped and cut into staple fiber to obtain bamboo charcoal.
polyester (BCP). SEM images of fiber indicated an even distribution of carbon particles. This was supported by XRD pattern of staple BCP fiber which showed both the patterns of amorphous and crystalline nature of charcoal and polyester fiber. DSC analysis showed a decrease in the charcoal fiber’s melting temperature and glass transition temperature over ordinary polyester.

The BCP staple fiber was blended with cotton in different ratios and was made into woven and nonwoven fabric. Fourteen different nonwovens were made by needle punching process in 150 GSM (Type I), 200 GSM (Type II) and their properties were analyzed. The thickness of 100% BCP sample was found to be higher at 200 GSM which indicated that higher percent of BCP resisted compression in nonwovens. A 100% BCP sample had high bending length and the flexural rigidity was high in type II samples than type I due to higher weight and thickness. Insulative value of 100% BCP was higher than polyester which may be due of the porous structure of charcoal. Highest air permeability value was found in 100% BCP than cotton. 100 % BCP had good tensile and tear strength properties in both 150 GSM and 200 GSM weight samples in cross direction than machine direction. This indicated that bamboo charcoal nano particles have given additional resistance to abrasion when added in the polymer matrix. Highest bursting strength was seen in 100% BCP of type II sample and least strength was found in cotton fabric of both the types.

Water filtration properties of nonwoven fabrics were analyzed. Bamboo charcoal polyester nonwoven fabric (200GSM) improved dissolved oxygen content in water and decrease BOD, COD concentrations and TDS level in the sewage water. Filtration of tap water showed higher calcium and magnesium mineral content in tap water which indicated that mineral content of bamboo charcoal was leached into water.

Bamboo charcoal polyester fiber was blended with cotton in two different ratios to make BCP/ cotton blended yarn. Cotton, Polyester, BCP and BCP/Cotton blended yarn was woven into fabric with different combinations of warp and weft yarn.

A total of eleven woven samples were made, 100 % bamboo charcoal fabric had shown the weight and thickness of sample woven with 100% BCP in warp and weft direction had shown least weight and thickness of all samples. Higher percentage of cotton in blended yarn yielded higher weight and thickness among samples due to higher fiber consolidation. Highest air permeability value was found in 100% BCP than cotton.

All sample had similar water repellency rating except polyester fabric sample. Bamboo charcoal yarn present in warp and weft must have contributed to the fabric’s wicking ability than cotton and polyester because of the micropore nature of the charcoal.

Higher tear strength was found in 100 % Bamboo charcoal fabric sample and least strength was found in cotton sample. A 100% BCP woven fabric showed higher tensile strength than 100% polyester sample but in blends, samples with high content of cotton had showed less tensile strength than BCP blends. Samples containing polyester as warp have shown more abrasion resistance over other fibers in warp direction. BCP fibers had good cohesion with cotton and polyester that helped the fabric retain good appearance without pill formation though fabrics were blends of natural and synthetic fibers.
Antibacterial reduction was noticed against *S. aureus* (55%) than *E. coli* (15%) for BCP1 wove fabric. This may be due to the bacteriostatic nature of bamboo charcoal which must have inhibited the growth of bacteria.

From the above research findings it can be concluded that 100% bamboo charcoal fabric and higher content of BCP in samples had properties that are more suitable in areas of technical textiles. The BCP woven and nonwoven fabric is suitable in protective apparel and healthcare textiles, filtration and other technical applications.
Clothing can be both beautiful and eco friendly. A Green Wardrobe is a new term to denote the wardrobe and its products that include both garments and accessories, is about living our lives in a way that conserves energy and resources in order to save the planet and lead life in a healthier and safer way. The creation of a Green Wardrobe should directly or indirectly benefit the status of the people working behind it (Adrian W., Ohio State Univ.).

Handloom weaving with natural dyes and colours has been an age old process, but contemporizing these products for present market is still upcoming. The art of hand weaving is very popular in India and particularly in Nagaland, amongst the Naga women especially in the rural areas. The Nagas are best known for their shawls in which three or more pieces are woven separately and then stitched together.

The present research on “Creating a Green Wardrobe inspired from the handwoven textiles of Nagaland” was carried out with the objectives of studying and documenting the traditional textiles and related crafts of Nagaland; adopting their existing motifs for developing new patterns, designing and producing a range of products for a coordinated green wardrobe and assessing the consumer acceptability of the products.
A survey was carried out at two districts of Nagaland for the selection of weavers for data collection. The districts selected were Kohima and Dimapur and 30 weavers were selected. Documentation of the Naga textiles and related crafts was done with primary and secondary source of data collection. From the data obtained, 2 weavers from Dimapur district were selected for the weaving process. The selection of the weavers and their families were based on the number of looms they possessed and the depth of involvement in weaving their traditional textiles.

A set of 70 garments for both the wardrobes (Wardrobe I – Young Working Women and Wardrobe II – College Going Girls) were designed and sketched, to select the style of the garment. Out of these 14 were finalised keeping in mind the silhouette, style and appeal of the garment. These designs were further sketched with different colour combinations and motifs placement. A total of 210 virtual images were developed for 14 garments finalized using the software ‘Photoshop’. The accessory designs were solely based on the researcher’s creativity. Seven ornamentation techniques were involved for the construction of both the wardrobe garments and accessories. The techniques used were weaving, kalamkari, hand painting, machine embroidery, hand embroidery, appliqué and embellishment technique. The fabrics were made using hand loom for cotton garments and jacquard loom for silk garments.

A preliminary study was conducted to know the predominantly used colours in Naga textiles. It was found that the colours used were red, black, white, blue, green, yellow, pink and orange. The colours finalised for designing textiles was done on the basis of the colour palette of natural colours. Cotton and silk yarns were selected for construction of garments. The yarns were dyed with natural colours, after which the samples were tested for its colour fastness properties.

Later garments and accessories constructed, were embellished with 7 different techniques and evaluated by 50 experts from different fields of textiles, fashion and designing. The techniques involved were; weaving, hand embroidery, machine embroidery, kalamkari, hand painting, appliqué and embellishment techniques. The evaluation was carried out in Hyderabad, Bangalore and Delhi, including faculties, students, PhD research scholars, fashion designers, fashion studio heads, accessory designers and IT professionals. The green wardrobe products were assessed on the basis of appearance and appropriateness of design; size, placement, repetition and colour of motif; quality of workmanship, fabric texture and fabric suitability, type of design and costing.

The results of the study showed that, all the respondents were involved in weaving as their primary source of income. Majority of the respondents were female weavers. Most of the respondents spoke Nagamese language, which is a common language spoken in Nagaland. More than half of the respondents belonged to low income group and were financially very weak. All respondents used traditional motifs in the weaving process. None of the motifs were diversified or manipulated in any way.

The garments and accessories constructed for young working women were: Saree, Dupatta, Trouser, Kurti, Dress, Scarf and Top along with a bag, belt and a set of jewellery. The garments and accessories constructed for college going girls were: Stole,
Skirt, Capri, Tunic, Harem pant, Dress and Top along with a bag, belt and a set of jewellery.

All the respondents were in favour of commercialization by product diversification, product diversification of traditional crafts for value addition and purchasing products with ethnic essence of traditional textiles.

All fabric samples dyed with natural dyes showed good to excellent fastness to washing, sunlight, crocking and perspiration with a grey scale grade above 3.

Majority of the respondents stated that, the appearance and appropriateness of garment designs for both the wardrobes were very good. The motifs size, placement and its repetition was liked by nearly all the respondents. The colour combination of motifs turned out to be one of the most liked features of all the garments and accessories. all the respondents felt the fabric texture was exclusive and coordinated nicely with the respective garments. All the respondents stated that the garments and accessories of both the wardrobes well justified each of them.

Fair trade was strictly followed and the weavers were reasonably paid as to what they asked for. The weavers and artisans were paid 25 – 30 percent more than they normally earned from local markets and cooperatives. The use of Vanya silk increased the cost of saree and stole, but otherwise all the other products were very reasonably priced. The costing was exclusive of the marketing. The two criterias of transporting and profit are excluded from the work.

The criterias of green wardrobe was strictly followed. These include; fair trade, use of natural ingredients, no involvement of child labour, no harmful chemicals, no harm to animals, eco-friendly packaging, employment creation, good working conditions, unethical profit margins, comfortable work timings, reducing paper waste and being Ethical.

The market for the Green wardrobe products was found to be very broad and demanding through a survey done in the city of Hyderabad. Many boutiques contacted were ready to pay double the amount of price fixed for the products.
APPAREL & TEXTILES

Author : SHARMILA NAGRAJ

Title of the Thesis : EFFECT OF CONSCIOUS CONNETIVE PROCESSES IN THE SUPPLY OF HANDLOOM AND APPAREL IN INDIA

Major Advisor : Dr. (Mrs.) A. SHARADA DEVI

Degree : Ph. D. (H. Sc.)

College : COLLEGE OF HOME SCIENCE, HYDERABAD

Accession Number : D 9567

ABSTRACT

Clothing has been one of the most ancient yet one of the most technologically advanced segments of the world's civilization. The excavations of the world heritage
sites have shown remnants of textiles in its finesse depicting the quality of fiber, yarn, fabric and the dyes used. At the same time the technologically sophisticated textiles have made way into space, water, fire and innumerable medical interventions creating some of the most unbelievable properties for protecting, enhancing and saving human life.

The technologies of the past around textiles in this country have lost the patronage from the princely and the commoner facing dire situations around artisan communities. In the wake of such situation this research was undertaken to prove certain perspective in consciousness in manufacturing which will not only create great products but also has the least impact on earth.

The grass root technologies around weaving which created the most beautiful and niche fabrics for the world face extinction today. The connoisseurs of good earth practices are coming together and started working towards various technologies to bring back what was so prevalent a few decades ago. This research was one step closer to all that is happening to uplift and empower the artisans of India with the objectives to study the effect of slowing down in all the processes of supply chain in textiles and apparel making which used to be the way for so many centuries.

To study the effect of horoscope weaving in the process of making custom made apparel which will not only create curiosity but also created fabrics with a unique line of thought. The energy fields of mass manufactured apparel with the custom designed and custom made apparel were compared to see if there was any change in energy fields of the material and people because of a consciously made product.

The health parameters of the wearer were compared before and after using the custom apparel. India was about fair trade in all its manufacturing and business practices which seemed to have been lost due to various reasons which was studied to see its impact on the energy fields in the process of textile and apparel making.

Materials were tested for energy fields with Poly interference photography technique which clearly showed that indeed the conscious connective processes which are slow and follow certain strict methods have imbibed significant positive energies to the water, yarn and fabric. This was achieved through slokas and mantras as detoxification process for a standard period of time in all processes of supply chain. What was the ritual of artisan community once is not followed anymore. This certainly has proved that artisans should get back to whatever they believed and used to do around crafts as it is imbibing good energies which will have long term impact on the users well being.

Twenty men and twenty women teachers and computer professionals were selected for this study. Horoscopes collected were meticulously decoded with the colour horoscope weaving technique. This textile design created very sophisticated fabrics which not only created a unique design but also created bonds between the weaver and the wearer through understanding each other's life.
Organic cotton was procured from a GOTS certified mill which in itself had positive energy when tested with PIP. Twelve colours were selected from a gamut of colours of natural dyes which were chosen according to the Promostyl colour forecast of fall winter 2010-11. The fabric and garment designs were made according to the choice of the subjects. This not only gave all the 40 subjects customized garments but also gave the subjects scope to understand the nuances of the whole process of textile and garment making.

Gas discharge visualization and Electro interstitial scan was used to measure the energy and health parameters respectively of the wearers before and after custom clothing. The GDV analysis significantly proved that the conscious connective processes imbibed positive energies in the projection area. The projection entropy had increased slightly which proved that the subjects where accommodating changes that were happening through the clothing and environment. Slight reduction in projection fractality not only proved that the gaps in the energy fields were filling but also showed that when energies are high it needs very minimal repair.

The EIS gave various health parameters with a non invasive technology. Thirty three parameters out of the 69 were selected for this study and found that 45.45 per cent (15) health parameters showed significant results when analyzed at 5 percent level of significance. The homoeostasis score which is the good health score of the entire analysis showed significant results which in itself proved that indeed clothing should be considered as one of the parameters of health analysis. The reduction of CO2 and increase in the cell energy not only proved that there is a positive change in the physiology through clothing but also leaves a path to see clothing as choice for good health interventions.

The carbon foot print assessment clearly showed that every country in the world should start thinking in terms of buying local which not only cuts carbon emissions but also keep the rural communities in the rural to take care of crafts and farming which is the need of the hour. The 100 per cent naturally dyed organic hand loom cotton has the least impact on the earth as it follows all the good earth practices in procurement, processes and disposal of waste.

The 40 subjects had experienced organic cotton clothing for the first time in their life through this research which not only gave them a perspective on good fabrics but also opened up new areas to look at for conscious buying practices. This study brought the weaver and wearer face to face and delivered an eco friendly product in the shortest supply chain.

APPAREL & TEXTILES

Author : SHRESHA, M.
The concern of the consumers for variety in textiles is driving the textile industry for designing and producing new textiles from time to time. The efforts were taken to develop eco-friendly and biodegradable fibres to control non-polluting environment. The renewed sisal fibre is produced because of its high potential applications. Enzymes are playing a major role in finishing of textiles in an eco-friendly way, protecting the environment on one side and providing gentle finish on the other side.

The bio-polishing was carried out on sisal fibre in order to soften the fibre for good pliability and impart the smooth feel and handle of the fabric. Enzymes are advantageous because of their low activation energy requirement. Various scientists have reported that enzymes are safe to use and easily bio-degradable.

Therefore the present study was undertaken to assess the performance characteristics of the enzyme treated sisal fibres with three different enzymes New smooth (2%), Microsil (1.5%), Sibasof (0.5%) with cellulase enzyme Britacel L+. After enzyme treatment the sisal fibres were used to weave union fabrics with cotton yarn and subjected 14 to various laboratory tests to evaluate the geometrical, handle, comfort and mechanical properties, the standard BIS and ASTM procedures were followed for the above.

The data obtained in the study was compiled, tabulated and statistically analyzed using frequency and percentage for subjective evaluation and by two way ANOVA (factorial CRD) for laboratory tests.

The fabric yarn count, fabric count and fabric weight were also increased due to the treatment. The positive changes resulted in sisal union fabrics after the treatment were handle and aesthetic properties. The stiffness was decreased and crease recovery and thickness were increased with enzyme treatment. The drape coefficient of the fabric was decreased which implied that the drape of the fabric was increased. Considerable changes were noticed in the comfort properties but the water repellency had not changed after treatment.

The mechanical properties of the fabric were decreased with increasing enzyme concentrations. The tensile and tear were decreased confirming the changes in the
molecular structure and arrangement. The pilling was decreased enhancing the aesthetics. Abrasion resistance was increased after softening treatment. Among three enzymes, new smooth cellulase enzyme showed better improvement in textile properties and followed by Microsil cellulase enzyme in all samples. Among the samples, sample 25%-75% showed good results.

The subjective evaluation on aesthetic qualities of fabrics revealed that treated fabrics receive high ranking than the untreated fabrics. The cost of the finishing was economically viable for adoption at the commercial level. Sample 100% with enzyme treatment I and 25%-75% with enzyme treatment I fabrics fairly found better in its performance characteristics than other fabric.

Overall with the enzyme treatment of sisal improved on several important properties such as surface smoothness, handle properties, mechanical properties necessary for enhancing their suitability to apparels.
APPAREL & TEXTILES

Author: SIVA THANMAYEE, P.

Title of the Thesis: EFFECT OF IRRADIATION AND BIOSYNTHESIZED COPPER NANOPARTICLES ON THE DYEABILITY OF COTTON FABRICS TOWARDS DIRECT DYES

Major Advisor: Dr. (Mrs.) D. ANITHA

Degree: M. Sc. (H. Sc.)

College: COLLEGE OF HOME SCIENCE, HYDERABAD

Accession Number: D 9565

ABSTRACT

Improvement of colourfastness properties of the direct dyed fabrics is a challenge. Besides this dyeing, one of the textile wet processing methods causes pollution to the environment. As a result, textile chemists have focused their attention towards eco-friendly treatments which improve colourfastness properties without causing pollution. New methods were innovated to achieve the goal of improving colourfastness properties in an eco-friendly way. Focus is diverted to areas of nanotechnology and irradiation in this regard.

Nanotechnology is an emerging field that reformulates materials with improved performance, while irradiation is a simple, economical and energy saving process.

Therefore the present study was focused on assessing the effect of gamma irradiation in combination with biosynthesized copper nanoparticles on the dyeability, fastness properties of the cotton fabrics using direct dyes. Copper nanoparticles were biosynthesized using Ashoka plant (Polyalthia Longifolia) leaves. Cotton fabrics were exposed to gamma irradiation at 2 doses i.e. 1KGy and 2KGy, using C\textsubscript{60} gamma irradiator. Fabrics were dyed with two different direct dyes, Brilliant BB and Scarlet Red SR in three different shades using 0.5%, 2% and 5% of dye. Dyeing was carried out by exhaustion method. Among the fabric samples, few were treated first with biosynthesized copper nanoparticles and dyed and few were dyed and treated with copper nanoparticles. Copper nanoparticle application was done using pad-dry-cure method in three different concentrations of 0.5%, 1% and 2%. All the samples were subjected to various laboratory tests to evaluate the effect of treatments on geometric, handle, mechanical and colourfastness properties using the standard BIS and ASTM procedures. TEM analysis was carried out to identify the size of copper nanoparticles. SEM analysis of irradiated
and copper nanoparticle treated samples was done to visualize their effect on the fiber’s surface.

TEM analysis of copper nanoparticles indicated that they were spherical in shape with a size range of 60-100nm. SEM analysis showed that the fibers had slightly smooth surface have become finer than untreated due to irradiation treatment and copper nanoparticles. Yarn count, fabric count and fabric weight have increased due to the effect of both the treatments which was clear from SEM analysis. Crease recovery and thickness has increased in samples with increase in the concentration of both irradiation doses and copper nanoparticle treatments. Similar trend was observed in fabric properties of tensile, tear and abrasion of samples in both types of dyes. Better resistance to pilling was observed in irradiated samples alone. Colour strength and colourfastness properties increased with a higher dose of irradiation and copper nanoparticle treatments. Colour strength values of dye-1 samples were higher than the dye-2 samples. Samples treated first with copper nanoparticles and dyed later had good colour strength and improved colour fastness properties than their counterparts. Irradiation treatment also helped in reducing the COD and BOD concentrations of the dye waste water.

Treatment of cotton samples with biosynthesized copper nanoparticles and gamma irradiation improved several important properties such as surface smoothness, handle properties, mechanical properties necessary for enhancing their suitability to apparels. Important properties of dyed textiles such as colour strength and colourfastness properties were also enhanced due to the treatments besides reducing the major problem of pollution in dye waste water. The data obtained in the study was compiled, tabulated and statistically analyzed by two way ANOVA (factorial CRD).
FOOD & NUTRITION

Author : FARHA HUSSAIN
Title of the thesis : ESTIMATION OF IRON AND ZINC CONTENT IN DIFFERENT FRACTIONS OF ELITE RICE LINES DEVELOPED BY MARKER ASSISTED SELECTION
Major Advisor : Dr. K. MANORAMA
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE AND RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9466

ABSTRACT

Rice (Oryza sativa L.) is the staple food for more than three billion people, over half the world’s population. It provides 27% of dietary energy and 20% of dietary protein in the developing world. Rice is cultivated in at least 114, mostly developing countries and is the primary source of income and employment for more than 100 million households in Asia and Africa. In India, rice is an important source of food as well as source of income to the farming community. India ranks first in area of cultivation and second in production of rice in the world after china.

Iron deficiency anemia (IDA) is the most common nutritional deficiency worldwide. The negative consequences of IDA on the cognitive and physical development of children and on the work productivity of adults are of major concern. Zinc is an essential micronutrient and plays an important role in growth, immune function and resistance to infections in children. Zinc deficiency places children in many low-income countries at increased risk of illness and death from infectious diseases.

Biofortification entails of the use of plant breeding and/or transgenic approaches to develop new cultivars with the potential to increase the nutrient concentration of edible portions of crop plants, and has emerged as one possible solution to alleviate malnutrition. Biofortification of staple food crops has thus been considered a sustainable strategy to overcome the problem of micronutrient deficiencies.

22 rice lines obtained from the Directorate of Rice Research, were analyzed for their proximate composition, iron and zinc content, and in vitro bioaccessibility of iron. Results indicated that the rice lines 236 (K), 185(M), 196 (M), BPT 5204 and Madhukar were found to be high in total iron. The rice lines that were found to contain high zinc content are 185(M), 195(M) and Madhukar.
Bioavailability of iron in rice lines using *in vitro* tests showed high availability in unpolished raw rice rather than in polished rice. Bioavailability of iron was estimated in cooked rice for four high iron containing varieties. Results showed that cooking rice results in the destruction of phytic acid which makes iron more available for absorption.
FOOD & NUTRITION

Author : JANAKI PRIYA, S.

Title of the thesis : DEVELOPMENT OF PCR BASED RAPID ASSAY METHOD FOR DETECTION OF AFLATOXIN IN FOOD

Major Advisor : Dr. ANURAG CHATURVEDI

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE AND RESEARCH CENTRE, RAJENDRANAGAR

Accession Number : D 9491

ABSTRACT

Mycotoxins are highly toxic secondary metabolic products of moulds mainly produced by Fusarium, Aspergillus and Penicillium species. Aflatoxins, zearalenone, trichothecenes, ochratoxins, fumonisins and ergot alkaloids are some of the important mycotoxins. Mycotoxins affect a quarter of the world’s food crops, including many basic foodstuffs and animal feed. Among these, aflatoxins are most important in food safety. Aflatoxins are potent hepatotoxic, mutagenic, immunosuppressive and carcinogenic toxins. Indian groundnut consignments are detained at countries in the European Union (EU), due to presence of a high level of aflatoxins (The Indian express, Feb, 2103). Contamination of Groundnut (Arachis hypogaea) with aflatoxins is one of the main factors that compromise the quality of the product. Enhanced food safety is the major factor for improvement in health, nutrition, food export and economic status of food producers and processors. During the last five years, out of approximately 750 official rejections of groundnut products, over 365 were rejected due to excess levels of aflatoxins in groundnuts, which is about 50% of all the rejections.

Analysis of mycotoxins forms an important tool in the control strategy, as these toxicants can never be completely removed from the food supply. Early detection of mycotoxin is critical to prevent this toxin entering the food chain and improve the food safety of the nation’s food supply, public health and trade. The traditional methods for
Detection of mycotoxins are time consuming and tedious procedures and methods like ELISA may not be conclusive about the presence of the toxins. DNA-based methods for identification of mycotoxin producing fungi have been developed and applied as an alternative to traditional approaches. However, a PCR based method to identify toxin is not available, hence this study was taken up to develop a PCR based method for identification of aflatoxin in groundnuts.

DNA was extracted from mycelia of *Aspergillus parasiticus* by using an Agilent DNA extraction kit. Mycotoxin producing gene fragments in fungal strains were amplified using PCR and visualised in a Bioanalyzer in an attempt to develop a rapid assay for aflatoxin detection. Based on the sequence of the biosynthetic pathway for synthesis of aflatoxin, the aflatoxin key gene, *aflQ*, involved in the production of aflatoxin was identified. Forward and reverse primers were designed by identifying homologous regions from original gene sequences (obtained from GENBANK). Sequences from different species of fungi were aligned using megalign software from DNASTAR Lasergene 8.0 version, and homologous regions were identified. Primer 3.0 software was used for designing primers from these homologous regions. By using a set of primers, 166 base pair fragment of the *aflQ* gene was amplified from DNA of *Aspergillus parasiticus*. PCR assay were conducted to detect the presence of the gene *aflQ* encoding the enzymes directly involved in the production of aflatoxin.

Presence of aflatoxins in 55 samples of groundnuts collected from various farmer’s fields and godowns, wholesale markets from Tamil Nadu (T.N) and Andhra Pradesh (A.P). Groundnut samples were checked for the presence of *aflQ* gene. PCR assay revealed the presence of aflatoxin producing *aflQ* gene in 12 out of 55 samples tested. The fragments were resolved on the DNA 1000 LabchipR, for generating data of fragment sizes. Use of the PCR combined with the Bioanalyzer was advantageous compared to traditional agarose gel electrophoresis and staining methods, in terms of precision of the bands and band sizes. Occurrence of aflatoxin in the groundnut samples was confirmed by LC-MS analysis, which revealed that 10 out of 12 of the PCR positive samples, showed presence of aflatoxin.

The PCR assay used in this study, required just a few hours (2.5 hours for DNA extraction, 2.5 hours for PCR amplification, and 30 minutes for resolving on the Bioanalyzer), enabling the rapid and simultaneous testing of many samples. Therefore, the PCR based method is suitable for rapid detection of aflatoxin in foods. Based on the molecular and biochemical data generated in the present study, it is possible to identify the aflatoxin producing ability of the fungi contaminating groundnut samples, even before the toxin is actually produced in the grains.
ABSTRACT

The study entitled “Pesticide Residues and Nutritional Quality of Selected Vegetables Grown in Southern Telangana Zone of Andhra Pradesh” was conducted to estimate the pesticide residues in tomato, bitter gourd and brinjal in fresh form and after washing and the nutrient composition in fresh vegetables. The other objective was to determine the pesticide residue levels, of the selected vegetables before and after washing. Comparison was made between recommended package of practices versus
farmers’ practices in the usage of pesticides and nutrient composition against reference values.

Ten farmers each of tomato, bitter gourd and brinjal were selected using purposive random sampling. The total thirty farmers were interviewed using the structured questionnaire that was prepared for the purpose. The questionnaire included information on the package of practices in relation to pesticide usage for different vegetable crops, dosage/hectare, mode of application, sources for the procurement of seeds and pesticides, processing techniques which included washing vegetables before consumption and the affect of pesticides on health.

Burning eyes, vomiting and headache were the most common immediate symptoms experienced and few of them used masks or gloves, very few used both. Nearly sixty seven percent did not use any precautionary measure while pesticide application. The reasons for application of pesticides were quoted as higher yield, better quality produce and prevention of pests. The farmers were aware of the use of natural pesticides like neem oil and crude garlic oil instead of chemicals but are not practicing. Most of them did not feel the need for washing the vegetables before consumption as they were unaware of the serious health effects of pesticides.

The nutrient compositions of selected fresh vegetables (moisture, reducing sugars, β-carotene and ascorbic acid) were comparable with the reference values. The moisture content of bitter gourd, brinjal and tomato were 92.15%, 91.13%, 94.51% and ascorbic acid content were 55.21mg%, 10mg%, 23.44mg% and β-carotene content were 1340μg%, 1150μg%, 250μg% and reducing sugars content were 0.6%, 2.46% and 3.13% respectively.

Pesticide residue levels in all the selected vegetables before and after washing were below detectable limits (BDL). Pesticide residues in vegetables were influenced by the time lag between pesticide spray and fruit harvesting, storage, transport, handling and processing techniques like washing and peeling before consumption of vegetables. The lower dosages of pesticides applied by the farmers than recommended could have also contributed to the non-detectable levels of pesticide residues in the vegetable samples.

Thus, the results of the present study indicate that the pesticide residue levels in the selected vegetables tomato, bitter gourd and brinjal of Southern Telangana Zone are within the MRL levels and are therefore safe for human consumption. Pre-processing techniques like washing with water or 3% salt water and peeling for obtaining edible portion further reduced the residual burden as the residues fell below detectable levels.
ABSTRACT

Sweet orange (Mosambi) Cv. Sathgudi (Citrus sinensis L. Osbeck) is an important citrus fruit grown in Andhra Pradesh. The major problem with sweet orange juice and other beverages with sweet oranges is bitterness in the extracted juice and short shelf life of the juice. The bitterness is due to triterpenoid limonin, formed during and after juice extraction, thus rendering the juice unpalatable. Therefore, an attempt was made for controlling the formation of limonin, which gives less bitter taste in sweet orange juice using hurdle technologies such as irradiation at three dose levels, microbial enzyme (Pseudomonas putida), microbial enzyme + irradiation, use of additives (Hydrocolloid (CMC) and Sodium benzoate) and development of value added product (jam).

The control and experimental samples made with sweet orange juice and value added products of sweet orange juice were analyzed for sensory, physico-chemical and microbial quality using standard methods.

All the experimental samples i.e. irradiated and microbial enzyme+ irradiated sweet orange juice samples were not acceptable because there was an unacceptable odour immediately after the irradiation.

Microbial enzyme (Pseudomonas putida) treated sweet orange juice samples were not acceptable because there was an unacceptable odour immediately after the incubation.

No significant difference was observed in the mean sensory scores for colour, texture, taste, flavor, mouth feel and overall acceptability of the jam with additives during storage period of 60 days.
Significant difference was observed in pH, reducing sugar and limonin content of both irradiated and microbial enzyme+ irradiated sweet orange juice samples. However, significant difference was not observed in TSS, Titrable acidity and Vitamin C content of the same.

Significant difference was observed in physico chemical properties i.e. pH, TSS, Vitamin C, reducing sugar and limonin content except titrable acidity of the sweet orange juice stored in polyethylene pouches compared to samples stored in aluminium pouches.

Significant difference was observed in physico chemical properties i.e. pH, Titrable acidity, Reducing sugar and Limonin content except TSS and Vitamin C content between the control and microbial enzyme treated sweet orange juice samples. However, significant difference was not observed in all the physico chemical properties including limonin content between two packaging materials.

Significant difference (p<0.05) was observed in the pH, TSS, Titrable acidity, Vitamin C, Reducing sugar and Limonin content between control and experimental samples and also within the treatments in sweet orange juice with additives. With increasing days of storage there was significant difference in pH, TSS, Titrable acidity, Vitamin C, Reducing sugar and Limonin content of sweet orange juice samples stored at refrigerated temperature. Additives and both temperatures (ambient and refrigerated) had no significant effect on various sensory attributes like taste, consistency and had significant effect on flavour, bitterness and over all acceptability of sweet orange juice.

During storage for a period of 60 days, significant difference was observed in various physico-chemical characteristics such as pH, TSS, Titrable acidity, Vitamin C, Reducing sugar and Limonin content of jam in both control and experimental samples.

Microbial load (TBC & TMC) was not detected in irradiated sweet orange juice samples. It was not detectable at ambient temperature in both control and sweet orange juice with additives on 1st day. The microbial load (TBC and TMC) showed presence and multiplication of microbes but at a lower rate in sweet orange juice with additives at refrigerated temperature during the storage period of 5 days.

Microbial load (TBC & TMC) was comparatively lower in jam with additives than in control sample.

From the results of the study, it can be concluded that the processing technologies such as irradiation, microbial enzyme and microbial enzyme with irradiation could not be used effectively for enhancing shelf life and debitterisation of sweet orange juice. However, additives [Hydrocolloid (CMC - 0.2g/1000ml) and Sodium benzoate (0.1%) can be used to enhance shelf life and debitterisation of sweet orange juice for 5 days and jam for 60 days of storage period.
ABSTRACT

Becoming a parent, is one of the most powerful of the human experiences, is often accompanied with feelings of celebration and relief, but it can also be a time of anxiety, and stress. The increase in stress that takes place when the hopes and dreams of the “perfect” pregnancy, labor, and delivery are shattered with the revelation of a heart disease, and the grieving process that ensues as parents cope with the challenges of having an infant with heart disease.

Children with cardiac problems present special challenges i.e. it has biological, behavioral, and social manifestations for the child and for the family. Hence the present study attempts to find out the coping strategies adopted by the primary caretakers of children with cardiac problems.

The sample consisted of 60 caretakers attending to children with cardiac in early phase (60), intermittent phase (17), and in advanced phase (23). The sample was selected from Government and Private Hospitals from twin cities of Hyderabad and Secunderabad. Ex-Post facto research design and purposive sampling procedure was followed for the present study. Data collected from the respondents (caretakers attending to children with cardiac problems) through in depth interviews were coded, scored, tabulated, analyzed and interpreted.

Half of the (52%) of the caretakers were young adults (26-30), out of 60 respondents 27 per cent were illiterates and belonged to nuclear family (70%), 33 per cent belonged to low income group with membership in Arogyasri Scheme.

Half (53%) of the patients were female children suffering with cardiac problems in the present study. More than half (60%) of the children were diagnosed in early phase - suffering with Hole in the heart, chest pain, and abnormal blood vessel. Current health
condition of the children was found to be improving. 23% of the children were found to be facing problems in advanced phase - such as reduced resistance power (weakness), chest pain, nausea, indigestion, radiation pain and numbness, pale coloration of the skin, shortness of the breath and increased heart rate.

Results indicated that less than half (38%) of the caretakers faced relationship problems with other children (siblings of the patient), i.e. getting less time to talk, having added responsibilities, recreation needs being compromised, sometimes being teased by the community, feeling isolated, and worrying about the future as the caretakers were spending most of the time attending to the medical and physical needs of the sick child.

Most (75%) of the caretakers tried, to solve the problem by seeking various alternatives. Problem solving was the common method used by the caretakers for gaining knowledge about cardiac problems which would help the parents to know child’s condition. More than half (63%) of the caretakers prayed for guidance, strength, faith, moral support and seeking alternative ways to solve the problems, and asking help from close relatives. Majority of the parents hoped that the problem would go away somehow; this perhaps helped them to reduce the psychological problems such as anxiety, stress and depression. With regard to positive appraisal, caretakers became more sensitive about the situation.

More than half of the caretakers used approach coping strategies such as guidance and support: seeking support from relatives, talking to close friends about the problem and praying for guidance and strength, and also used Problem solving, positive appraisal, and logical analysis.

Caretaker’s Education, problem experienced and stress perceived was found to be positively correlated and age was found to be negatively correlated with the coping strategies adopted by the primary caretakers attending to children with cardiac problems. With regard to child’s variables, type of child’s problem was positively correlated with the Coping strategies adopted by the primary caretakers attending to children with cardiac problems.

No Gender difference was found in the coping strategies adopted by the caretakers attending to the children with cardiac problems.
HUMAN DEVELOPMENT AND FAMILY STUDIES

Author : NEEMI DEVI, A

Title of the Thesis : EFFECT OF INTERVENTION ON THE DEVELOPMENTAL NUTRITIONAL AND HEALTH STATUS OF THE TRIBAL CHILDREN

Major Advisor : Dr. (Mrs.) M. SARADA DEVI

Degree : M. Sc. (H. Sc.)

College : COLLEGE OF HOME SCIENCE, HYDERABAD

Accession Number : D 9459

ABSTRACT

The tribal children are the most vulnerable group due to poverty and lack of parental education they faced multiple deprivations such as excess to stimulation, nutrition, immunization, as well as water and sanitation. The first few years of life were considered to be the most important developmental phase of a person’s life. Optimal development in terms of physical, social/emotional, and cognitive (including language) domains is vital for children’s immediate and long-term health and wellbeing. Early intervention is a system of coordinated services that promotes the child’s growth and development and supports families during the critical early years.

Many theories explain the effect on intervention on changing the behavior of the individuals. According to Cognitive social-learning theory (Bandura), the most important prerequisite for behavior change is a person's sense of self-efficacy or the conviction that one is able successfully to execute the behavior required to produce the desired outcome. Operant-conditioning builds on classical conditioning and focuses on the hypothesis that the frequency of a behavior is determined by its consequences. According to theory of reason action if a person believes that performing a given behaviour will lead to whole positive outcomes, then s(he) will hold a favourable attitude toward performing that
behaviour. Therefore, to enhance the understanding of these constructs, a study has been on the “effect of intervention on the developmental, nutritional and health status of the tribal children” with the following objectives- to study the existing developmental, nutritional and health status of the tribal children: to implement intervention programme to improved the developmental, nutritional and health status of the tribal children: to study the effects of intervention on the developmental, nutritional and health status of the tribal children.

The sample consists of 50 children in the age range of 1-6 years with purposive sampling from the Kollapur & Pangal mandals, Mahebubnagar District. The respondents were divided into two groups and these were boys and girls. The tools used in the study were as follows: General information schedule (questionnaire), Bayley scale of infant and toddler development, Gesell Developmental Schedules, anthropometric scales, nutrition and health schedules was used to assess the developmental, nutritional and health status of the tribal children.

From the results it was found that the highest educational status attained by the fathers was higher secondary. Majority of the father have completed high school. The educational status of mothers for boys was better than the educational status of mother’s for girls. Maximum of the father occupation were labourer and most of the mothers were unemployed. It was seen that most of the fathers earns an income of 5000-10,000. More than half of the children belong to nuclear family.

For 2-3 years old children it was found that only in the motor development few children of reached high developmental status. In receptive communication maximum of the children were in average category. Regarding expressive communication most of the children were in low average. It was observed that boys were better in cognitive development than girls. With respect to children of 4-6 years most of the children were in average developmental status.

Further it was noticed that the parameters of height, weight, mid upper arm circumference and chest circumference/head circumference revealed that most of the children were in mild malnutrition. It was seen that least number of children suffered from vitamin A, C and D. Regarding vitamin B deficiency mild cases were found maximum. It was observed that most of the children were having fair health and hygienic status.

It was interesting to find that after intervention there was significant increase in the fine motor development in girls and cognitive development in boys of 2-3 years old. With respect to children of 4-6 years it was observed that there were significant increased in the motor development for boys and personal-social development in girls. The children improved in weight, mid upper arm circumference profoundly after intervention. It was found that the incidence of vitamin B deficiency reduced significantly in boys.

It was evident that age was not related to the developmental, nutritional and health status of the children. Children of 2-3 years who reported high fine motor, gross motor and cognitive development had high educational status father. Children of 2-3 years
having high developmental status have mothers of high educational status. Children of 2-3 years having high income fathers have better cognitive development. Children of 2-3 years old who have high income mothers have high fine motor and cognitive development. Children of 4-6 years old who reported high motor development and adaptive behaviour had high educational status mothers. No relation was found between the parents’ occupation and developmental status of the children. Children who reported to increase in height, weight and mid upper arm circumference have high father education. Children who have high mother educational status have increased in height, weight, mid upper arm circumference, chest circumference/head circumference and health and hygienic status. No relation was found between the parents occupation and nutritional and health status.

From the present study it was concluded that the pretest scores shows most of the children were in average developmental status followed by low average. Majority of the children were in mild level of malnutrition and few numbers of children suffered from protein, vitamin A, C and D deficiency. After the intervention programmes significant improvement were found in the different areas of developmental and nutritional status of the children. Thus, the intervention programme was effective in improving the developmental and nutritional status of the children.

The study helps us to know the existing developmental, nutritional and health status of the tribal children. It also helps us to understand the importance of intervention during the early years of life to improve the developmental, nutritional and health status of the tribal children. The findings will be useful to educators and policy makers who are working for the tribal children in understanding the developmental, nutritional and health status of the tribal children. These findings can be used to plan and implement different programmes and policies for the welfare of the tribal children.
ABSTRACT

A mobile phone is considered to be one of the greatest and most important inventions of all times, because it enabled people to communicate without wires and connected people from all continents into one global community. Mobile phones have
changed the life of people considerably, as it enables one to communicate any time and from any place. With the help of mobile phones such spheres as business trade began to function more effectively and productively. The development of mobile phones made the world busier, because the streets are full of people talking over the telephone and hurrying somewhere.

Mobile phones, which were introduced a decade ago in 1995-96 in India, are becoming the dominant means of accessing communication. At the end of 2005-06, there were 90 million mobile subscribers in India in comparison to 50 million subscribers for land lines. The increase in mobile phones has been phenomenal in comparison to land lines since the introduction of mobiles in the country.

The Internet is a vital part of the education process; resources for learning and educating are implemented into lesson plans and homework every day. Students and teachers can access unlimited amounts of information to broaden their education. With Internet access in colleges, there is almost no limit to what students can learn. Traditional teaching methods might not be the norm anymore.

Internet usage in India has a population of 1.2 Billion, 934.1 Million (78%) have mobiles and 137 Million (11%) are internet users. 60.5 Million (5%) on social networks. 56 percent are under the age of 30 and 30 percent are under the age of 15 years. What this says about the future is that 10 years from now there will be 26% of the population (factorizing growth at 1.33%) which would be between the age of 15-25 reducing our new available work force to just 1/4th of the population.

Adolescents are using mobile phone differently from adults – for example, they use for texting more than talking. Adolescents are also rapidly shifting towards using mobile phones as multimedia devices. This is because mobiles can be used as web browsers, cameras, photo albums, diaries, address books, MP3 players, game consoles and more.

Many Adolescents use the internet to talk with friends, and to share their ideas and creative outputs. It’s an important way for teenagers to connect with each other, socialize, and feel part of a peer group.

Exploratory research design was adopted for the present study. Hyderabad was purposively selected for conducting the study. The sample of the study was 200 adolescents between both the age groups 18-19 and 20-21 years. The data was collected by using the questionnaire. The collected data was scored, tabulated, analyzed and interpreted with appropriate statistical procedures.

The results of the study revealed that boys were spending more than 2 hours with mobile phone for talking, whereas girls were spending much time in texting the messages. Younger boys were using internet on their mobiles for more than two hours, whereas girls of same age were using internet on the mobile phones only for 1 to 2 hours. Both boys and girls were making phone calls to others when they were alone and when they have problem. Majority of the respondents (boys and girls) agreed that more usage of mobile phones would create more problems to themselves.
With regard to usage of internet, adolescents preferred to spend much time online at home compared to college and have at least 2 social networking websites. Face book was very popular among graduate college students irrespective of the gender and age group.

Results no adolescents' perceptions on usage of mobile phone and internet indicated that nearly 59 percent of the students said that they use mobile phones in college. Nearly 89 percent of the students said that mobile phone is useful to keep contacts with friends and family. Thirty two percent of boys and girls reported that they never shutdown their mobile phone and the only reason for shutting down the mobile phones was during exams.

Both the age groups perceived that communication was the best thing and radiation was the worst thing in using mobile phones. Ninety four percent of the students reported that they have Email ID. Eighty two percent of the students said that internet is responsible for many of the good things they enjoy. Both the age groups reported that information gathering was the best thing and becoming addicted was the worst thing about the internet.

There was no significant difference found between age and gender with respect to usage of mobile phone and internet in a day. In the age group of 18-19 years there is no significant difference between boys and girls further there is significant difference between 20-21 years usage of mobile phone in a day. There was no significant difference between age and gender both the age groups 18-21 years usage of internet in a day.

The reasons for the above results could be explained to the factors that there was less difference in the age range of the sample because the entire 200 hundred students fell in the age range of 18-21 years hence, the entire sample had similar usage pattern with respect to mobile phone and internet.

HUMAN DEVELOPMENT AND FAMILY STUDIES

Author : WARSHA, N.
Title of the Thesis : CHILD TO CHILD: YOUNG CHILDREN’S PHYSICAL, COGNITIVE AND SOCIO-EMOTIONAL INTERACTIONS WITH INFANTS AND TODDLERS
ABSTRACT

The possibilities of what infants and toddlers experience through interaction with their older counterparts are still not adequately researched. Theories such as Attachment theory, Social learning theory and Cultural Historical theory indicate some possibility for placing older children as a source of affectionate attachment figure for the infant or toddler as well as for imitation and identification and to further the infant’s cognitive and social development.

This observational study is an attempt to know if older children; siblings and others affect infant and toddler world in any significant way and if yes, in what ways do older children affect infants and toddlers. This study also explores the qualitative differences in interactions among rural and urban children.

The total video samplings used for this study are 88 video clippings. The duration of each video clipping is 10 minutes. 39 video clippings were recorded in urban settings and 49 video clippings were recorded in rural areas. These video clippings were evenly distributed both in indoor and outdoor settings of schools, apartments, colonies and summer camps. All the video clippings consists the data of physical, cognitive and socio-emotional interactions among children. Observer Behaviour Software was used for coding behaviours using the coding scheme developed by the researcher in four different areas of interactions viz. verbal, physical, gestures and ambivalent behaviours. These categories of behaviours were sub categorised as positive and negative except for ambivalent behaviours. The data in the video clippings were analyzed using observation behaviour software and further empirically analyzed using statistical measures such as one way ANOVA, two way ANOVA and chi square test to find the age, gender and urban and rural differences.

The following aspects came to light due to this study

- Toddlers were the most active group in interpersonal interactions. Toddlers justified their title as “Terrible Two”s” by being the active initiators and explorers in all situations of interacting with younger and elder children. The toddlers were involved in the maximum number of interactions in all categories of behaviours; verbal positive and negative, physical positive and negative gestural positive and negative as well as ambivalent behaviours, the frequencies ranging from 82-533 times.
• Toddlers and preschool children exhibited the largest number of interactions in all behaviour categories. This might be because of the fact that developmentally this age between 12 months to 5 years is a critical period with rapid developmental changes in all aspects especially, cognitive and socio-emotional development are happening. Toddlers are enthusiastic to know more while the preschoolers are excited to offer what they know to their successors.

• Rural children were more frequently observed in negative behaviours than urban children. This may be because of lack of adult monitoring as well as poor examples of positive adult models for imitative learning. Rural communities are more likely to show examples of negative and aggressive behaviours than urban societies. Children in rural areas seek the advantage of over using the role of adults in the absence of actual ones.

• Boys expressed more interactions with younger children than girls. The gender differences were however not statistically significant. The general assumption that girls would be more likely interested in younger children was not seen in the findings of this study. Further research is required before any conclusions can be drawn.

• Rural older age group children were more into interactions with younger children than urban older age group children. Older age group children in rural areas are tuned to take the role of caretaker in absence of adults. This must be the continuing habit for those children which will make it hard for them to ignore younger ones. This is totally different in urban areas where children are less seen in the caretaker role.

• More often, positive behaviours were expressed than negative behaviours by all children in their interactions. In a given setting, it is generally seen that positive behaviours are more often seen by any group of individuals. Family and society trains human for this. Some of the negative behaviours seen could be due to their instrumental value for children or simply as form of imitation.

Throughout this study it is comprehensible that child to child interactions provoke various kinds of positive and negative behaviours that determine the temperaments of children in various situations. A specific behaviour that sparks the interactions can't be quoted because most of the time the behaviours which were exhibited are transitory and follows the natural instinct. The frequency and duration of any behaviour that is elicited in an interaction is not equal. Though there are no significant gender differences, significant age and qualitative differences based on social setting are evident which can help modify theoretical perspectives on children's interactions. Child to child interactions basing on the existing theories and findings of previous research can be a reliable source for furthering the benefits of child to child approach in the field of Early Childhood Care and Development.
ABSTRACT

India’s residential sector is a major consumer of energy and these demands will grow with the population growth. Although electricity currently accounts for a small share of total household energy consumption, it is the main source of energy for lighting. Introducing energy efficient appliances in the household sector is an important alternative to increasing generating capacity while also reducing the growth of carbon dioxide emissions.

Exploratory research design was adopted to conduct the study. A total of two hundred randomly selected women consumers formed the sample for the study. The information related to the demographic profile, awareness of star rating, awareness on use of energy efficient appliances, factors affecting their purchase decision, reasons for conservation of electricity and sources of information of these appliances were collected through a structured questionnaire.

The total sample consisted of 100 women consumers who had already purchased the energy efficient household product and 100 who are considering the purchase of energy efficient household product. The results of the test indicate that there is significant difference between the consumers who have already purchased the energy efficient appliance and those who are considering the purchase of the appliance in terms of the parameters they are brand, function, durability, star rating, quality, appearance, price, lower energy consumption, maintenance and replacement cost. The results were further confirmed using a two sample Z test and it was found out that there is significant difference in the purchase behaviour of women who have purchase the appliance and those who are considering the purchase in terms of the above mentioned parameters.

Educational qualification, income and occupation are factors which influenced the purchase behaviour of women in relation to purchase of appliances. The respondent’s knowledge about these appliances increases with their level of education as higher understanding rates are associated with higher education. The respondents who are employed home makers in comparison to respondents who are full time home makers are better aware because all the employed home makers are either graduates or post graduates. The results also indicate that quality, brand and function is more important factor in selection of energy
efficient household products than star rating and lower energy consumption irrespective of income group and educational qualification.

The efforts to conserve energy at household level can be fulfilled by educating the women on star rating, on the use of energy efficient appliances and factors influencing their purchase decision.

The comparison shows that the knowledge of the consumers has increased because more women are getting educated and getting acquainted with information related to the purchase of appliances, since they are the managers at home and this requires them to be updated with latest information. The awareness of the appliance increases with the income of the respondents and it is evident in the study that majority respondents belonging to a higher income group have a better knowledge of term energy efficiency. Energy conservation reduces the electricity bill, these efforts should be made available more for the low income group individuals as it is not penetrating the segment because energy efficiency and star rating are always associated with higher price.
RESOURCE MANAGEMENT AND CONSUMER SCIENCES

Author : DEEPIKA JANGETI
Title of the thesis : IMPACT OF LIGHT SOURCES ON HUMANS AND MATERIALS IN RETAIL CLOTH STORES
Major Advisor : Dr. NEERAJA TELAPROLU
Degree : M.Sc. (H. Sc.)
College : COLLEGE OF HOME SCIENCE, HYDERABAD
Accession Number : D 9461

ABSTRACT

Lighting design in commercial establishments should be oriented towards product sales taking into consideration the health and well-being of store employees. The study aimed at exploring the lighting designs in retail cloth stores, investigating the impact of lighting in retail cloth stores on workers’ health, analyzing the impact of lighting in retail cloth stores on purchasing behaviour of consumers and finding out the effect of lighting on cloth materials.

The lighting environment in retail cloth stores was assessed based on the quantitative and qualitative lighting parameters. The quantitative lighting parameters in all the ten stores were measured Dialux 4.10 software was the tool used to measure the lighting variables. The raw data was subjected to cluster analysis. Ten retail cloth stores were formed into four groups with similar lighting conditions. The degree of association is strong between members of the same cluster and weak between numbers of different clusters. Further, these four groups were treated as independent variables to explore the impact of lighting design of retail cloth stores on health of workers, consumer purchasing behavior and material.

A total of 100 workers selected at random from ten retail cloth stores formed the sample for investigating the effect of lighting parameters in retail cloth stores on the physiological and psychological health of workers. Hundred consumers chosen at random from consumer visiting the retail cloth stores formed the sample for the investigating the impact of lighting on purchasing behaviour of consumers. The retail cloth stores I, II, III and IV categorized through cluster analysis were treated as four independent groups for data analysis. The data was subjected Analysis of variance (ANOVA) to find out the association between independent and dependent variables of the study. The experimental research design was adopted to study the effect of lighting from selected lighting sources on selected cloth material in terms of colour, tear strength and tensile strength over a period of stipulated time.

With reference to quantity and quality of light emitted by different light sources in retail cloth stores, variations and similarities were observed. The factors like Spacing to height ratio and Light loss factor were found to be same for all the ten retail cloth stores. Variations were observed in case of Illuminance, Luminance, Uniformity ratio, Luminaire efficiency, Colour rendering index, Correlated colour temperature, Walls/working plane illuminance quotient and Ceiling/working plane illuminance quotient.
According to the study illuminated environment in retail cloth stores had an impact on workers blood pressure before starting the work and during work and it had not shown any impact on blood pressure after the work. In case of heart rate illuminated work environment had not shown any impact on workers heart rate before work, during work and after work. The study found the impact of lighting conditions in retail cloth stores on workers body temperature before starting the work and during work. Whereas lighting conditions in workplace had shown no impact on body temperature after the work.

Lighting in the retail cloth stores showed no effect on the skin and eyes of the workers who got exposed to artificial illumination throughout the day. However, workers were found experiencing symptoms like watering, redness, itching, dry eyes, burning eyes, and heaviness of the eyelids, tired or sore eyes and sticky eyes.

According to the study, artificial lighting in the retail cloth stores was found to have an impact on the hair of the workers. Workers’ were found complaint about baldness. Workers who were exposed to lighting in retail cloth stores suffered with sleeping disorders. The workers were found complain about difficulty in falling asleep at night, waking up frequently during the night, light fragmented or refreshing sleep, sleepiness and low energy during the day, difficulty in getting back to sleep after waking up during the night. Lighting condition in retail cloth stores was not exerting any impact on general health conditions of the worker. Out of the three psychological health variables studied. Only the mood of the worker was found to be influenced by the lighting environment in retail cloth stores. Visual discomfort experienced by consumers and their alertness while shopping were not influenced by illumination in work environment.

Lighting conditions in retail cloth stores were not exerting any impact on shopping attitude of consumers, planned purchase behaviour, time and money spent by consumers in shopping, choice of material, shop image, alertness of consumers while shopping, perception of colour and motivation of consumers. However, lighting condition in retail cloth stores had an impact on impulse buying behaviour of consumers, their shop choice, mood while purchasing clothes and visual discomfort perceived by consumers while shopping. According to the study, though the lighting conditions did not show great impact on consumer buying behaviour it showed moderate impact. It can be concluded that the lighting condition in retail cloth stores do influence the buying behaviour of consumers.

According to the study, the lighting was found to be affected by time and duration of lighting exposure affected the colour of cotton cloth, polyester and silk. In case of denim and wool, colour of the material changed by the duration of exposure to lighting. However, the change in colour according to time was not found significant. With reference to tear strength of warp and weft of the material under exposure to different light sources the lighting was found to be affected by time and duration of lighting exposure affected the tear strength of warp and weft of cotton, denim, polyester, silk and wool. With reference to tensile strength of warp and weft of the material under exposure to different light sources the lighting was found to be affected by time and duration of lighting exposure affected the tensile strength of warp and weft of cotton, denim, polyester, silk and wool.
The concept of employment and wages are as old as mankind in India. Once Lord Buddha said that men works to satisfy the primary or basic urges of hunger, thirst, and sex, as well as host of secondary wants and desires created by a commercial civilization. Employment wage complements rural India the right of work should, therefore, be assured to all, as a pre-requisite for the good life. It is the duty of the state to uphold justice, and provide for the material and spiritual welfare of its subjects and give structure and discipline to life. Wage employment is monetary compensation paid by an employer to an employee in exchange for work done. Payment may be calculated as a fixed amount for each task completed, or at an hourly or daily rate, or based on an easily measured quantity of work done.

The government of India, therefore, placed increasing emphasis on taking up schemes for providing additional employment opportunities and various special schemes of employment generation right from 1960s. The Government of India created a historic act, by enacting the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), the largest employment generating programme in the world, ensuring the right to work in a country with a population of over one billion.

The Government of Andhra Pradesh has formulated the Scheme called Andhra Pradesh Rural Employment Guarantee Scheme which has come into force with effect from 2nd February 2006 during the first phase of implementation, in the rural areas with good objectives.

Ex-post-facto research design was selected for the study with sample of 120 respondents 60 from each village were selected randomly. Stratified random sampling procedure was adopted in the selection of the respondents at two villages Two ICRISAT adopted villages were purposively selected where the said programme was launched in 2009 under the research scheme entitled Village Dynamics in South Asia (VDSA).
Lowest percentages of MGNREGA beneficiaries were observed as young in both the villages. In JCA majority were middle aged (48.3%), while majority (65%) were adults in PMD. Majority were illiterate in both the villages. However, heterogeneity among the remaining respondents could be observed, as the educational status ranged from primary to graduation and above categories.

Most of the respondents of JCA belongs to backward caste, followed by forward and scheduled castes. Majority had category 1 type of house in both the villages, followed by category 2. Least percentage was found in category 3&4. It can be concluded that in both the villages, respondents were possessing pacca houses, which is one of the indications of development. Nuclear families were more common in both the villages. Extended families also existed to a considerable extent. Majority in both the villages were small in size, followed by medium and large.

Half of the respondents in both the villages were small farmers. Less than one third of them were medium famers. However there were large farmers also, but less in number. It could be concluded that MGNREGA beneficiaries comprise of all categories of farmers, but mostly small, followed by medium. Majority of the respondents in JCA had agriculture (56.7%), followed by farm labour (20%) and nonfarm works (18.3%) as occupation. Caste occupations and livestock were very less. In PMD, there were more agriculturists (81.7%). Farm labourers and nonfarm workers were less compared to JCA. With regard to family income, most of them were belonging to medium income group (43.3% & 50%), followed by low (33.3% &30.0%) in JCA and PMD respectively. Compared to PMD, there were more respondents in very low income group (15%) and less in high income group (8.3%) in JCA.

The total working days above 300 days, ranging from 85-96% in a year, could be noted from the above table. Out of this, 20 to 27% was MGNREGA while remaining general. As majority of the respondents were agriculturists, the general working days could be attributed to farming activities. The range of this was between 65-68%. The contribution MGNREGA works period was 73-100 days, was almost fulfilling the norms of MGNREGA. Compared to JCA, PMD has almost 28 days less, because for the past two years no works were carried during 2010-12, due to some fraud in payments. The respondents reported at the time of investigation, that the issue got resolved. Lean period could be considered as low in both the villages. The lean period has reduced after the introduction of MGNREGA could be interpreted from the data.

The respondents had four major liabilities, viz., loans from nationalized banks, cooperative banks, SHG and also from local money lenders, which means that both institutional and non-institutional lending had increased after participation in MGNREGA Liabilities, in general has enhanced after participation in MGNREGA. Availing credit facility from banks has increased from 10.0 to 43.3% in JCA and it is still higher in PMD from 15 to 60.0%. Next to this was SHG, which was increased to almost 30% in both the villages.

Use of mechanical labour for certain operations. The respondents reported that they utilized it when it was impossible for human labour. The intervention occurred whenever and wherever necessary. Most of the farmers were small, followed by medium. Inspite of that some substantial amount was spent during the five years of study on land development. MGNREGA has acted as an initiative and also motivator to make maximum use of available land for cultivation. Developed land has thus become the created asset because of participation in MGNREGA. PMD was observed to be spent more than JAC. Probably there
were more medium and large farmers compared to JAC. Per capita investment might be claimed as Rs. 0.5 and 0.7 lakhs in JAC and PMD respectively.

The earnings were diverted for procurement of materials is evident from the data. The respondents attained varied benefits. House, the basic amenity of life was attended. Live stock like buffalos, enrich the diet as well as provide additional income. Electrical and electronic goods reduce drudgery. Transport vehicles saves time as well as facilitate comfort. Some amount was spent on payment of educational fee. High expenditure, almost 50% more could be concluded in JCA compared to PMD, because of purchase of electronic and electrical goods.

Community works taken under MGNREGA programme. The sustainability of assets created through MGNREGA. Accessing information was achieved to the maximum, followed by leadership, communication and decision making in JCA. In case of PMD accessing information was followed by leadership, communication and decision making. The attribute of accessing information was achieved in both the villages.

There were more middle and adult farmers than young farmers among the respondents. The programme may concentrate on covering of young beneficiaries. Most of the respondents were small farmers; hence as the land holding was small the family income was also less. Though work participation ranged between 73-100 wage employment days of total employment days of 300-350 days, the wage per day on piece rate was Rs. 60/-. Hence it could not influence the dependent variable to a significant extent. Policy and institutional factors had negative weak relationship with all the three dependent variables, as half of the policy and institutional factors were not observed properly.

On the whole a nonlinear relationship was existing. There may be some more variables other than what were studied. Such variables need to be identified and addressed through the programme.
ABSTRACT

India is a country of wide variety of fruits and their extracts. As everyone is conscious about their health they consume fruits in their diet because they are rich in carbohydrates, vitamins and minerals. So fruits are consumed by people in different forms as the fruit itself and their extracts. Among them sugarcane juice is one of them where the juice is widely consumed, as it is rich in vitamins, minerals, carbohydrates and also have medicinal properties in curing many diseases. The sugarcane juice is usually extracted by using a semi-automated sugarcane crusher commonly seen in the market. The machine is built up by gears and bearings which are connected to an operating motor. There is a space designed to insert the sugarcane for extracting the juice.

Sugarcane juice is not a new invention. Even in the past sugarcane juice is extracted from the sugarcane with the help of bullocks which is the traditional way of extracting juice from sugarcane. There is a great change in the technology of sugarcane juice extraction where different machines have been emerged in the market. People working with manually operated machines found to have been put to use. In spite of mechanical operations, workers have equal number of health problems. As the vendors adopt different postures repeatedly while extracting the juice from sugarcane, the vendor face pain in different body parts which further lead to musculoskeletal disorders. So a study has been conducted on the vendors who were working on table top two roller extractors.

Exploratory research design was adopted to conduct the study. Sixty sample from Hyderabad city were randomly selected to collect the demographic information, work related information, problems faced by the worker, features of workstations, dynamic anthropometric measurements and different postures adopted by the vendor while performing different activities through a framed interview schedule. The data collected was analyzed using correlation statistical analysis. Different sugarcane juice workstations were ergonomically evaluated to assess the comfort and occupational safety of the worker. Considering the lacunae found in the evaluation, various new designs were proposed to mitigate the problems faced by the vendors.
The mean age was found to be 39.75± 8.9. The mean of the experience was found to be 13.83± 9.6. The activities involved in extracting sugarcane juice are sizing the sugarcane, feeding the sugarcane to the machine, extracting the juice from sugarcane, straining juice into glass, adding ice to juice, serving the juice, cleaning of glasses and cleaning of machine by using different working tools like vessel, strainer, disposable glasses, glass, icebox and hammer. Different types of workstation used were customized and readymade where majority of the respondents used customized workstations. For the easy access and work comfortability, the different features that were incorporated in the existing workstations used by the vendors are built-in storage space, storage provision for sugarcane, space for motor, space for inverter, sitting facility and portability. While performing different activities the vendor face problems with the workstation viz., experience fatigue and develop pain in different body parts.

Majority (72%) of respondents experienced fatigue during third quarter (evening) of the day. More fatigue was realized, specially when feeding the sugarcane to the machine and extracting the juice from sugarcane. During sizing the sugarcane, cleaning of glasses, cleaning of machine and purchasing the sugarcane was less strenuous. The highest prevalence rate of perceived pain was found in the shoulder and arm followed by the lower back, wrist, fingers, neck, swelling of wrist and headache. Among the different aged respondents, middle aged vendors were found to be experiencing pain when ever work was done as well as the intensity of the pain in this group was found to be medium.

Rapid Upper Limb Assessment tool was used to assess different postures adopted by the vendor which revealed that majority of the respondents were facing problems with the present workstation. It was revealed that the workstation had to be evaluated to incorporate ergonomic features for the comfort of the vendor. Hence ergonomically designed sugarcane juice workstation was developed. The proposed design was evolved by incorporating facilities like portability, storage for money, double storied sugarcane storage, provision for storing glasses, decrease of height.
ABSTRACT

The cultures of rural India are largely gender stratified and male dominated, that exclude women. Gender discrimination, gender inequality and patrachal domination go hand in hand. It dwells not only outside the household but also centrally within it. The essence of gender discrimination is unequal power relations. The social instruments for perpetuating such unequal power relations is restricting access to property, land, credit and inputs, technology and skill development opportunities, education, employment and training, social access and control over resources and assets, basic needs like food, sanitation and health care.

Lack of access to and control over productive resources is the main factor limiting women’s equal participation in economic activities, thereby hampering the human development process (Acharya, 2003). Hence, equal access to resources and assets both at household and occupational level provides empowerment to women of any flock and is critical not only for their welfare but also for the development of the country.

The study on “Gender wise analysis of access to and control over assets and resources in rural households of Andhra Pradesh (Drought prone areas)” was conducted with the following objectives: To find out the non-human resources and fixed assets available in the families of the selected sample, to study the accessibility and control over assets by gender in the families of selected sample, to explore the accessibility and control over resources by gender in the families of selected sample and to assess the empowerment status of gender with respect to access and control over assets and resources.

An exploratory research design was adopted for conducting the study in two villages namely Aurepalle and Dokur of Mahbubnagar district. The study was conducted on 112 households comprising 66 households from Aurepalle and 46 Households from Dokur using simple random sampling. One male and female from selected household were selected i.e. a total of 224 individuals (112 males and females from Aurepalle and 92 males and females from Dokur). Males and females who were the decision makers of each household were interviewed separately. An interview schedule was used to collect the data.
The results of this study proved that there was gender differences seen in the rural households selected for this study. With regard to assets, men had access to more number of assets when compared to women. The control levels of the assets varied between men and women. This was same in the case of access and control of resources too. Men had more access to and control over farm assets, household assets and vehicle assets. This showed that women were disadvantaged at household and farm level too. The decision making also varied between the genders. In this study, the results showed that the household decisions were dominant by women and farm decisions were dominant by men. The decisions regarding the financial issues and socio-religious activities were taken up jointly. As decision making is an important factor for promoting empowerment, this need to be addressed properly in motivating and mobilising women folk towards empowerment. The results also showed that women had a moderate social and economic empowerment since they were also partially involved in the decisions regarding the financial, socio-religious, household and agricultural activities.

This study provides a greater understanding on existing gender disparities in asset distribution and control and how gender based asset distribution can affect women’s lives. The study also gave an indication to strengthen women’s access to productive assets and resources in order to achieve gender equality in the society.
RESOURCE MANAGEMENT AND CONSUMER SCIENCES

Author : PRASUNA, V.
Title of the thesis : WORK RELATED MUSCULOSKELETAL DISORDERS AMONG WOMEN WORKERS IN PACKING UNITS OF PHARMACEUTICAL INDUSTRY: GUIDELINES FOR ERGONOMIC INTERVENTIONS
Major Advisor : Dr. (Mrs.) T. NEERAJA
Degree : Ph. D.
College : COLLEGE OF HOME SCIENCE, HYDERABAD
Accession Number : D 9464

ABSTRACT

Hyderabad has emerged as a major drug manufacturing city with a presence in the global market. In pharmaceutical industry mostly women are engaged for sedentary and repetitive manual work. Though the process of manufacturing is mechanized, the process of packing is still undertaken manually. The majority of packing activities are characterized by a sitting posture, worker’s head and trunk flexed forward and shoulders flexed and abducted. In this posture high rate of work related musculoskeletal disorders occurrence could be expected. Work related musculoskeletal disorders (WMSD) are a group of painful disorders of muscles, tendons and nerves.

Musculoskeletal disorders being one of the serious occupational health hazard effecting the health of women in particular needs to be focused as women are the key factors in the very basic unit of the society, the family. Comparatively prevalence of musculoskeletal disorders among workers in industries of organized sector especially in women was found less explored. Government and organizations involved in Occupational Health and Research and the educational institutes working in the area of women health should focus on exploring the reasons for musculoskeletal disorders and develop ergonomic interventions to prevent WMSD.

The present investigation was aimed to explore the variables that contribute towards developing WMSD among women involved in packing activities in pharmaceutical industry and develop guidelines for ergonomic interventions to control and prevent WMSD. Ex post facto research design was adopted. A sample of 270 women, satisfying the selection criteria viz. age above 30 years, a minimum 3 years of work experience were selected using simple random sampling technique from 9 pharmaceutical industries.

The dependent variable Work related Musculoskeletal Disorders (WMSD) was measured in terms of musculoskeletal symptoms, musculoskeletal disorders and loss of physical functioning. The independent variables selected for the investigation were categorized as personal variables and organizational variables. Personal variables of the study consisted of age, education, length of service, anthropometry, level of exposure to risk factors.
associated with upper limb disorders, body mass index, physical fitness, mental work load and work stress. The organizational variables consisted of work place layout, physical work environment and organizational support.

To quantify the study variables the measuring instruments were developed. A scale was constructed to measure prevalence of the musculoskeletal symptoms, musculoskeletal disorders and loss of physical functioning. Mental work load assessment scale, work stress scale, workplace lay out scale and physical work environment scale were developed in the present research. Organizational support scale developed by Telaprolu and George, 1998 was used to measure the extent of social support. Risk factors associated with upper limb disorders were measured using Rapid Upper Limb Assessment (RULA) technique. The data was collected through structured interview schedule.

Statistical analysis of the data was done through frequencies and percentages. Product moment correlation was computed to understand the association between the dependent and independent variables of the study. Analysis of variance was computed and when significant 'F' values were found, t-tests were carried out. Step wise regression test was applied to assess the order in the influence of independent variables on each of the dependent variable. The age of the sample showed significant positive correlation with WMSD. The women with less number of years of work experience were frequently experiencing musculoskeletal symptoms. The sample with low height and short upper limb length were experiencing WMSD. As weight and body mass index increased the WMSD were found to be increased. Respondents with low and high average physical fitness were suffering from WMSD. As mental work load and work stress increased the WMSD among them increased.

The organizational variables were found to be non contributing factors in developing WMSD. The deviation of anatomical body parts from neutral position contributed to the WMSD in neck, shoulder, upper limb, back, lower limb and over all body. Awkward body postures like twisting, bending, reaching and gripping were found to be risk factors in causing WMSD. Through step wise regression test the neck position and trunk position were found to be major contributing factors for developing WMSD among the workers. Musculoskeletal symptoms in respondents were found to be leading to musculoskeletal disorders and functional limitations in anatomical body regions of the subjects.

To control and prevent the identified risk factors causing WMSD among women working in packing units of pharmaceutical industry, the guidelines for ergonomic interventions were proposed in terms of engineering, administrative and personal or behavioral controls. It was advised to provide adjustable chairs with lumbar support for aged women and to allow them to work on self- pacing to reduce muscle strain among aged women. Provision of adjustable work table, fixing of sliding racks below the table to rest the upper limbs were suggested for women with short stature. The low physical fitness group was advised to increase physical fitness through regular exercises, yoga and nutritious food. To overcome the disadvantage of awkward postures in upper arm, lower arm, wrist, wrist twist, neck, trunk, legs, and body posture the ergonomic interventions like job rotation, job enlargement, provision of arm rests, foot rests, training and education in good ergonomic practices were suggested. It was proposed to reduce mental work load by ensuring reasonable workloads and deadlines in an organized way without pressure in the last moment. To control work stress it was advised to reduce monotonous work and encouraging team work.
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