CONTACT

Dr. K. VEERANJANEYULU
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UNIVERSITY
RAJENDRA NAGAR
HYDERABAD - 500 030.

Phone No. 040-24015319
e-mail:
veeru_123@rediffmail.com
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AGRICULTURE

Juice is the liquid that is naturally contained in fruit or vegetable tissue and is prepared by mechanically squeezing or macerating fresh fruits or vegetables without the application of heat or solvents. The consumer is basically concerned if it is a real fruit juice or a synthetically constituted product. The synthetic drinks are synthetic products with fruit or other flavors. India’s packaged fruit juices industry is one of the largest industries in the country. With the growing population, Indian packaged fruit juices requirements are growing and thus gaining momentum to country’s GDP.

The study on consumer’s preference for packaged fruit juices in Hyderabad city of Telangana state was carried out with the following objectives:

1. To study the consumption pattern of packaged fruit juices among various age groups.
2. To estimate the seasonality of packaged fruit juice sales in Hyderabad region.
3. To study the factors influencing the purchasing behaviour of packaged fruit juices.
4. To analyse the perception of consumers about packaged fruit juices.

The study was conducted in Hyderabad city, which was purposively selected. The sample of 160 consumer’s were randomly selected from three different categories of market structure viz., local trader, super market and corporate retail sector with 80, 40 and 40 consumers respectively. Apart from this, 10 local traders 5 super markets and 5 corporate retail markets involved in the business of packaged fruit juices were also selected.

The results of the study showed that most of the consumers were students (31%) and those reside at home (53%), while the preferred place to consume is ‘with friends’ (27%) and frequency of purchase is on daily basis (37%). The monthly expenditure group of Rs.100-
Rs.500 recorded the highest per cent of purchases. The highest quantity of purchases as well as sales of fruit juices were recorded in the month of May, coinciding with the hot weather period.

It is suggested to install automatic vending machines in the residential colonies, adopt price discrimination methods for supply of packaged fruit juices and encourage sales promotional activities. It is also suggested to maintain a balance between quality and taste, besides adopting uniform price policy for different branch of packaged fruit juices available in the market.
ABSTRACT

The present study was undertaken mainly to estimate the growth trends in sweet orange production in various states of India, mapping major sweet orange production areas in Nalgonda district, assessing the efficiency of existing marketing channels of sweet orange in the study area, and to conduct an analysis to know the feasibility of establishing sweet orange collection centers in the study area to procure 3000 tons of sweet oranges per annum.

About 150 farmers were selected from various mandals of Nalgonda district of Telangana state to form the sample, 20 market intermediaries including pre harvest contractors and commission agents were also included in the sample. Primary data was collected from farmers and market intermediaries. Secondary data on area, production and productivity of Sweet orange in India, Telangana, Nalgonda was collected for a period of ten years from 2004-05 to 2013-14.

In the present scenario the major problems faced by agriculture commodities are long supply chain, more number of intermediaries involved leading to lower price realization by farmers, lack of inadequate infrastructure, lack of proper marketing channels, poor technology for handling and storage. To develop and to solve these issues, it is necessary to have a collection center where market intermediaries and commission charges will not be there hence best price can be realized by the farmer for any commodity. The results of the study show that compound growth rate of area, production and productivity of Sweet orange in India was 6.2 per cent, 7.1 per cent and 0.9 per cent. The compound growth rate for area, production and productivity of Sweet orange in Telangana for the period 2004-05 to 2013-14 was 8.0 per cent, 8.4 per cent and 4.0 per cent while the compound growth rate in Nalgonda was 5.5 per cent, 6.7 per cent and 1.3 per cent for area, production and productivity of Sweet orange. Four marketing channels were
identified in the study area. Majority of the farmers (60.6 per cent) marketed their product through channel I: Producer- Pre-harvest contractor– Commission agent- Retailer. In channel- II: Producer – Pre-harvest contractor – Wholesaler –Commission agent – Retailer, were involved and 23.4 per cent farmers marketed the produce through this channel. 10 per cent of the farmers in the study area marketed through channel- III- Producer – Wholesaler – Retailer, and 6 per cent farmers marketed through channel- IV- Producer – Consumer. The marketing efficiency of above marketing channels was 1.67, 2.57 and 8.03 for channels I, II, III and IV respectively, hence channel IV was more efficient in marketing Sweet orange, however it is not a viable channel to market large quantities of the produce.

In the case of establishment of collection center for Sweet orange in the study area 80 per cent growers are willing to bring the produce to collection center for the reasons of proper price realization, no market fees, non involvement of traders etc.

Organizing collection centers either by private players or in the public private partnership mode in the study area will eliminate the involvement of the middlemen and will get more remunerative prices to the farmers. At collection centers, post harvest infrastructure facilities can be provided such as pre-cooling, cold storage and refrigerated vans for transport. Establishing a collection center is not viable unless the collection center develops profitable supply chain channels to dispose the produce. This aspect has to be addressed while establishing collection center.
AGRICULTURAL MANAGEMENT

Author: LOKESH, P.

Title of the thesis: ASSESSMENT OF MARKET POTENTIAL FOR MAHAVEER BRAND OF INSECTICIDE ON PADDY CROP IN KODAD REGION OF NALGONDA DISTRICT OF TELANGANA STATE.

Major Advisor: Dr. MANOJ P. SAMUEL

Degree: MBA (ABM)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D 9812

ABSTRACT

Though India has huge land under agriculture and lot of potential to produce surplus after feeding 1.24 billion people but still it is not happening so. India losses nearly 30 percent of its potential crop to insects, weeds and rodent attacks which shows the necessity of usage of plant protection chemicals thereby giving scope to agrochemical industry.

The study was carried out to assess the market potential of Fipronil 5%S.C, Mahaveer brand of pesticide which is used to control sucking pests in paddy in the region of Kodad, Nalgonda district. Kodad region is one of the major producer of rice in the Telangana and there is a huge potential for agrochemical business.

Five mandals in the Kodad region was selected for the study. About 2 villages from each mandal and 10 farmers from each village were selected randomly. Therefore a total of 100 farmers formed the basis of the study. Further 4 dealers from each mandal were selected randomly for the study. Thus a total of 20 dealers were interviewed to gather the data. The total sample was 100 farmers and 20 dealers. A well designed questionnaire was chosen to collect data from the respondents. The data was tabulated and analyzed using simple mathematical and statistical tools like arithmetic mean and Garrets Ranking Technique.

The study revealed that the farmers are highly influenced by the factors like effective control of the pesticide, price and brand image in selecting the pesticide brands. The factors like packaging and safety of the products were less importance to the respondents while selecting the pesticides. There are few products of Fipronil 5% S.C in the markets like Sonic (Tata Rallis), Regent (Bayer Crop Science), and Fax (Dhanuka Agritech) and Mahaveer brand of Gharda chemicals which has 26.55%, 22.67%, 16.27%, 21.37% of the market share respectively. It was
observed that the past record of the company, profit margins and brand image of the product are most influencing factors considered by the dealers in stocking pesticides brands. It is noticed that the market share of Mahaveer insecticide was 21.23% in the year 2014. However as per the perceptions of dealers it may fall marginally by 0.23% in the coming year 2015 due to several factors. Hence it is recommend that the company may concentrate on weaker links and come up with novel promotional and brand building strategies.
AGROBISINESS MANAGEMENT

Author : MANASA, J.

Title of the thesis : FINANCIAL FESIBILITY IN CULTIVATION AND MARKETING OF ASHWAGANDHA- A CASE STUDY IN KURNOOL DISTRICT IN ANDHRA PRADESH

Major Advisor : Dr. ALDAS JANAIAH

Degree : MBA (ABM)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9807

ABSTRACT

This study plays an important role in assessing the financial feasibility in cultivation of Ashwagandha in Kurnool district of Andhra Pradesh. It helps the producers as well as processors to analyze the profitability of Ashwagandha production. About 150 Ashwagandha growers and 10 traders were selected from three regions of Kurnool district in Andhra Pradesh viz. Adoni, Imiginuru and Aluru. Secondary data on area, production and productivity of Ashwagandha in Kurnool district was collected for period of ten years from 2003-0 to 2013-14, from which trends in growth rates of Ashwagandha production were analysed by using Compound Annual Growth Rate (CAGR) function. The result of the study showed the Compound Growth Rate of area, production and productivity of Ashwagandha in Kurnool during the period of 2004-05 to 2013-14 was 0.19, 0.45 and 10.22 per cent respectively. The cost of cultivation of Ashwagandha is Rs. 13970 per acre and gross return per acre is 28347. Thus, Benefit Cost Ratio in Ashwagandha cultivation is 2.02 and Return on Investment is 102 per cent per acre. Two channels of marketing were identified for guar gum, which are

**Channel I**Producer – Commission agent – Processor – Buyer

**Channel II**Producer – Processor – Buyer

The producers share in consumer’s rupee in channel II is higher than channel I since it is the shorter channel (82.83 per cent). Whereas the producers share in consumer’s rupee in channel I is 79.52 per cent. The marketing efficiency index of channel I and II was 3.4 and 5.0 respectively indicating the superiority of channel II. Ashwagandha after processing is being used in many Ayurvedic medicines and in Pharma industry. Major problems of producers and market intermediaries in the study area are higher cost involved in weeding and harvesting and lack of storage facilities respectively. The study suggested an overall improvement in providing market information, improved machinery for weeding, provision of storage facilities etc.
AGROBUSINESS MANAGEMENT

Author : NALASANI NAVYATHA
Title of the thesis : BUSINESS PLANS FOR THE NOVEL TECHNOLOGIES DEVELOPED BY THE PREMIER ICAR INSTITUTION IN HYDERABAD
Major Advisor : Dr. B DAYAKAR RAO
Degree : MBA (ABM)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9804

ABSTRACT

IIMR has come up with 30 sorghum based convenient and healthy products through value chain approach in a PPP consortium mode. They are projected as healthy and nutri-rich products with superior nutritional profile and suitable for health conscious consumers. Among 30 products, nine products - multi grain atta, sorghum flakes, sorghum kichidi rawa, sorghum atta, sorghum pasta, sorghum vermicelli and sorghum cookies are launched based on market potential studies conducted by Commodity India which are further commercialized under various business plans (Rao et al., 2014). They are packed, labeled and registered under trade name Eatrite brand of IIMR and are available in Heritage Fresh Retail Ltd (organized sector) and other unorganized retail outlets in Hyderabad and also some other metros of India. Even their spread is encouraged through Future retail Ltd, Hyderabad and Mumbai. However, the new challenge is horizontal expansion of these commercialized technologies across the country, which can be undertaken either by start-up entrepreneurs or big players in the food industry. Hence the present study entitled “Business plans for the novel technologies developed by the premier ICAR institution in Hyderabad” was undertaken to study the soundness of selected novel technologies developed at IIMR, business prospects of pilot tested products developed by IIMR by carrying out SWOT analysis and market potential and develop business plans. In view of this scenario, the present study is under taken with the following objectives.

The primary data collected from the consumers was based on recall memory for market potential. The data regarding socio economic status, consumption pattern, Brand preference and awareness about the eatrite products was collected. Secondary data was collected from the IIMR, regarding technologies, SWOT analysis and costs of processing. Data collected from primary and secondary sources were subjected to tabular analysis. Overall Equipment Effectiveness (OEE) was used to the efficiency of machinery. Garrett ranking analysis was carried out to identify the reasons to consume sorghum and constraints in the eatrite products. Capital budgeting techniques were used to determine the financial feasibility of sorghum processing plant.
The processing technologies developed by IIMR that are considered for the present study are sorghum biscuits, multigrain atta and sorghum rawa. The machineries used for these product manufacturing are examined for their soundness in terms of overall equipment effectiveness. The chakki mill has highest OEE of 91 per cent, followed by pulverizer (88%), blender (82%), planetary mixer (81%), convection oven (68%), biscuit cutting machine (60%) and lowest was observed in vibro sifter (52%).

According to the SWOT analysis of sorghum products, the major strength identified was consumers preference for nutritious and convenience products, while weakness was lack of supply chain management i.e. backward integration. The opportunity was an emerging industry in future and threat was alternate health and nutritious foods other than sorghum products and other brands of sorghum products that are launched in the market.

According to Garrett ranking analysis, consumers reported that the health benefits of sorghum were the most important reason for its consumption with mean score of 70.43 followed by interest towards new products (59.17). The major reason to prefer the particular brand of the product was the quality followed by its availability.

Consumer preference study of three sorghum products and control products on-shelf, existing in the market were evaluated. For multigrain atta consumers have given highest preference to its availability (66%) followed by quality (20%). In case of sorghum biscuits preference given was given to taste (56%) followed by appearance (17%). While for sorghum rawa, the first preference was given to taste (48%) followed by its quality (32%).

Out of 100 respondents, 18 respondents were consuming eatrite products. Consumer acceptability of eatrite products was found that quality followed by taste were major factors for acceptance while the availability is the main constraint followed by price.

To establish sorghum processing plant, investment analysis was attempted for three products for five years. The investment cost for three products was 3.5 crores because of high variable cost compared to the fixed cost.

For all the three products, the estimated payback period was in the range of 1 to 1.2 years, net present worth ranged between Rs. 45000 to 370000, benefit cost ratio was in the range of 1 to 1.02, whereas the internal rate of return was in the range of 13 to 29 and the profitability index was in the range of 1 to 58. So, it can be concluded that these three products are feasible and among the three products processing of multigrain atta is more profitable when compared to other two products.
AGRICULTURE MANAGEMENT

Author : PANDU, R.
Title of the thesis : SUPPLY CHAIN ANALYSIS OF PADDY IN NALGONDA DISTRICT OF TELANGANA
Major Advisor : Dr. P.C.MEENA
Degree : MBA (ABM)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9801

ABSTRACT

Rice (*Oryza sativa*) is the most important and extensively grown food crop in the World. It is the staple food of more than 60 percent of the world population. Rice is mainly produced and consumed in the Asian region. India has the largest area under paddy in the world and ranks second in the production after China. India is a major rice consumer. Food, the basis need of the people, is an agricultural product and is already in short supply in our country. This shortage is going to be more pronounced by the turn of this century as the population is likely to be doubled some time after. Many countries which used to produce limited quantities of rice have become self-sufficient, and have even at certain times exported their surplus. But in many regions where rice is grown people still do not have enough to eat.

India is the home country for rice and it is staple food for more than 65% of its population. It is being grown in variety of situations.

**Channel I:** Producer — Pre-harvest contractor — Commission agent cum wholesaler — Retailer — Consumer

**Channel II:** Producer — Village trader — Wholesaler(local) — Commission agent(distant) — Wholesaler (distant) — Retailer (distant) — Consumer

**Channel III:** Producer — Procuring agency (FCI/others)—Miller—Distributor Agency—Consumer

The producer share in consumer’s rupee was the highest in channel, III since it is the shortest channel (67.53 per cent). Whereas the producers share in consumer’s rupee in channel I, II, and III are 65.07 per cent, 66.33 per cent and 67.53 per cent respectively. The marketing efficiency index of channel I, II and III was 1.86, 1.97 and 2.07 respectively. The constraints analysis of data collected was subjected to conventional analysis which includes tabular, averages and percentages approaches. Beside this, graphical representation like pie charts and bar graphs have also been utilized. The highest among the constraints identified under production, marketing fluctuation, lack of storage facilities and transportation respectively. The study suggested an overall improvement in providing market information, quality of rice, provision of storage facilities etc.
AGRICULTURE MANAGEMENT

Author : PRAVEEN BABU, CHIRUTHOTI

Title of the thesis : A STUDY ON CONSUMER PURCHASE BEHAVIOUR OF INSTANT FOOD PRODUCTS IN ANDHRA PRADESH

Major Advisor : Dr. P. RADHIKA

Degree : MBA (ABM)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9799

ABSTRACT

Secondary data was collected from the companies database which showed that there is an increasing trend in the sales of instant food products. The primary data regarding product awareness, brand awareness, and factors influencing consumer behaviour was collected from the consumers through personal interview with the help of a pre-tested questionnaire designed especially for the purpose. Extent of consumer awareness and factors influencing the buying behavior were analyzed. The data was compiled, tabulated and analyzed. General information of consumers, sales trends, product brand awareness, instant food purchase, preference of purchase location, brand loyalty, influencers and nature of purchase decision, alternative purchase plans are recorded in percentages. Source of information and parameters of quality, are analyzed through Garrett ranking. Consumer perception, future demand potential, brand preference are analyzed through Likert scaling technique.

The analysis of sales trends of major firms in India over a period of 2009-2013 showed that there is an increasing trend in the sales of instant food products. Consumer awareness about instant products was high with regard to atta and noodles with 70.67 per cent and 63.67 per cent respectively. Brand awareness of Maggie (Nestle) was the highest with 93.33 per cent of the respondents being aware and it was followed by bambino with 90 per cent awareness. Mass media and print media are the major sources of information.

The major influencers of purchase decision are children with 58.67 per cent in breakfast, 46 per cent in main course, 52 per cent in snacks categories. Consumers perceive instant foods as easy to prepare- (67.33%), tasty-(65%), time saving- (50.67%), well packed-(53.67%), convenience food-(59.67%) and expensive- (55.33%). A products quality according to respondents is perceived through its packaging, price, place of availability, nutritional value, preservatives, certification, ingredients and recipe presentation. The purchase decision of the consumers is mostly planned rather than impulsive in nature. The purchase locations are distributed among the super market chains, retail stores, mom and pop shops.
It is suggested that a proper survey of the market and the tastes and needs of the consumers of various age groups should be done in order to focus on the product development and marketing. Innovative technology should be explored in order to increase the shelf life of the product variants and simultaneously reduce the cost of the product. Promoting the concept of wholesome and fortified foods in the instant products. The health issues of the consumers should also be given importance accordingly with the palate and more promotional activities should be carried upon to make the instant foods reach the vast number of people.
AGRICULTURE MANAGEMENT

Author: SARFARAZ ASGHAR

Title of the thesis: STUDY OF SUPPLY CHAIN MANAGEMENT AND MARKETING OF APPLE IN KASHMIR REGION OF JAMMU AND KASHMIR, INDIA

Major Advisor: Dr. Y. RADHA

Degree: MBA (ABM)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D 9802

ABSTRACT

About 80 apple growers and 40 market intermediaries were selected from four tehsils viz., Rafiabad, Sopore, Kellar and Shopian in Jammu and Kashmir state. The results of the study showed the supply chain, marketing channels and marketing efficiency, price spread and constraints associated with various aspects of production and marketing. Four channels of marketing were identified which are:

Channel I: Producer — Pre-harvest contractor — Commission agent cum wholesaler — Retailer — Consumer

Channel II: Producer — Village trader — Wholesaler (local) — Commission agent (distant) — Wholesaler (distant) — Retailer (distant) — Consumer

Channel III: Producer — JKHPMC — Wholesaler — Retailer — Consumer

Channel IV: Producer — Consumer

➢ The producer’s share in consumer’s rupee was the highest in channel IV since it is the shortest channel (60.99 per cent), whereas the producers share in consumer’s rupee in channel I, II, and III were 39.09 per cent, 23.49 per cent and 44.19 per cent respectively.

➢ The marketing efficiency index of channels I, II, III and IV was 0.641, 0.30, 0.79 and 2.56 respectively.

➢ The constraints analysis of farmers through RBQ value revealed that spurious pesticides and fungicides, involvement of too many middlemen, inadequate grading facilities and
lack of labeling and trademark were ranked the highest among the constraints identified under production, marketing, value addition and policy aspects respectively.

➢ The traders expressed that high transport cost and dual inter-state taxation were the major constraints under marketing and policy aspect respectively.

The study suggested an overall improvement in providing market information, quality of fruits, provision of cold storage, etc. to increase producer’s share in consumer’s rupee. It was also suggested to have one time taxation on weight basis to avoid the problem of dual inter-state taxation.
AGRICULTURE MANAGEMENT

Author : SHRUTI NAIR

Title of the thesis : INVESTMENT VIABILITY OF COLD STORAGE INFRASTRUCTURE FOR AGRICULTURAL PRODUCE IN TELANGANA STATE

Major Advisor : Dr. SEEMA

Degree : MBA (ABM)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9809

ABSTRACT

The study focused on the growth in the number of cold storage units in the study area which plays an important role in assessing investment viability and helps the investor to analyze feasibility of establishing cold storage unit. The study included estimation of investment cost, cost and returns and financial feasibility of cold storage units. The data was primarily collected through personal interview with the help of a pre-tested questionnaire designed especially for the purpose. The establishment and maintenance cost for cold storage and total returns are analyzed. The data was compiled, tabulated and analyzed using Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost-Ratio (BCR). Pattern of storage of commodities was recorded in percentages. Constraints faced by the cold storage units are analyzed through Garrett ranking techniques.

The compound growth rate of cold storages in Hyderabad and Ranga Reddy districts and of Telangana state for the period 2003-2013 was found to be 6.44 and 8.36 respectively. The results of the study showed that there is more scope for investment with positive Net Present Value of Rs.2,57,39,295, Rs.1,76,99,041 and Rs.1,22,94,846 for large, medium and small size cold storage units respectively. Benefit Cost Ratio was 1.61 for large, 1.79 for medium and 1.55 for small size cold storage units. The Internal Rate of Return being 96 per cent, 93 per cent and 90 per cent for large, medium and small size cold storage units respectively.

The storage pattern was mostly multipurpose in nature with 57.5 per cent of the cold storages in the area under study, followed by fruits and vegetables (27.5 per cent), milk and milk products (10 per cent) and meat and fish cold storage (5 per cent).

The major problems faced by the cold storage units are high electricity cost and power shortage. Other problems encountered are high maintenance cost, heavy capital investment, high storage cost and heavy competition. The cold storage units are demanding power subsidy and capital subsidy from the government.
AGRIBUSINESS MANAGEMENT

Author : SIRISHA, B.
Title of the thesis : COMPETITIVENESS OF MILLETS IN MEDAK DISTRICT, TELANGANA STATE.
Major Advisor : Dr. B DAYAKAR RAO
Degree : MBA (ABM)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9800

ABSTRACT

Millets are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food. They are important crops in the semi-arid tropics of Asia and African countries (especially India, Nigeria and Niger) with 97 per cent of the world is coming from developing these countries only. Millets are categorized as two categories major and minor millets. Major millets are Sorghum, Pearl millet and Finger millet while minor millets are Little millet, Barnyard millet, Proso millet, Foxtail millet and Kodo millet. They cater in restoring the biodiversity as well as in creating livelihood to the farmers residing in arid and semiarid areas. In India, millets are grown on about 20 million ha with an annual production of 18 million tonnes and contribute 10 per cent to the country's food grain basket. In Telangana, as per the census 2011-12, the total area under millets was 1.54 lakh ha with a production of 1.67 lakh tonnes. Medak district has been identified as target district of INSIMP, a Department of Agriculture and Cooperation initiative. Hence the present study was taken under the objectives, identify the on-farm cultivation practices in millet production and work out their competitiveness with respect to other crops, to assess the existing utilization and marketing of millets in the study area, to analyze the constraints in production and utilization of millets in the study area, to study the value addition of millets at farmer’s level and their future prospects for commercialization.

The primary data collected from the farmers was based on recall memory. At producer’s level, data regarding the on-farm cultivation practices, costs associated with the production of the millets and also of their competing crops was collected. Data collected from primary and secondary sources were subjected to tabular analysis. Cost concepts were used to determine cost of cultivation for millets and its competing crops. Farm income measures viz., gross income, net income, farm business income, family labor income and farm income investment income were worked out to determine competitiveness of millets with its competing crops. Garrett ranking analysis was carried out for production and utilization constraints of millets in the study area.
According to the farm income measures the millets have less returns when compared to that of the pulses and the maize as competing crops whereas cost of cultivation was low for millets than its competing crops. According to the garrett ranking analysis the major constraints for production were low volumes of disposed produce and low land holding size and for utilization of millets was unavailability of processing technologies. The on-farm cultivation practices that were followed were completely organic. In order to improve the yields to attain on-par with that of the inorganic yield levels, farmers should go for either application of right doses of fertilizers or by adopting intensive organic cultivation practices. It was noticed that the average percentage difference between organic and inorganic yield levels was more than 50 per cent which appears to be huge. In the absence of realization of higher prices for organic produce, it is advisable to go for inorganic farming and realize higher profits through increased yields.

Millets are best known for their high intrinsic value, farmers would rely on them for their daily livelihood and cattle fodder requirements and thereby millet cultivation would continue though at minimum level. It would support small and marginal farmers in meeting their livelihood apart from meeting the fodder requirement of their domestic livestock. This also indirectly contribute to the nutritional security of the farm households.
AGRICULTURE MANAGEMENT

Author : SURABHI PALLAVI

Title of the thesis : GROWTH AND CONSUMER PREFERENCE OF MAJOR BRANDS OF LIQUID MILK IN HYDERABAD CITY

Major Advisor : Dr. ALDAS JANAIAH

Degree : MBA (ABM)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9808

ABSTRACT

India is the largest producer of milk in the World with annual production of 133 million tonnes during 2012-13 (The Economics Times 2012). Further it is expected that total milk production may touch about 140.6 million tonnes in India by the year 2013-14 (Financial Express, 2014). Milch animals (45% indigenous cattle, 55 % buffaloes, and 10% cross bred cows) are having immensely low productivity i.e. around 1000 Kg/year (world average is 2038 Kg/year). Indian Dairy

Several measures have been initiated by the government to increase the productivity of milch animals, which has resulted in increasing the milk production significantly from the level of 84.4 million tonnes in 2001-2002 to 127.9 million tonnes 2011-12. (Sharma, 2013).

Out of the total milk produced only 35% is distributed through the organized sector and the rest of 65% is through the traditional unorganized sector. In the organized sector, cooperatives and private dairies are playing major role in selling the processed milk, whereas the traditional unorganized sector involves selling the loose milk.

The compound growth rates of Vijaya, Jersey, Mother Dairy and Heritage brands of liquid milk are increased, but to very negligible rate, whereas the growth trends of prices of DTM was no change, TM was 0.019%, 0.017%, 0.011%, 0.016%, WM was 0.014% , 0.013%, 0.013%, 0.013% in Hyderabad during 2004-05 to 2013-14.

As in the present days most of the consumers are aware of Milk brands (Vijaya, Heritage, Mother Dairy and Jersey) becoming health conscious, consumers prefer a particular brand mainly because of its quality, wide advertisements and their health benefits. Majority of the respondents purchase one litre (32%) of milk through door step delivery and from milk parlours and rated the quality of milk as good for Vijaya and Heritage. From the retailers it is known that the sales for milk brands are good indicating that an increasing trend & future projections and the loyalty towards these brands is good as increasing loyalty leading to purchase of these brands.
It was concluded that majority of consumers are aware of milk brands of liquid milk and purchase Heritage brand due to the high marketing efficiency, high margin, timely supply, long shelf life with not much of leakage and spoilage complaints when compared to other brands of milk every retailers has Heritage in his outlet. Consumer prefer to purchase milk morning in a daily bases. When compared to all the milk brands majority of the switching over takes place to either Heritage or Vijaya because of their quality and brand image. TV/Radio, Hoardings are highly influencing in generating customers awareness.

It was suggested that milk may be made available at the consumer’s doorstep so that the consumer convenience and acceptability increases. Margins to the retailers may be enhanced.
AGRIBUSINESS MANAGEMENT

Author : SUREKHA KOKKU

Title of the thesis : A STUDY ON FUNDAMENTAL ASPECTS OF DEMAND AND SUPPLY OF MAIZE AND ITS PRICE OUTLOOK FOR THE YEAR 2015

Major Advisor : Dr. Y RADHA

Degree : MBA (ABM)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9803

ABSTRACT

The secondary data on sowing and harvesting patterns of maize were collected from different sources viz., web, books, journals, annual reports of different organizations, etc. The information about the supply and demand of maize for the past 55 years from 1960 to 2014 and data pertaining to the price trends for the past ten years from 2005 to 2014 in India were collected from the Karvy organization from their authenticated websites ‘Bloomberg’ and ‘USDA query’. By exploring the past literature pertaining to maize, various patterns of sowing and harvesting followed during the last five years were identified. The estimation of supply and demand and price forecasting of maize were analysed through Auto Regressive Integrated Moving Average (ARIMA) model.

The following are the major findings of the study:

- Broadcasting and line sowing were the two methods of sowing of maize commonly followed in India.
- Maize could be grown in all the three seasons viz., kharif, rabi and spring, in the country.
- Harvesting of maize was practiced either by plucking of cobs or by stalk cutting.
- Maize harvesting could be done either by manually or by machines.
- The forecasted value for maize supply based on ARIMA model for the year 2015-16 was 26.6013 MT, while that of maize demand was 25.12MT.
- In the year 2015 the prices of maize during the period from January to December will increase from Rs 1221.25/q to Rs 1287.45/q with an average price Rs 1255.09/q for the year.
• The month-wise forecasted prices of maize for the year 2015 are given below

<table>
<thead>
<tr>
<th>Month</th>
<th>Forecasted prices (Rs/q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1221.25</td>
</tr>
<tr>
<td>February</td>
<td>1228.89</td>
</tr>
<tr>
<td>March</td>
<td>1234.75</td>
</tr>
<tr>
<td>April</td>
<td>1240.6</td>
</tr>
<tr>
<td>May</td>
<td>1246.46</td>
</tr>
<tr>
<td>June</td>
<td>1252.31</td>
</tr>
<tr>
<td>July</td>
<td>1258.17</td>
</tr>
<tr>
<td>August</td>
<td>1264.02</td>
</tr>
<tr>
<td>September</td>
<td>1269.88</td>
</tr>
<tr>
<td>October</td>
<td>1275.74</td>
</tr>
<tr>
<td>November</td>
<td>1281.59</td>
</tr>
<tr>
<td>December</td>
<td>1287.45</td>
</tr>
</tbody>
</table>

It could be concluded from the study that supply for maize will be more than the demand forecasted during the year 2015-16. Hence, efforts may be initiated to export surplus production at competitive prices, so as to earn foreign exchange. The price outlook also throws light on increasing prices of maize as the year passes by. The farmers may be advised to adopt a suitable cropping pattern, to include maize by adjusting the sowing and harvesting dates and there by increasing its production and productivity.
ABSTRACT

Nalgonda district was purposively selected for the study because this district has a great potential for agrochemical business as it is one of the leading paddy growing belt of Telangana state and also the Gharda Chemicals Private Limited had made huge investment on promotional activities to improve their market share in the district. Random sampling technique were used to select the dealers for the study. The data for the present study pertained to agricultural year 2013-14.

The study was carried out in the selected five clusters of Nalgonda district Viz. Suryapet, Kodad, Miryalaguda, Nakrekal and Choutuppal wherein the concentration of the dealers was the highest. From each of the 5 clusters, 10 dealers were selected thus total sample comprised of 50 dealers. Primary data was collected from the selected dealers with the help of well-designed pretested questionnaire. Secondary data was collected from various published sources such as journals, websites, books, government reports, company’s records, dealers’ records etc. The collected data was tabulated and analyzed using simple mathematical and statistical tools like percentages, arithmetic mean and Garrets Ranking Technique.

The study revealed that the factors like brand image and quality played a major role and were the deciding factors for any dealer to stock the product. With regard to the dealers’ perception about agrochemical brands the respondents ranked Gharda was first with respect to the quality and second with respect to the dealers’ margins. It is observed from the results that, demonstrations, pamphlets and field visits have proved to be very effective to improve the sales when compared to television, radio, wall paintings, free gifts etc. It is inferred from the results that the impact of promotional activities on the sales of products saw a net percent increase in the
sales (2013-14) over previous year (2012-13). It is observed from the study that the farmers were loyal towards Gharda brand majorly because of the product performance, brand image and promotional activities.

Thus the study helps the company to understand the dealers’ perception about their agrochemical brands and purchasing behaviour of the farmers towards various brands of agrochemicals and it also helps the company to find out various reasons for dealers in stocking particular agrochemicals products. It helps the company to device strategies for sales promotion.
AGRIBUSINESS MANAGEMENT

Author : YOGESH KUMAR
Title of the thesis : IDENTIFICATION OF BRAND STATEMENT OF LASSO IN NORTH PUNJAB MARKET
Major Advisor : Dr. P.C. MEENA
Degree : MBA (ABM)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9811

ABSTRACT

The study was conducted in the North Punjab region which includes the Jalandhar region (Hoshiarpur territory) and Nawanshahr region (Nawanshahr Territory) of Punjab. About 20 markets were surveyed precisely 10 markets from each territory; this comprises of the 2 retailers from each market which deals in Lasso and have total sales of Lasso was100 l’s for previous year 2014. From each market, five villages those having total cultivated area of more than 100 acres were selected and from each village 5 farmers, cultivating Corn, Pea or Mentha were interviewed. Along with this 5 distributors were also studied from both the territories. So the sample size comprises of 500 farmers, 40 retailers and 5 distributors.

The motive of the research is to find the position of Lasso in the market. The study revealed after the analysis of the views of respondents that the awareness level for Lasso is 85% and 95% in Hoshiarpur and Nawanshahr respectively. The total area covered so far in the study was 3367 acres and 3204 acres from Hoshiarpur and Nawanshahr respectively. Among the total aware and user farmers 180 (100%) in Hoshiarpur and 212 (100%), 96 % farmers from Hoshiarpur and 100% farmers from Nawanshahr responded that Lasso is a very good herbicide. This implies its good performance in the area.

The major source of information for the farmers was retailers, as asserted by 86% and 100% of the farmers in Hoshiarpur and Nawanshahr respectively. Hence it is required to increase the margin in order to promote sales by the retailers as suggested by the 85% retailers in Hoshiarpur and 63% retailers in Nawanshahr. Mode of business by the retailers was observed credit based i.e. 67% in Hoshiarpur and 60% in Nawanshahr so there is a need of increasing the credit limit of retailers. Along with this the promotional schemes reach to farmers is only suspended to 13% in Hoshiarpur and 27% in Nawanshahr, hence campaigning for the product is also required.
The study also revealed that Lasso is used mostly in corn and pea crops in both the territories, which comprises of 100% in Hoshiarpur and 85% in Nawanshahr. It is also found that Lasso is used alone (48%) and with Atrazine (52%) in Hoshiarpur territory and in Nawanshahr alone (62%) and with Atrazine (38%) by the farmers. In Hoshiarpur the farmers use Lasso for both the crops but in Nawanshahr the farmers use Lasso mainly for the corn crop. Atrazine mixed with the Lasso may cause the variation in the results and also cause deterioration in the brand value of Lasso. The farmers of both the territories use lasso @1 l/ac alone and 1.5 l/ac when used with Atrazine.

Lasso is perceived as a good herbicide by the farmers as responded by 96% and 100% of farmers in Hoshiarpur and Nawanshahr respectively. As per retailers, Lasso is sold because it is a farmer’s demanded herbicide. Farmers purchase Lasso because of its performance in the field and they were unaware of the gifts; based on the responses it can be inferences that they perceive Lasso as good herbicide. In Nawanshahr 100% of farmers responded that Lasso is used for controlling all the weeds and in Hoshiarpur territory about 85% responded the same perception about Lasso.

Studying the patterns of price and sale of Lasso among the farmers during Corn season is founded to be -0.29 in Hoshiarpur and 0.13 in Nawanshahr. Whereas in the season of Pea the correlation was found to be -0.15 and 0.07 for Hoshiarpur and Nawanshahr resp. The sales are correlated negative to the prices that depicts that the sales will fall down with increase in the prices of Lasso. Due to the awareness level and performance level there was negligence towards the price of Lasso by the farmers. The positive correlation may arise due to this factor. There are about 57% farmers in Hoshiarpur and 76% farmers in Nawanshahr that are using Lasso for more than 2 years. So there is more number of loyal consumers that use Lasso. These farmers continue to use Lasso irrespective of the price change.

The study suggested encouraging the retailers by providing incentives and increasing the sales volume of Lasso. The non-user farmers are made aware of the benefits of Lasso by organising Demo plots and farmers meetings. The product may make available at grass root level through cooperatives. The research may be taken up to improve the quality of Lasso so that it could be applied in all types of soils and also without the combination of other chemicals.
AGRICULTURAL ECONOMICS

Author : JAMES KOFI BLAY
Title of the thesis : SPATIAL MARKET INTEGRATION AND PRICE TRANSMISSION OF IMPORTANT CROP MARKETS IN GHANA
Major Advisor : Dr. D.V. SUBBA RAO
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9754

ABSTRACT

This study was conducted to examine market integration and price transmission of yam, sorghum and millet markets in Ghana. Spatial market integration and price transmission of agricultural markets play important role in agricultural production and marketing efficiency. Ghanaian agricultural commodity markets have been studied extensively, but there have been few if any empirical studies written with direct application to selected crop markets. Knowledge of spatial performance of markets is relevant for agricultural market policy development.

The main objective of the study was to determine the extent of price transmission and market integration between yam, sorghum and millet markets in Ghana. To achieve this objective, a sample of six major markets were selected for each of selected crops, comprising Techiman, Tamale, Bolgatanga, Wa, Kumasi, Accra for the analysis with Techiman as the reference markets for yam, Tamale for sorghum and millet. The dataset for the analysis was average monthly secondary price series from January 2006 through December 2013.

The estimations were performed using Johansen’s cointegration approach, and the momentum threshold autoregressive and threshold vector error correction models. Results of the pair-wise cointegration analysis between reference market and other markets for all the selected crops under study through the application of the Johansen’s cointegration approach revealed cointegration between the reference markets and all other markets implying an integrated marketing system for yam, sorghum and millet. The results of the standard momentum threshold autoregressive (MTAR) and consistent momentum threshold autoregressive (CMTAR) model revealed cointegration and asymmetric adjustment. However, the results of the Hansen and Seo test for presence of threshold effect between the markets failed to be rejected for Kumasi, Accra, Tamale and Wa in yam except Bolgatanga market. Conversely, the test rejected the presence of threshold effect in sorghum and pearl millet markets except in Accra and Kumasi sorghum markets. This implies that yam markets are characterized by discrete
threshold behavior (threshold co-integration) which accounts for non-linear adjustments to equilibrium while sorghum and millet exhibited linear cointegration and asymmetric or symmetric adjustment to equilibrium.

The findings of the threshold vector error correction model revealed that in yam markets exhibited negative asymmetric transmission in the long-run price equilibrium due to changes in the Techiman market prices implying the intermediaries’ response quickly to price movements that stretch the margin than movements that squeeze margin. However, Techiman market does not responded to both positive and negative discrepancies in the long-run price equilibrium arising from perturbation in other market price changes.

Furthermore, in both sorghum and millet commodities markets, the markets in relation to the reference market exhibited asymmetric adjustment in the long-run with little adjustment for positive deviations as compared to negative deviation. In Sorghum and Millet markets Tamale was found to be the market leader. There were higher levels of price instability and risk in all markets for the commodities under present study in the country accompanied by typically periods of higher persistent and explosive volatility levels stemming from both positive and negative shocks of new information.

It is therefore, recommended that the government should invest in the agricultural market information system (AMIS) in the country to enhance food market information and transparency, regulation and supervision of agricultural markets. Further, the policy makers should develop price risk management instruments such as minimum support price to farmers to mitigate the impact of price shocks.
Over the last three decades (1981-2011), N, P, K and NPK in absolute quantity and its per hectare consumption observed an increasing trend with fluctuation in some years. The absolute NPK consumption was found to be increased by four times while per hectare consumption, by five times. The per hectare nitrogen consumption was more compared to phosphorous and potassic fertilizer in all the study years. The compound growth rate of absolute N,P,K and NPK for the state as a whole was 4.09, 5.18, 7.59 and 15.12 respective while for per hectare was 3.98, 5.06, 7.46 and 4.62 over the study year. The ratio of per hectare consumption of N:P:K was 12:4:1 and 4:2:1 during 1981-82 and 2010-11 respectively showing convergence towards recommended practice.

The per hectare consumption of NPK, N, P and K was increased in all districts over the study years (1981-2011). The per hectare consumption of NPK was 58.32 during TE 1981-84 which increased to 235.46 kg ha\(^{-1}\) in TE 2008-11. In TE 1981-84, the per hectare NPK consumption was range from 166.17 kg ha\(^{-1}\) (Nizamabad) to 15.10 kg ha\(^{-1}\) (Adilabad). Similarly, in TE 2008-11 there it was range from 473.63 kg ha\(^{-1}\) (Ranga reddy) to 95.71 kg ha\(^{-1}\) (Vishakhapatnam) during the same period. Among the districts highest increased in NPK consumption was observed in Adilabad and Ranga Reddy while lowest increase in Adilabad. The variation of NPK per hectare consumption was reduced overtime. Among the nutrient fertilizer, potash has highest variation among the districts while nitrogen has less variation. This shows nitrogen was most familiar among the farmers compared to other fertilizer nutrients. This might be due to easy availability of nitrogen base fertilizers.

Over the three decades (1981-2010), all the districts have shown positive growth in per hectare consumption of NPK, N, P and K fertilizer. Among the districts, highest growth in consumption of nitrogen and phosphorous fertilizer was recorded in Ranga Reddy district.
followed by Adilabad. For potash, Vizianagaram recorded the highest positive growth by Srikakulam.

During the TE (1981-84), almost all the districts consumed more NPK in rabi season than kharif season. While during the TE (2008-11), most of the districts (9 districts) consumed more NPK during kharif season. The per cent difference in NPK used in two seasons was 31.99 per cent during TE (1981-84) which decreased to 6.14 per cent during TE (1981-84).

Both absolute and per hectare consumption of pesticide showed a negative growth rate of -10.28 per cent and -12.47 per cent during this two decades, which shows decrease in consumption over the year. The per hectare consumption of pesticides was 0.87 a.i. kg ha\(^{-1}\) during 1989-90 which reduced to 0.11 a.i. kg ha\(^{-1}\) (2009-10). In both the TE period, Guntur shared the highest consumption of pesticide followed by Khammam.

In the farmers sample data, the land use intensity was 121.59 per cent during 2010-11. Paddy and cotton (Bt) were the two main crops of the sample farmers in Andhra Pradesh occupying about 70 per cent of gross cropped area. Maize and blackgram crops were the other main crops, which covered about 4.66 per cent and 4.44 per cent of gross cropped area, respectively. Soybean and chilli occupied less than 2 per cent of gross cropped area. Per hectare consumption of total NPK, N, P and K was 196.07, 103.91, 59.98 and 32.18 kg ha\(^{-1}\) respectively. Out of the total fertilizer consumption in terms of NPK, the highest was consumed by paddy (64.93 %) followed by cotton (Bt) (11.78%) and maize (5.57 %). Deviation in per hectare fertilizer consumption was less in major crop while it was more in pulses and minor crops. The highest total pesticide per hectare was consumed by cotton (1.90 a.i. kg ha\(^{-1}\)) followed by paddy (1.87 a.i. kg ha\(^{-1}\)), maize (1.72 a.i. kg ha\(^{-1}\)), groundnut (1.39 a.i. kg ha\(^{-1}\)) and redgram (0.92 a.i. kg ha\(^{-1}\)). In most of the crops, share of insecticide was more compare to other category of pesticides.

Among the factors which affects the paddy yield, NPK was the most important factor followed by land and seed quantity. The major factor which affect yield of maize was the quantity of seed and per hectare fertilizer consumption. For groundnut crop, most important input was human labour followed by seed and area while pesticides and fertilizers was non significant. For cotton crop human labour was the most important factor while increase in the cost of pesticide had negative effect on yield and NPK has positive impact on yield but it was not an important factor in increasing the yield.

The most important determinant for fertilizer consumption among the farmer was area under fertilizer intensive cropped followed by relative price of output to fertilizer price and wages. Similarly, the important determinant of expenditure on pesticide was quantity of NPK consumption among the study crops.

At state level, the determinant of fertilizer consumption was price of fertilizer, irrigation and output price. Between the input and output price, former was the most powerful factor in influencing fertilizer consumption. So it is necessary to prioritize reduce input price policy mechanism over higher output prices as high output price benefit a small proportion of farmer while low input price will increase fertilizer consumption on millions of small and marginal farmers.
The study shows that consumption of fertilizer will increase while pesticides demand will reduce in future.

The conclusion and policy recommendation is that effort should be made to reduce disparities of consumption of fertilizer and pesticides among the districts by taking up programme like timely supply of inputs in remote areas, extension services for the use of inputs in a scientific line. Soil testing facilities should be provided to the farmers so that optimum quantity might be use by farmers. Facility should be made ready to provide required input amount to the farmers in future. Input price should be kept in affordable level to all farmers.
AGRICULTURAL ECONOMICS

Author : PONNAM PRASHANTHI
Title of the thesis : IMPACT OF FARM MECHANIZATION IN MAJOR CROP OF KARIMNAGAR DISTRICT
Major Advisor : Dr. R. VIJAYA KUMARI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9765

ABSTRACT

Keeping in view the importance of farm mechanization in the state, the present study "Impact of farm mechanization in major crops of Karimnagar district" has been undertaken to identify the major farm operations that can be mechanized, assess resource use efficiency, work out the impact of mechanization on crop production and returns, and identify the constraints for adoption of farm mechanization.

A total of 180 farmers (90 each of mechanized and non-mechanized) from nine selected villages in three selected mandals of Karimnagar district were purposively selected by adopting random sampling technique for the present study. The data required was obtained from both primary and secondary sources. The primary data were obtained from the selected sample farmers by interview method through a pre-tested questionnaire. The major crops covered under the study include paddy, maize and cotton. After comparing the farm management practices of mechanized with those of non-mechanized crop cultivation it was observed that the major operations (ploughing, spraying, harvesting, threshing and shelling) are done by the machinery in mechanized paddy, maize and cotton, while same is done manually in non-mechanized paddy, maize and cotton.

The average total cost of cultivation per hectare of mechanized and non-mechanized paddy, maize and cotton farms was 82805.66, 65063.78 and 101235.65, and 90922.85, 67456.45 and 106568.64 respectively. The cost of production of each quintal of paddy, maize and cotton on mechanized farms was estimated to be 771.30, 579.69 and 2416.36 respectively. The same on non-mechanized farms was 1070.13, 692.35 and 2765.36 respectively. The gross returns per hectare of paddy, maize and cotton cultivation from mechanized farms were 119521.66, 96055 and 114300 respectively, while the same in case of non-mechanized farms were 103700.83, 89792.5 and 107700 per hectare respectively.
The production elasticity coefficients obtained from the Cobb-Douglas analysis for fertilizers were found to be significant with negative sign in both mechanized and non-mechanized paddy farms. Machine power was the factor that has higher potential for increased output on mechanized farms. Among the variables included in the model for mechanized and non-mechanized maize farms, the seed was found to be significant with negative sign. Machine power was also significant with negative sign in mechanized maize farms. In cotton among the variables included in the model the human labour was not significant in both mechanized and non-mechanized farms indicating that it was not significantly contributing to increase in the yield. Machine power and number of PPC applications were the factors that have higher potential for increased output on mechanized farms. Seed and fertilizers were significant but with negative sign in mechanized cotton farms. In non-mechanized farms number of PPC applications and number of irrigations were significant with negative sign.

The regression coefficients of dummy variable for mechanization obtained through fitting a multiple linear regression model were found to be significant in paddy, maize and cotton farms. The sign of the coefficients obtained in the analysis is positive, there by showing that the mechanized paddy, maize and cotton farmers respectively realize 5.7, 11.6 and 1.61 quintals more yield by adopting farm mechanization when compared with non-mechanized farms.

The opinion survey carried out to identify the various constraints in adoption of farm mechanization revealed that purchase and maintenance of farm implements and machinery as the major constraints in adoption of mechanization by all sample farmers (100%). Other constraints expressed by sample farmers include procedure for acquisition of farm machinery on government subsidy (97.22%), unawareness about technology (96.1%), inadequate and untimely availability of farm machinery and implements on hire basis (91.11%), lack of credit facilities to purchase the implements and machines (75%), lack of required training (57.22%), low education levels (56.66%), small size farms (52.77%), lack of technical staff to operate machines and attend repairs and maintenance services (47.22%) and poor researcher-extension-farmer linkage (43.88%).

In the face of such problems, apparently it appears that it is not possible to cover each and every farm household under government subsidy or assistance programmes. However, certain measures could be taken up to promote mechanization among the farming community. Policy issues on farm power requirements such as the establishment of maintenance workshops near farmers’ fields equipped with genuine spare parts of different makes at reasonable cost could be implemented. Public lending on priority basis for farm mechanization may be encouraged. Training programs are needed to improve operators skills for efficient and safety use of farm machinery.
AGRICULTURAL EXTENSION

Author : ADI LAXMY, D.
Title of the thesis : AN ANALYTICAL STUDY ON RELEVANCY AND UTILITY OF THE PADDY CROP PRODUCTION TECHNOLOGIES DISSEMINATED THROUGH RURAL KNOWLEDGE CENTRES (RKCs) OF ANDAMAN AND NICOBAR ISLANDS
Major Advisor : Dr. M. JAGAN MOHAN REDDY
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9792

ABSTRACT

The present study had been initiated focusing on the extent of awareness, perception on relevancy and utility of paddy crop production technologies disseminated through Rural Knowledge Centres and the constraints and suggestions elicited by respondents on dissemination of paddy crop production technologies.

Ex-post facto research design was adopted. All the three districts (South, North and Middle and Nicobar) were selected purposively. Three RKCs and three tehsils selected purposively and 150 farmers from 15 villages and 30 officials were selected randomly for the study.

Majority of the respondents had middle aged, small farm size, having primary school education, possessed medium level of farming experience, farm income, extension contact, mass media exposure, innovativeness, scientific orientation and risk taking ability, low level of socio political participation and trainings undergone.

Majority of the respondents had medium extent of awareness and medium level of perception on relevancy and utility of paddy crop production technologies disseminated through RKCs. Majority of the respondents had aware of transplanting paddy seedlings at the age of 20-25 days followed by awareness on suitability of paddy varieties Jaya, Mashuri, ADT, Bhawani, BPT-5204 and Caridhan to A & N Islands. Majority of themattributed more relevancy to the paddy technologies like suitability of paddy varieties Jaya, Mashuri and BPT-5204 to the A&N Islands followed by maintaining the water level of 2-3 cm in rice field for 10-15 days after transplanting. They attributed more utility perception on practicing rouging from ear head to dough stage to maintain varietal purity followed by maintaining thin layer of 2-3 cm water level for 10-15 days after transplanting in the rice field.
The correlation analysis indicates that there was positive and significant relationship between extent of awareness on paddy crop production technologies disseminated by the RKC and the independent variables like education, farming experience, trainings undergone, mass media exposure and scientific orientation, where as positive and significant relationship was seen between perception on relevancy and farming experience, extension contact, socio-political participation and innovativeness. Positive and significant relationship between perception on utility and the independent variables like farm size, farm income, innovativeness and risk taking ability.

Major problems elicited by the farmers on dissemination of paddy crop production technologies were non-availability of paddy seeds in time, suggestion offered was seeds of various paddy crop varieties should be supplied in time before commencement of the season, problem on uninterrupted internet facility should be provided at RKC to browse information on paddy crop, the suggestion given was internet connectivity should be on broadband mode and the constant speed and delivery of the net has to be provided.

Major problems elicited by the officials on dissemination of paddy crop production technologies were difficulty in designing the paddy crop modules according to the farming situation, the suggestion offered was PRA techniques have to be conducted at each farming situation to unearth the natural and physical resources, strengths, weaknesses, opportunities, and threats on paddy crop cultivation to design effective crop modules, problem on poor transport facility to attend various activities of RKC, the suggestion given was good transport facility has to be provided to attend multifarious activities of RKC and also to have a close supervision of ongoing programmes / schemes.
AGRICULTURAL EXTENSION

Author : LATHA, M.
Title of the thesis : IMPACT OF NATIONAL HORTICULTURE MISSION IN NORTH AND MIDDLE ANDAMAN DIRECT ANDAMAN AND NICOBAR ISLAND
Major Advisor : Dr. I SREENIVASA RAO
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9794

ABSTRACT

The present study undertaken to assess the Impact of National Horticulture Mission, vis-a-vis objectives of NHM scheme especially for the major focused crops i.e Tissue culture banana and black pepper in terms of area expansion, increase in production and productivity, income generation, employment generation and creation of assets. An Ex-post facto research design with a sample 120 farmers i.e 60 each beneficiaries non beneficiaries of NHM from 6(six) villages was adopted. A total of 11(eleven) independent variables to their profile and dependent variables namely Awareness, Knowledge and Adoption of recommended package and practices of selected crops were analyzed for the study.

The analysis of profile characteristics of NHM beneficiary indicated that majority were old aged, had primary education, holding small farm size, high farming experience, socio political participation, innovativeness and subsidy orientation and medium in annual income, information seeking behaviour, risk taking ability and achievement motivation. Majority of beneficiaries had medium awareness about NHM, high knowledge in cultivation of tissue culture banana and black pepper with high adoption.

The analysis of profile characteristics of non beneficiaries National Horticulture Mission indicated that majority of them old aged, capable of read and write, holding marginal farm size (below 1.00 ha), high sociopolitical participation, innovativeness, subsidy orientation, achievement motivation. Where as they were medium in risk taking ability and information seeking behaviour and low farming experience, annual income. Majority of respondents of non beneficiary had medium level of awareness about NHM, had medium knowledge of the scientific package of practices of tissue culture banana and black pepper and medium adoption recommended package of practices tissue culture banana and black pepper. No significant difference was observed between beneficiary and non beneficiary farmers regarding awareness of NHM, but there was a significant difference between beneficiaries and non beneficiaries regarding the knowledge and adoption of recommended package of practices of tissue culture banana and black pepper.
The analysis of profile characteristics of non beneficiaries National Horticulture Mission indicated that majority of them old aged, capable of read and write, holding marginal farm size (below 1.00 ha), high sociopolitical participation, innovativeness, subsidy orientation, achievement motivation, where as they were medium in risk taking ability and information seeking behaviour and low farming experience, annual income. Majority of respondents of non beneficiary had medium level of awareness about NHM, had medium knowledge of the scientific package of practices of tissue culture banana and black pepper and medium adoption recommended package of practices tissue culture banana and black pepper. No significant difference was observed between beneficiary and non beneficiary farmers regarding awareness of NHM, but there was a significant difference between beneficiaries and non beneficiaries regarding the knowledge and adoption of recommended package of practices of tissue culture banana and black pepper. The impact analysis revealed that NHM scheme showed positive impact with regard to area, production and productivity of the selected crops, income and employment generations and assets creation in the selected district. The independent variable namely farming experience, sociopolitical participation, information seeking behaviour, risk taking ability and achievement motivation had positive significant relationship with awareness of beneficiaries, all the independent variables except age had positive correlation with knowledge and adoption of recommended package and practices of tissue culture banana and black pepper, where as risk taking ability had no significant relationship with knowledge of beneficiaries.

The independent variable namely education, farming experience, sociopolitical participation, information seeking behaviour, risk taking ability, subsidy orientation and innovativeness had positive significant relationship with awareness and others showed non significant relationship with awareness about NHM. The independent variable namely annual income, risk taking ability, information seeking behaviour had non significant relationship with knowledge of banana, where as the variables namely age, annual income, farming experience, risk taking ability and achievement motivation showed negative and non significant relationship with knowledge and adoption of recommended package and practices of tissue culture banana and black pepper with respect to non beneficiaries of NHM. The major constraints perceived by them were lengthy documentation, lack of irrigation facility, transportation, post harvest management and infrastructural facility and suggested to provide training and capacity building in pots harvest technology for horticultural crops and provision of subsidy on drip and sprinkler irrigation.
AGRICULTURAL EXTENSION

Author : NEHA ARYA.

Title of the thesis : RURAL OUT MIGRATION IN UTTARAKHAND IN THE CHANGING AGRARIAN SCENARIO

Major Advisor : Dr. R. VASANTHA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9789

ABSTRACT

The present study had been initiated to unearth the causal factors of migration and for suggesting suitable strategies to reduce the problem of out migration.

Ex-post facto research design was adopted for carrying out the study. Selection of Uttarakhand state, Almora district and two blocks of Almora district namely Chaukhutiya and Dwarahat and four villages of these blocks namely Barati, Kaney, Gangolihat and Seemapali was purposive based on the intensity of migration. Thirty migrated respondents from each village were selected at random to make a total sample of 120 migrants. Interview schedule was developed for data collection and the statistical measure like frequency, percentages, correlation and multiple linear regression were used. Salient findings of the study are given below.

Majority (64.17%) of the respondents were below 25 years of age, had education upto intermediate (30.84%). Majority of the respondents used cooperative societies (44.16%) as source of credit, had medium family size (55%), low annual income (56.66%), medium family debts (57.50%), one migrant in the family (73.33%), two occupations (57.50%), medium level of farm resources (64.16%). Majority of the respondents were migrated for non agricultural purposes (85.84%), migrated for medium term (69.16%) from rural areas to urban areas (77.50%). Majority (76.67%) of respondents had adopted medium level of survival strategies before migration, had medium level of economic motivation (61.67%) and medium level of risk orientation (61.67%).

Majority (56.67%) of the migrants earned low remittances from migration and 94.16 per cent of them used remittances for their children education followed by purchase of food (90.83%). Majority of the migrants had high perception on push determinants of migration (64.17%) and medium perception on pull determinants of migration (59.16%).
Majority of the migrants had low opinion about consequences of migration on agriculture (71.67%), medium opinion about consequences of migration on women empowerment (61.67%), low opinion about consequences of migration on biodiversity (80.00%), often had food security (75.83%) and medium opinion about consequences of migration on nutritional security (65.84%).

Relationship of profile characteristics of the migrants with push and pull determinants of migration indicated that the independent variables like education, family size, annual family income, family debts, number of migrants in the family, amount of remittances, economic motivation and risk orientation were positively and significantly related with both push and pull determinants of migration. The independent variables like age, credit availability, number of occupations and survival strategies adopted before migrating were negatively and significantly related with migration. The independent variable purpose of migration was negatively and significantly related with push determinants of migration and positively and significantly related with pull determinants of migration. The independent variables like farm resources, duration of migration and pattern of migration had shown positive and non significant relationship with migration.

Keeping in view the findings of the study a suitable strategy was developed for reduction of rural out migration. The strategy included the interventions to be taken up by the Government, State Agricultural University, NGOs and KVKs.
AGRICULTURAL EXTENSION

Author: NEEMA PARVEEN, SHAIK.
Title of the thesis: A STUDY ON FEASIBILITY AND ADOPTION OF BEST MANAGEMENT PRACTICES OF COTTON IN NALGONDA DISTRICT OF TELANGANA
Major Advisor: Dr. V. SUDHA RANI
Degree: M.Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9793

ABSTRACT

The present investigation carried out to analyse the level of feasibility of best management practices in cotton in terms of the attributes as perceived by the farmers and extent of adoption of the same. An Ex-post facto research design was followed for the study. The state of Telangana was purposively selected and Nalgonda district was randomly selected. Two mandals from the district and two villages from each mandal were selected randomly. 30 cotton growers from each village were selected constituting a sample of 120 respondents.

The analysis on profile characteristics of respondents indicated that majority of the respondents belonged to middle age group, had primary education, marginal farm size, medium income, medium farming experience, medium social participation, medium extension contact, medium scientific orientation, high management orientation, high economic motivation, medium information seeking behaviour, high risk taking ability, medium cosmopoliteness, medium mass media participation and medium environmental consciousness.

Majority of the respondents perceived overall best management practices as moderately feasible followed by highly feasible and less feasible. Majority of the respondents perceived soils and recommended spacing as moderately feasible. With respect to intercropping, less than half of the respondents perceived it as moderately feasible. Most of the respondents perceived irrigation at critical stages as highly feasible.

Less than half of the respondents perceived overall nutrient management practices as moderately feasible. Among the components under nutrient management, most of the respondents perceived application of fertilizers as highly feasible, split application of N and K, application of FYM/organic fertilizers and correction of micronutrient deficiencies as moderately feasible and foliar application of nutrients as less feasible.
Most of the respondents perceived overall weed management practices as moderately feasible. Among the components under weed management, most of the respondents perceived manual weeding as less feasible, intercultivation and post emergence weedicide application as moderately feasible and pre-emergence weedicide application as highly feasible. Less than half of the respondents perceived overall pest management practices as moderately feasible. Among the components under pest management, most of the respondents perceived stem application and growing of barrier crops/ bund crops as less feasible, yellow sticky traps and application of NSKE as moderately feasible and application of insecticides (but not based on ETL) as highly feasible.

Majority of the respondents perceived overall disease management practices as less feasible. All disease management practices selected for the study viz. seed treatment, soil application and soil drenching were perceived as less feasible by most of the respondents.

The analysis on adoption of selected best management practices revealed that adoption of correct type of soils has ranked first followed by harvest and post-harvest management practices, appropriate spacing, nutrient management practices, weed management practices, irrigation at critical stages, pest management practices, intercropping and disease management practices in the order of priority.

Relationship between overall perceived feasibility index and overall extent of adoption was found to be positive and significant at the 0.01 per cent level. With respect to component wise relationship between level of feasibility and extent of adoption of selected best management practices, it was revealed that irrigation at critical stages, nutrient management, weed management, pest management, harvest and post-harvest management practices have shown positive significant relationship. Spacing and disease management practices have shown non-significant relationship. Intercropping has shown negative but non-significant relationship.

Analysis on practice wise relationship between perceived attributes and extent of adoption has shown that perceived compatibility, perceived profitability and perceived observability have shown positive significant relationship with extent of adoption in most of the practices. It was also found that, perceived complexity was negatively and significantly correlated in certain of the practices.
AGRICULTRAL EXTENSION

Author : PRASHANTH, P.

Title of the thesis : STAKEHOLDER ANALYSIS OF TANK MANAGEMENT UNDER PROJECT AND NON-PROJECT AREAS IN ANDHRA PRADESH

Major Advisor : Dr. M. JAGAN MOHAN REDDY

Degree : Ph. D.

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9798

ABSTRACT

The present study had been initiated focusing on community participation and group dynamics of tank users and management behaviour of officials.

Ex-post facto research design was adopted. The state of Andhra Pradesh, three regions and three districts of the state (Mahabubnagar from Telangana, Vizianagaram from Coastal Andhra and Chittoor from Rayalaseema) were selected purposively. From each district four tanks (two from project and two from non-project area) were selected randomly. A total of 240 (120 under project area and 120 under non-project area) tank users selected from 12 tanks were considered as sample for the study. Sixty officials (10 from project and 10 from non-project areas) were selected randomly to study the management behaviour.

Dependent variables i.e. attitude of tank users towards community participation, extent of community participation and group dynamics of the tank users and management behavior of the officials were selected for the study. Independent variables i.e. age, education, farm size, farming experience, socio-political participation, participation in extension methods, extension contact, information seeking behavior, empathy, training received, scientific orientation, risk taking ability, decision making behavior, marketing behavior were selected for the study. A scale was developed to measure the attitude of the tank users of both project and non-project areas in tank management.

Majority of the project tank users had primary school education and small farm size, high levels of socio-political participation, extension contact, information seeking behavior and marketing behavior. Whereas, they fell under medium category in terms of age, experience, participation in extension methods, empathy, training received, scientific orientation, risk taking ability and decision making behaviour. Majority of the non-project tank users had primary school education and marginal farm size. Variables like age, experience, socio-political participation, participation in extension methods, extension contact, scientific orientation and decision making...
behaviour, comes under medium category. Whereas, majority of them had low information seeking behavior, empathy, training received, risk taking ability and marketing behaviour.

The project tank users had high and non-project tank users had low favorable attitude towards community participation in tank management. Majority of the project tank users had medium, and non-project tank users had low extent of community participation in tank management. Majority of the project tank users had high level of group dynamics, and non-project tank users had low group dynamics in tank management. Majority of the project tank users had high overall tank management, whereas non-project tank users (53.33%) were grouped under low category. The significantly and positively related variables with extent of community participation of project tank users are education, farming experience, socio-political participation, extension contact, empathy, training received, scientific orientation, and decision making behavior, whereas with non-project tank users are education, extension contact, empathy, and decision making behaviour. The variable farm size was significant negatively with extent of community participation of non-project tank users.

The significantly and positively related variables with the group dynamics of project tank users are education, extension contact, information seeking behavior, empathy, training received, decision making behavior and marketing behaviour whereas with non-project tank users are education, extension contact, information seeking behaviour, empathy, risk taking ability and marketing behaviour were found significantly and positively related. The management behavior of both project and non-project officials is manifested in the form of clubbing tank performance with recognition, formulating plans based on needs and interests of tank users, and floating new ideas by the officials for better tank management.

Major constraints elicited by the tank users in tank management are lack of linking mechanism among the tanks (project) and lack of public private partnership (non-project). Major suggestions expressed for better tank management are protecting the tank area from encroachment (project) and demarcating the tank area (non-project).

Major constraints elicited by the officials of project area are lack of enthusiasm among tank user groups to share responsibility and poor participation of farmers (non-project). Major suggestions expressed by the officials are strengthening information sharing behavior among the officials (project) and filling of man power to guide the tank users (non-project).

The strategy on strengthening tank management system include farmer to farmer extension, providing good infrastructure and exploring opportunities to take up various income generation activities under the tank.
AGRICULTURAL EXTENSION

Author : SADVI, P.

Title of the thesis : A STUDY ON ADOPTION OF HYBRID RICE SEED PRODUCTION IN KARIMNAGAR DISTRICT OF TELANGANA STATE

Major Advisor : Dr. M. JAGAN MOHAN REDDY

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9791

ABSTRACT

The present study had been initiated focusing on the knowledge and adoption of hybrid rice seed production technologies and the constraints and suggestions elicited by them in the adoption of hybrid rice seed production technology.

Ex-post facto research design was adopted in the present investigation. Karimnagar district of Telangana state was purposively selected for the study. The study was conducted in 12 villages selected from 4 mandals of the Karimnagar district, which included 10 farmers from each of the selected village. A sample of 120 hybrid rice seed growers were selected for the study.

The analysis of profile characteristics of hybrid rice seed growing farmers indicates that majority of them are middle aged, having primary school education, fell under medium category in terms of farming experience, annual income, information management behavior, achievement motivation, extension contact, low socio political participation, low trainings received and high scientific orientation. Majority of the respondents had medium level of knowledge, high extent of adoption of Hybrid rice seed production technologies. With regard to the item analysis of level of knowledge of the respondents on hybrid rice seed production technology, majority of them had high knowledge on items like rice seedlings are to be transplanted at the age of 20-25 days followed by male and female nurseries must be raised separately and the least ranked knowledge items are spraying the urea @ 2% will delay in flowering and spraying of GA3 will increase panicle exertion from flag leaf and increases duration of flower opening.

With regard to the item analysis of extent of adoption of hybrid rice seed production technologies, majority of the respondents had high adoption of transplanting the seedlings at the age of 20-25 days followed by following isolation distance of 100 mts, rouging at tillering, flowering and at maturity stage and the least ranked adoption items are adoption of maintaining
the isolation distance of 100mt, application of FYM in last puddling, seed treatment of paddy seeds with carbendazim.

The correlation analysis indicates that there was positive and significant relationship between level of knowledge on hybrid rice seed production technology and the independent variables like education, farming experience, trainings received, scientific orientation, achievement motivation and information management behaviour.

Major problems elicited by the farmers in hybrid rice seed production are- labour were scared for snakes during pollination, labour problem during critical agricultural operations like transplanting, weeding, pollination and harvesting time, more risk in pollination as the snakes are easily attracted by the smell of the hybrid rice pollen grains, escalation of cost of cultivation due to high prices of fertilizers and pesticides and applying indiscriminately without scientific knowledge, scarcity of labour due to employment guarantee scheme during critical agricultural operations and improper weighing there by farmers are losing 10-100 kg of seed, lack of support and control from the government on hybrid rice seed production and delayed payment for a period of 25-30 days after procurement, sole control of private companies leading to more exploitation, harvesting of male lines with manual labour is costly, dissynchronization of flowering under adverse weather conditions and variation in yield due to weather conditions.

The suggestions offered for these problems were instead of pollination with sticks, rope pollination may be popularized and standardized, suitable machinery has to be developed, multiplied and distributed for transplanting and other agricultural operations, timely technical support should be provided by Department of Agriculture or State Agriculture University through electronic and print media. Employment Guarantee Scheme should be converged for agricultural operations. Weighing should be done at the farmers’ field or in presence of farmer and weight loss should be reduced. Government should design policies and procedures to have complete control on hybrid rice seed production. Payment should be done to the farmers at the time of procurement only. Brush cutters or some other machinery has to be made available to farmers for harvesting of male lines. Researchers should do research on synchronization of flowering under adverse weather conditions. Weather based crop insurance scheme has to be designed and operationalized in true spirit.
AGRICULTRAL EXTENSION

Author : SHAMNA, N.

Title of the thesis : “A STUDY ON FARMERS PERCEPTION ON PROSPECTS AND PROBLEMS OF POKKALI RICE FARMING IN THE STATE OF KERALA”

Major Advisor : Dr. R. VASANTHA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9795

ABSTRACT

The present study had been initiated focusing on the documentation of status of Pokkali Rice Farming, farmers perception on prospects and problems of Pokkali Rice Farming, consequences of adoption & discontinuation of Pokkali Rice Farming, farmers perception on research and extension interventions and attributes of Pokkali rice.

Ex-post facto research design was adopted in the present investigation. The state of Kerala was selected for study purposively as Pokkali farming system is unique to Kerala. The district Eranakulam was selected purposively, since out of total Pokkali cultivated area, major area is in Eranakulam district. Out of eight blocks of Eranakulam district, where Pokkali Rice Farming is concentrated, three blocks having largest area under Pokkali Rice Farming were selected. From each block, two villages were selected and from each village, 20 farmers engaged in Pokkali rice cultivation were selected making a total sample of 120 respondents for the study.

Analysis of profile characteristics of respondents indicated that, majority of the Pokkali rice farmers belonged to middle aged group, had high school education, had marginal land holding, had medium socio economic status, had medium extension agency contact, had low credit orientation, had high input availability, had medium farming experience, had low scientific orientation, had medium economic motivation, had medium risk orientation, had low formal information sources utilization, had medium utilization of both informal and mass media sources, no training undergone, medium marketing orientation and low socio- political participation.

Majority of the respondents perceived the status of Pokkali rice farming when compared to 10 years back as: the area under Pokkali Rice Farming has decreased, farmers cultivating Pokkali rice in the village has decreased, farmers using local Pokkali variety- ‘Pokkali’ has increased where as other local varieties such as ‘Cheri virippu’ and ‘Chetti virippu’ has decreased but high yielding Pokkali varieties such as Vyttila-4 and Vyttila-6 has increased, cost of cultivation of Pokkali rice has increased, yield/acre has decreased, market price and demand of Pokkali rice has increased, labour availability for Pokkali rice cultivation has decreased, labour wages for Pokkali rice cultivation has increased and no change in availability of seeds.
Majority of the respondents had high perception (40.13%) on the attributes of Pokkali rice followed by low (30.00%) and medium (29.87%) perception on attributes of Pokkali Rice Farming. Majority of the respondents had medium perception (48.38%) on the prospects of Pokkali Rice Farming followed by low (34.95%) and high perception (16.67%) on prospects of Pokkali Rice Farming. Majority of the respondents had high perception (45%) on the problems of Pokkali Rice Farming followed by medium (34.17%) and low (20.83%) perception on problems of Pokkali Rice Farming.

The consequences of adoption of Pokkali rice farming as perceived by scientists were “adoption is beneficial for subsequent shrimp cultivation which improves economic conditions of farmers” and “continuous adoption of Pokkali rice-shrimp rotational farming system may lead to shortage of prawn seeds which leads to reduction in annual prawn yield” whereas, majority of the officials of department and farmers did not perceive these consequences. Majority of scientists, officials of department and farmers perceived the consequences of adoption such as “Pokkali rice which has high quality, good taste and having international market value is highly beneficial to Pokkali farmers”, “The soil fertility in Pokkali Rice Farming increases due to tidal flows which is beneficial for ecosystem” and “Since Pokkali fields are highly organic, it does not require any external inputs like fertilizer or pesticides; which reduces the cost of cultivation and save money for farmers”. Majority of the Scientists and officials of department perceived that there is a scope for labour saving heavy equipments like tractors and harvesters in water logged Pokkali fields’ whereas, only 10 percent of farmer could perceive this consequence.

Majority of scientists, officials of department and farmers could perceive the consequences of discontinuation such as “discontinuation negatively affects prawn farming”, “as more area is being gradually brought under fallow-prawn and prawn-prawn systems, it is leading to monoculture of prawn, which in turn disturbs ecological balance”, “discontinuation leads to loss of indigenous rice varieties having medicinal properties” and “monoculture of shrimp leads to serious social and environmental implications”. All scientists and officials of department perceived the consequences such as “The discontinuation results in the entire Pokkali fields getting flooded and more acidic that is detrimental to prawn larvae” and “The discontinuation of Pokkali rice cultivation leads to reduction of oxygen in the field affecting ecosystem adversely whereas, only 40-50 percent of the farmers perceived these consequences. Majority of the scientists, officials of department and farmers disagreed with the consequence that “if Pokkali Rice Farming is discontinued, the farmers can reap high profit by selling Pokkali fields to real estate people”.

The results of correlation between the profile characteristics and perception of respondents towards prospects indicated that the profile characteristics such as socio economic status, extension agency contact, credit orientation, economic motivation, risk orientation, source of information utilized and socio political participation were found to be positively and significantly correlated with perception of farmers towards prospects of Pokkali Rice Farming whereas, the variables such as land holding, socio economic status, experience in Pokkali Rice Farming, sources of information utilized and socio political participation were found to be positively and significantly correlated with perception of farmers towards problems of Pokkali Rice Farming.

Majority of the farmers perceived that research is needed on development of high yielding, non-lodging and short duration varieties, development of land preparation and harvesting
machinery for Pokkali fields. Majority of the farmers had an unfavourable opinion towards the research on value added products, research on development of winnowing and dewatering machinery. Majority of the farmers expressed a favourable perception towards training programmes on scientific methods of shrimp farming, demonstration of new machinery and pamphlets and leaflet distribution on implements whereas, the respondents had undecided and not favourable perception towards having training programmes in export oriented production, cultivation of improved varieties, demonstration of value added product preparation, pamphlet and leaflet distribution on importance of Pokkali Rice Farming and exposure visits.

Suitable strategies developed for the promotion of Pokkali Rice Farming, which included interventions to be taken up by the government, research workers, extension personnel, NGO’s and PLDA (Pokkali Land Development Agency). Strategies for government included: establishment of agricultural labour bank, incentives and health insurance cover for harvesters, separate premium price for Pokkali rice, Pokkali agro-service centers, market infrastructure development, ‘ecological incentives’ for Pokkali rice farmers, attractive credit policy, pollution control measures in back waters, strengthen PLDA, package for Pokkali farmers, establishment of ATIC model product cum service center etc. Strategies for research workers included: development of suitable machinery for land preparation and harvesting, research and development on high yielding, lodging resistant and short duration varieties, product diversification and value addition, collection and preservation of various landraces of Pokkali rice. Strategies for extension personnel included: awareness programmes on medicinal properties and organic nature of Pokkali rice, trainings, demonstrations and exposure visit to farmers for quality improvement and revitalisation of Padashekhara samithi activities. Strategies for NGO’s and private companies included: assist farmers to form organization for production, procurement and marketing of Pokkali rice, identify and motivate farmer innovators to develop location specific farm machinery and implements, assist farmers in identification of profitable markets, constitute a committee for obtaining organic certification or brand label for Pokkali rice. Strategies for PLDA included: assist farmers for organic certification, labeling and branding of Pokkali rice, monitor conservation acts of government, infrastructure development in Pokkali fields and multiplication and distribution of good quality seeds.
AGRICULTURAL EXTENSION

Author : SHASHANK, D.
Title of the thesis : “A COMPARATIVE ANALYSIS OF ADOPTION OF NUTRIENT MANAGEMENT PACKAGES IN RICE IN NALGONDA DISTRICT OF TELANGANA STATE”
Major Advisor : Dr. I. SREENIVASA RAO
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9796

ABSTRACT

The present study had been initiated mainly focusing on the adoption of nutrient management packages in rice farming community.

Ex post facto research design was adopted in the present investigation. Nalgonda district of Telangana state was selected purposively and conducted in 15 selected villages from 3 mandals. A sample of 110 farmers (SAU 45, FP 45, SSNM 20) was selected for the study.

The analysis of profile characteristics of SAU practice respondents, indicated that majority of them were middle aged with high school level of education, and having medium annual income, farming experience, information seeking, machinery ownership, capacity enhancement and profit orientation whereas majority of them had small farms, low extension contact and majority depending on canals for irrigation.

In case of farmers practice respondents majority of them were middle aged with high school level of education, and having medium farming experience, information seeking, capacity enhancement and profit orientation and had low extension contact, machinery ownership, small farms whereas majority had high annual income and depending on canals for irrigation.

In case of SSNM respondents majority of them were middle aged with high school level of education, and having medium annual income, extension contact, capacity enhancement and profit orientation and had low farming experience, machinery ownership, small farms whereas majority had high information seeking and depending on canals for irrigation.

Majority (57.8%) of the SAU respondents had high level of knowledge, whereas it was low (40.0%) in case of farmer practice respondents but in case of SSNM respondents, majority (60.0%) possessed medium level of knowledge on nutrient management in rice. Further Z test
results revealed that significant difference was observed between knowledge levels of SAU-FP (15.242), FP-SSNM (5.155) and SAUSSNM (6.624) respondents.

Majority (68.9%) of the SAU respondents had medium extent of adoption, similarly majority (75.6%) of farmer practice respondents and majority (60.0%) of SSNM respondents also had medium extent of adoption. Further Z test results revealed that significant difference was observed between extent of adoption of SAU-FP (3.336), FP-SSNM (12.439) and SAU-SSNM (8.458) respondents.

Comparison of yield (q/acre) difference between SAU, FP and SSNM nutrient recommendations by using Z test revealed that significant difference was observed between yield production of SAU-FP (2.414), FP-SSNM (8.209) and SAU-SSNM (17.163) nutrient recommendations.

Correlation analysis between SAU practice respondents and profile characteristics revealed that the independent variables viz., education, farm size, farming experience, irrigation water supply, information seeking, extension contact and capacity enhancement were found positively and significantly related with the level of knowledge about nutrient management where as education, annual income, information seeking, extension contact, capacity enhancement and profit orientation were found positively and significantly related with extent of adoption about the SAU nutrient recommendation.

Correlation analysis between farmers practice respondents and profile characteristics revealed that the independent variables viz., education, annual income, farm size, extension contact and capacity enhancement were found positively and significantly related with the level of knowledge about nutrient management where as annual income, irrigation water supply, information seeking, extension contact and capacity enhancement were found positively and significantly related with extent of adoption of farmers their own recommendation.

Correlation analysis between SSNM practice respondents and profile characteristics revealed that the independent variables viz., education, annual income, farm size, irrigation water supply, information seeking, extension contact, machinery ownership and capacity enhancement were found positively and significantly related with the level of knowledge about nutrient management where as education, annual income, farm size, information seeking, extension contact, capacity enhancement and profit orientation were found positively and significantly related with extent of adoption of SSNM nutrient recommendation.

A great majority (81.8%) of rice farmers perceived the major problem of high cost of fertilizers followed by non-availability of farm yard manure (FYM)(79.1%), lack of fertilizer subsidies (69.1%), non-availability of fertilizers at proper time (67.3%), lack of proper fertilizer management skills (61.8%) etc.

The major suggestions offered by rice respondents to overcome above problems were provision of fertilizer subsidies (86.4%), formation of farmers’ cooperative societies (79.1%), creation of awareness on skillful management of fertilizers (65.5%), organization of fertilizer promotion workshop and enlightenment campaigns (65.5%), availability of fertilizers at proper times for the farmers (67.3%) etc.
AGRICULTURAL EXTENSION

Author : SHIREESHA. DEVARAKONDA
Title of the thesis : A STUDY ON GENERATION OF FARMER INNOVATIONS AND RE- INVENTIONS IN ANDHRA PRADESH
Major Advisor : Dr. I. SREENIVASA RAO
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9797

ABSTRACT

Generation of farmer innovations and re-inventions is not a new phenomenon to the farming community. Farmer innovations and re-inventions is a subject that is increasingly making people sit up and think. At the very least it underpins a refreshing new approach to indigenous environmental knowledge that goes further than just passive admiration. At the most it is a potentially important new direction for research and extension wherever else the conventional approaches have failed to deliver.

To highlight the value of this rich resource and to develop mechanisms for local innovations and re-inventions to find their way into the formal research and development system, documentation of farmer innovations and re-inventions is necessary to give the real picture of its wealth. Scientific enquiry into the documented practices would make it to a status of formal knowledge base and studying extent of adoption of these practices by the farmers will give the real picture of farmers innovations and re-inventions. Finding out the various constraints and analysis of the Innovation Development process will fetch a base which can be utilized by scientists, extentionists and user system.

In this study 216 farmer innovations and re-inventions were identified in different farming situations of Andhra Pradesh and Telangana regions through informal interview with innovative farmers who were identified for the purpose of giving information on farmer innovations and re-inventions in the selected 3 districts and also from non sample area through secondary sources. A total of 216 farmer innovations and re-inventions were documented in this study out of which 164 (75.92%) farmer innovations and re-inventions belonged to the selected sample area of the study and the rest 52 (24.08%) collected from secondary sources. Among them 67(31.02%) belonged to wetland farming situation whereas 66(30.55) were from dry land and 64 (29.63%) from garden land and few 19(8.80%) of them were from hill area Majority i.e., 63 (29.17%) out of 216 of the documented innovations and re-inventions belonged to the discipline Agronomy, followed by 57(26.38%) Agricultural Engineering, 47 (21.76%)
Horticulture, 38 (17.60%) Plant protection, 6 (2.78%) to Veterinary and 5 (2.31%) belonged to Agro forestry. Rationality analysis revealed that 132 (80.48%) were judged rational by the scientists and 32 (19.52%) were judged as irrational.

Findings of the study revealed that profile characters of the majority of the farmer innovators were middle to young aged, educated from under graduation to high schooling, possessing larger land holdings, found to have medium farming experience, annual family income, research and extension contact, mass media consumption, achievement motivation, scientism vs fatalism and progressivism have high creativity, risk bearing ability, and high research orientation.

With regard to the generation of farmer innovations and re-inventions, out of 164 farmer innovations/re-inventions all (100%) of them were passed the first two stages of need/problem identification and Research and Development but 45.73 per cent (75 out of 164) farmer innovations/re-inventions were struck up at R&D stage, whereas 52 (31.70%) innovations/re-inventions has passed the fourth stage and fifth stage i.e., diffusion & adoption and consequences and 37 (22.57%) farmer innovations/reinventions has passed the fifth stage i.e., consequences without passing through Diffusion and adoption stage. None of the farmer innovations or re-inventions has passed through the all the stages of the Innovation Development Process.

Majority of the farmer innovations/re-inventions 155 (94.51%) has shown high perceived effectiveness followed by medium 7(4.27%) and low 2 (1.22%) perceived with regard to the different attributes i.e., inexpensiveness, availability of inputs, high relative advantage, compatibility, low complexity, trialability, observability, predictability and profitability.

There was positive and significant correlation between Education, Research Extension contact, Mass media consumption, Creativity, Risk bearing ability, Scientism vs fatalism and Research orientation where as Age has negatively significant relationship with the generation of innovations and re-inventions.

Profile characteristics land holding, farming experience, annual income and achievement motivation were non significant with generation of innovations and re-inventions. It was observed from the study that eight variables i.e., Education, Land holding, Research Extension contact, Achievement motivation, Creativity, Scientism vs fatalism and Research orientation explained 24.46 per cent variation in generation of innovations/re-inventions by the farmers of which three variables Education, Research extension contact and Creativity were Significant at 1 per cent level of probability.

Comprehensive strategy suggested include Identification of farmer innovators, Recognition of farmer innovators, Documentation of farmer innovations and reinventions, Testing of farmer innovations and re-inventions for scientific rationality and validity, Commercialisation of the innovations and re-inventions, Networking of farmer innovators, Providing farmer innovation support fund, Monitoring and evaluation of the farmer innovator network groups, Farmer innovator to farmer innovator cross visits and Popularisation of Farmer Innovations and Re-inventions.
AGRICULTURAL EXTENSION

Author : RAJASHEKAR, B.

Title of the thesis : A STUDY ON THE ADOPTION OF INTEGRATED WEED MANAGEMENT PRACTICES IN MAJOR CROPS IN MAHABOOBNAGAR DISTRICT OF TELANGANA STATE

Major Advisor : Dr. V. SUDHARANI

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9790

ABSTRACT

The present study Ex-post facto research design was adopted for carrying out the study. The state of Telanganawas selected purposively. Mahaboobnagar district was selected randomly. Four mandals, three villages from each mandal and ten respondents from each village were selected randomly, thus a total of 120 respondents constituted the sample for the study. Interview schedule was used for data collection and was analysed using appropriate statistical techniques. Salient findings of the study are, most of the respondents were middle aged (46.70%), had primary level education (35.05%), had semi medium farm size (44.20%), low farming experience (50.80%), medium extension contact (50.00%), low mass media exposure (54.20%), low information seeking behaviour (50.80%), medium farm mechanization status (70.00%), medium risk orientation (65.00%), medium innovativeness (55.00%), medium input availability (55.00%), medium labour availability (55.00%) and low training (43.33%).

Majority of the respondents had medium knowledge on rice (44.45%), cotton (53.65%), groundnut (50.00%), chilli (47.50%) and had medium overall knowledge (65.00%).

Majority of the respondents had medium extent of adoption of rice (55.55%), cotton (48.74%), groundnut (50.00%), chilli (55.00%) and had medium extent of adoption (50.85%) under overall adoption.

Relationship of profile characteristics of the respondents with their knowledge and extent of adoption of IWM practices:

The independent variables like education, training, extension contact, mass media exposure, information seeking behaviour, farm mechanization status and innovativeness was positively and significantly related with level of knowledge and age, farm size, farming experience, risk orientation, input availability and labour availability was showing positive and non significant association level of knowledge. The independent variables like education, farm

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size, farming experience, training, extension contact, mass media exposure, information seeking behaviour, farm mechanization status, risk orientation and innovativeness was positively and significantly related with extent of adoption while age, input availability and labour was showing positive and non significant with extent of adoption.

The major problems elicited by the respondents were non availability of labour, High cost of labour ‘Lack of credit facilities for purchase of weeding implements, high cost of herbicides, non availability of weeding machinery and lack of technical information and skill about IWM practices.

The major suggestions offered by the respondents were ‘Banks should provide credit facilities on different weeders, Provision of subsidy to power weeder, ‘Providing farm literature regarding herbicides application and recommended dosages,’Providing weeding implements and machinery in time, ‘Enhancing awareness on different IWM practices by providing literature on weed management, Herbicides must be made available in time and cheaply.

Keeping in view the findings of the study a strategy for effective adoption, dissemination and diffusion of IWM practices in suggested. There is lot of scope to improve the knowledge and adoption levels through capacity building activities enabling farmers to access agriculture information, contact extension officers and participate in extension activities conducted by Department of Agriculture, KVKs, DAATTCs, Input dealers, NGOs and others. For effective transfer and dissemination of IWM practices, the extension agencies/ institutes must conduct field/ result, method demonstrations, field visits, training programmes focusing IWM practices and awareness campaigns about IWM practices. At the some times SAUs and ICAR institutes must orient their research to develop low cost, less drudgery involving weeders and hand implements and assess the farmers innovations for further scaling up. In this regard in a public private partnership mode SAUs and input agencies have initiate efforts on commercialisation of low cost SAU/ ICAR technologies and farmers innovations for mass production and use by the farming community.
AGRONOMY

Author : BALAJI NAIK, B.
Title of the thesis : GROWTH AND YIELD OF RICE VARIETIES AS INFLUENCED BY DIFFERENT DATES OF SOWING UNDER AEROBIC METHOD OF CULTIVATION
Major Advisor : Dr. D. RAJI REDDY
Degree : Ph.D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9783

ABSTRACT

Experiment was conducted during Kharif 2012 and 2013 at Agricultural Research Station, Madhira, Khammam to find out optimum time of sowing and suitable varieties under aerobic condition and effect of weather parameters on growth and yield of aerobic rice and suitability of CERES-Rice model under aerobic conditions.

The soil of the experimental site was clay in texture, saline in reaction, low in available nitrogen, phosphorus and high in available potassium. The experiment was carried out with five dates of sowing 18 Jun (D\textsubscript{1}), 7 Jul (D\textsubscript{2}), 20 Jul (D\textsubscript{3}), 4 Aug (D\textsubscript{4}) and 18 Aug (D\textsubscript{5}) as main plots and four varieties (V\textsubscript{1}: JGL 17004, V\textsubscript{2}: MTU 1010, V\textsubscript{3}: JGL 11470 and V\textsubscript{4}: MTU 1061) as sub-plots in split plot design replicated thrice.

Higher plant height, panicle weight, total and filled spikelets panicle\textsuperscript{-1} were observed in crop sown on 18 Jun (D\textsubscript{1}) and significantly superior to rest of the sowing dates in 2012 and 2013. The number of tillers m\textsuperscript{-2}, dry matter m\textsuperscript{-2}, yield attributes viz., effective tiller m\textsuperscript{-2}, panicle length and grain yield in 18 Jun (D\textsubscript{1}) and 7 Jul (D\textsubscript{2}) sown crop were comparable and significantly higher over succeeding dates of sowing. However, the 1000 grain weight and straw yield did not differ significantly among the dates of sowing. The harvest index was increased with every successive 15 days delay in sowing from 7 Jul (D\textsubscript{2}) to 18 Aug (D\textsubscript{5}). Early sown crop took more number of days to attain the panicle initiation, days to 50% flowering and physiological maturity.

Among the varieties, the long duration cultivar MTU 1061 (V\textsubscript{4}) was recorded significantly highest plant height, panicle length and weight, grain and straw yield over rest of the varieties in 2012 and 2013. However, the medium duration variety JGL 11470 (V\textsubscript{3}) produced significantly more number of effective tillers m\textsuperscript{-2}, total and filled spikelets panicle\textsuperscript{-1} over other varieties. The extra short duration variety JGL 17004 (V\textsubscript{1}) was the least producer in all the growth parameters, grain and straw yield during both the years of study. The short duration variety MTU 1010 (V\textsubscript{2}) was moderate in all the growth and yield parameters. The long duration variety MTU 1061 (V\textsubscript{4}) attained the panicle initiation by 68 and 70 days, 50% flowering in 102 and 104 days.
and physiological maturity in 137 and 140 days during 2012 and 2013, respectively. Among the varieties the highest harvest index was recorded with extra short duration variety JGL 17004 (V₁).

The highest gross, net returns and B:C ratio was recorded in 18 Jun sowing, which was however, comparable with 7 Jul and significantly superior over rest of the date of sowing. Among the varieties the long duration variety MTU 1061 (V₄) recorded highest and net returns and B:C ratio and which was comparable with the medium duration variety JGL 11470 (V₃) and significantly superior to rest of the varieties during both the years of study.

The highest crop ET was recorded at 18 Jun (D₁) sowing in 2012 and 2013. Among the varieties, the long duration variety MTU 1061 (V₄) was stood 1st in position in terms of amount of water consumed through ET followed by the medium duration variety JGL 11470 (V₁). The water productivity of all the varieties was higher at 18 Jun sowing (D₁) and decreased with subsequent delayed sowing in both the year. Among the varieties, the short duration cultivar MTU 1010 (V₂) was recorded highest water productivity in both the years.

The data on different agrometeorological indices revealed that, more Growing Degree Days and Phothermal units (PTU) were accumulated in 2012 than in 2013 by all the varieties sown across all the dates. Among the varieties, the long duration variety MTU 1061 (V₄) accumulated more growing degree days (AGDD) and photothermal units (APTU) followed by medium (V₃), short (V₂) and extra short (V₁) duration varieties.

The correlation studies reveals that, the tiller and dry matter accumulation in most of the varieties were positively and significantly correlated with the minimum and mean temperatures recorded from sowing to heading stage of the crop. The solar radiation (RAD), accumulated growing degree days (AGDD) and photothermal units (APTU) were also positively and significantly correlated with tiller production, dry matter accumulation, yield and yield attributes of all the varieties.

Stepwise regression analysis predicted 65%, 92%, 79% and 89% variation in dry matter production by rainy days during P₆, mean morning and afternoon relative humidity during P₄, rainy days during P₇, minimum temperature and rainfall RF during P₇ and 87%, 79%, 76% and 86% variation in grain yield by mean morning relative humidity and rainy days during (P₃), solar radiation and photothermal units during (P₃), the mean morning relative humidity (RH₁) and photothermal units during (P₃) and mean maximum temperature and solar radiation during (P₃) in JGL 17004 (V₁), MTU 1010 (V₂), JGL 11470 (V₃) and MTU 1061 (V₄), respectively.

Simulation of days to 50% flowering and physiological maturity, grain yield proved to be excellent with NRMSE value less than 10%. Validation of CERES-Rice model confirmed that the model can be used as a research tool in the variable agro-environments of both Telangana and Andhra Pradesh to suggest suitable sowing window and varieties under aerobic method of cultivation. Optimum sowing window for aerobic rice considered from 10 Jun to 29 Jul. The optimum sowing window for medium and long duration varieties was from 10 Jun to 1 Jul. The extra short and short duration varieties have a wider sowing window during kharif season.
AGRONOMY

Author: ABDELMUNIEM YOUSIF ELAMIN ELHOSAIN
Title of the thesis: INTEGRATED NUTRIENT MANAGEMENT IN Kharif SORGHU (Sorghum bicolor L. Moench) -rabi CHICKPEA (Cicer arietinum L.) CROPPING SYSTEM
Major Advisor: Dr. K. MADHAVI
Degree: Ph. D.
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9770

ABSTRACT

The present investigation carried out under field condition during 2012 and 2013 with Kharif sorghum and rabi chickpea at ARI Main Farm, Rajendranagar, Hyderabad. Experimental site was clay loam in texture, slightly alkaline in reaction, low in organic carbon as well as low available nitrogen, medium in the available phosphorus and high in available potassium. There are 9 treatments which included application of three different manures as a main treatments viz., Farm Yard Manure (FYM) Vermicompost, (VC) and Neem Seed Cake (NSC) and their combinations with 0 %, 50 % and 100 % RDF as sub plot treatments. Manures were applied as the recommended doses @ 5 t ha⁻¹ for FYM and 2.5 t ha⁻¹ for VC and NSC. The objectives of the study to evaluate the effect of integrated nutrient management (INM) on growth and yield of Kharif Sorghum-rabi chickpea cropping system, to study the nutrient uptake and post harvest nutrient status of soil with INM practices in sorghum-chickpea cropping system and to work out the economics of INM practices in sorghum-chickpea cropping system.

The data recorded for two years indicated that plant height was significantly increased as influenced by VC, NSC, FYM, 0 %, 50 %, 100 % RDF and interactions. The highest LAI was recorded at boot stage (60 DAS) in both years 2012 and 2013 for organic manures and inorganic nutrients. VC resulted in significantly higher LAI over FYM and NSC and 100 % RDF over 0 % and 50 % RDF at 60 and 90 DAS, while it was not significant at 30 DAS and at harvest.

Application of VC, NSC, 50 % and 100 % RDF produced significantly higher dry matter than FYM and 0 % RDF at 60 and 90 DAS in both years. Among the organics the least days to 50 % flowering reported with VC which is significantly less compared to NSC and FYM, application of 50 % and 100 % RDF also showed significantly less days to 50 % flowering days which is significantly less than 0 % RDF.

Ear head length, ear head grain weight (g) and number of grain head⁻¹ were significantly influenced by VC, NSC and chemical nutrients at 50 % and 100 % RDF. The highest head length and number of grain head⁻¹ recorded with VC +100 % RDF. Shelling % differed significantly by
VC, NSC and FYM, and VC reported significantly the highest shelling % followed by NSC. Significant increase were noted with NSC compared to FYM. Application of 50 % and 100 % RDF achieved significantly higher shelling % than 0 % RDF and 100 % RDF was significantly higher than 50 % RDF.

The 1000-seed weight of *kharif* sorghum was significantly influenced by application of VC which reported the highest 1000-seed weight compared to NC and FYM. Application of 50 % and 100 % RDF reported a significant increase in 1000-seed weight compared to 0 % RDF and 100 % RDF registered the highest 1000-seed weight which was significantly higher over 50 % RDF.

The data in the main plot showed that the VC application significantly overtook NSC and FYM in grain yield during both years. The results of sub plot showed that 100 % RDF and 50 % RDF along with VC recorded highest grain yield in both years (3526, 3759 and 3355, 3600 kg ha\(^{-1}\)) and (3645, 3808 and 3578, 3665 kg ha\(^{-1}\)) respectively and the grain yield was found to be higher in *kharif* 2013 than in 2012.

Grains yield significantly influenced by interactions during the two years of experiment and application of VC, NSC or FYM when supplemented with either 50 % or 100 % RDF result in significant increase in grain yield over 0 % while 50 % RDF came on par to 100 % RDF.

Application of VC, NSC and inorganic nutrient at 50 % and 100 % RDF among fertilizer levels recorded significant increase in the harvest index compared to FYM and 0 % RDF during both years respectively, and NSC found significantly higher than FYM.

Application of VC showed significantly higher stover yield followed by NSC compared to FYM, inorganic nutrients at 50 % and 100 % RDF showed significant increase in stover yield compared to 0 % RDF. Moreover, 100 % RDF was found significantly higher over 50 % RDF.

Nitrogen and phosphorus uptake (kg ha\(^{-1}\)) by sorghum increased significantly as influenced by VC, NSC, 50 % and 100 % RDF at 60 and 90 DAS but at 30 DAS and at harvest uptake by grain in the main plot is not significant while, significant in sub plot treatments for both season.

Potassium uptake (kg ha\(^{-1}\)) by sorghum at 60 and 90 DAS was differed significantly with VC and NSC compared to FYM but at harvest was not significant in the main plot. Uptake was significantly higher with application of 50 % and 100 % RDF compared to 0 % RDF at 30, 60 and 90 DAS and at harvest by stover and grain for both years.

Soil pH was slightly changed from the initial value to be slightly alkalized after the second season by application of NSC. However, application of FYM, VC and NSC or RDF at 50 % and 100 % made slight change in soil pH. NSC and NSC+100 % RDF caused highest soil pH after first and second season compared with the other organic sources. During two years VC, NSC, FYM, 0 %, 50 % and 100 % RDF showed non-insignificant improvement in OC and EC for the two seasons. FYM registered the highest EC compared with VC and NSC while, 100 % RDF was slightly higher compared to 0 % and 50 % RDF.

Available NPK after *kharif* sorghum and *rabi* chickpea cropping system was consistent. The status of NPK after harvest of chickpea was higher following the preceding seasons with INM treatments than of not INM treatments. The available NPK increased with the increasing rate of NPK to *kharif* sorghum supplemented with VC, NSC and FYM.
Morphological characters viz., plant height, LAI and dry matter accumulation were significantly influenced by residual effect of different treatments viz., FYM, VC, NSC and 0 %, 50 % and 100 % RDF in rabi chickpea. Days 50 % flowering, Number of pod plant\(^{-1}\) and seed yield m\(^{-2}\) showed significant increases by residual effect of VC, NSC and FYM and 0 %, 50 % and 100 % RDF for the two years of experiment, while seed protein content showed non-significant result. Among the main treatments, VC recorded the least days to 50 % flowering, higher number of pods plant\(^{-1}\) and higher seed yield (g m\(^{-2}\)) followed by NSC and 100 % RDF reported the highest results which is significantly higher over 0 % RDF.

The 1000-seed weight, seed yield kg ha\(^{-1}\) haulm yield kg ha\(^{-1}\) and harvest index showed significant increases by residual effect of VC, NSC and FYM and 0 %, 50 % and 100 % RDF treatments for the two years of experiment and among the organic nutrients VC recorded higher 1000-seed weight, seed yield, haulm yield and harvest index followed by NSC and 100 % RDF which reported significantly the highest.

Nitrogen uptake increased significantly as influenced by residual effects of VC, NSC, FYM, 0 %, 50 % and 100 % RDF at 60 and 90 DAS and at harvest (uptake by haulm and seed) but not significant at 30 DAS during the both seasons. Similar trend was noticed with respect to phosphorus and potassium uptake.

Among the different integrated nutrient management treatments the highest net returns (92270 and 101161) and B: C ratio (2.68 and 2.39) were registered by VC+100 % RDF followed by FYM+100 % RDF (64257, 98126, 1.40 and 1.94 respectively) during both season.
AGRONOMY

Author : KADASIDDAPPA MALAMASURI
Title of the thesis : DRIP IRRIGATED MAIZE AND SUNFLOWER: GROWTH, YIELD, EVAPOTRANSPIRATION AND WATER PRODUCTION FUNCTIONS
Major Advisor : Dr. V. PRAVEEN RAO
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9782

ABSTRACT

The field experiment was conducted at the Research and Development (R&D) farm of Water and Land Management Training and Research Institute (WALAMTARI), Himayatsagar, Hyderabad, Telangana, India during rabi season of 2012-13 and 2013-14.

Two crops viz., maize and sunflower were tested separately with six irrigation treatments involving five irrigation levels through drip (40%, 60%, 80%, 100% and 120% pan evaporation replenishment) in comparison with one surface furrow irrigation at 1.0 IW/CPE ratio laid out in Randomized Block Design (RBD) with four replications. Surface drip irrigation system used in the study consisted of 16 mm integral dripper line laid out on the ground surface along the crop rows at 1.20 m and 0.90 m apart for maize and sunflower, respectively with emitters spaced at 0.40 m on laterals having discharge capacity of 4 LPH. The application rate was adjusted as per the treatments.

Growth parameters viz., plant height, number of functional leaves plant\(^{-1}\), leaf area index, dry matter production; Crop Growth Rate (CGR), Leaf Area Duration (LAD), Biomass Duration (BMD), Relative Growth Rate (RGR) and Net Assimilation Rate (NAR) were measured/determined at periodical intervals (At 15 DAS and then onwards at every 30 days intervals) for maize and sunflower crops. Likewise, yield attributes viz., number of cobs plant\(^{-1}\), cob length, number of grain rows cob\(^{-1}\), number of grains cob\(^{-1}\) for maize and capitulum diameter, total number of seeds capitulum\(^{-1}\), percentage of filled and unfilled seeds capitulum\(^{-1}\) for sunflower and test weight, grain/seed yield, total dry matter yield and harvest index were measured at harvest for both the crops. Nutrient (NPK) uptake was estimated at different crop growth stages, and at harvest and expressed as total NPK uptake. Water use studies include daily pan evaporation data, irrigation water applied and periodical monitoring of soil moisture. From the water use data seasonal crop evapotranspiration, water productivity, crop coefficient, water production functions, optimization of water and economic ramification were generated. Weather elements viz., temperature, relative humidity, rainfall and rainy days, sunshine hours and wind velocity were also
measured during the crop growing seasons. The data generated on various aspects in this study on effect of irrigation levels on maize and sunflower were analyzed through standard statistical methods and logical conclusions were drawn.

Drip irrigation scheduled at 100% pan evaporation replenishment (Epan) recorded significantly higher growth parameters, yield attributes, grain/seed and total dry matter yield over drip irrigation scheduled at 40%, 60% Epan and surface furrow irrigation at 1.0 IW/CPE ratio. However, the drip irrigation scheduled at 100% Epan was at par with the 80% and 120% Epan in respect to all the parameters signifying the importance of frequent application of optimum or suboptimum amount of water in root zone of crop to maintain good soil moisture favourable to plant growth. Regression relationships between soil moisture versus growth and yield parameters were highly significant and associated to one another indicating the importance of adequate soil moisture throughout the crop growth periods in both the crops.

Grain yield was found to be significantly and positively correlated to growth viz., plant height ($R^2 = 0.977**$), number of functional leaves plant$^{-1}$ ($R^2 = 0.933**$), leaf area index ($R^2 = 0.903**$) and dry matter production ($R^2 = 0.965**$); and yield components viz., cob length ($R^2 = 0.878*$), number of grain rows cob$^{-1}$ ($R^2 = 0.931**$), number of grains cob$^{-1}$ ($R^2 = 0.977**$), test weight ($R^2 = 0.984*$) for maize. Sunflower seed yield was also found to be significantly and positively correlated to growth viz., number of functional leaves plant$^{-1}$ ($R^2 = 0.946**$), leaf area index ($R^2 = 0.994**$) and dry matter production ($R^2 = 0.993**$); and yield components viz., capitulum diameter ($R^2 = 0.924*$), total number of seeds capitulum$^{-1}$ ($R^2 = 0.999**$), % of filled seeds capitulum$^{-1}$ ($R^2 = 0.936**$), test weight ($R^2 = 0.971**$) and harvest index ($R^2 = 0.967**$). Similarly, correlation studies between growth and yield traits and yield were also showed significant and positive association between themselves in both the crops.

Significantly highest oil content (43.0% and 42.1% during 2012-13 and 2013-14, respectively) and oil yields (1195.0 kg ha$^{-1}$ and 1124.8 kg ha$^{-1}$ during 2012-13 and 2013-14, respectively) in sunflower were obtained when irrigation was scheduled at 100% Epan through drip system. Similarly, significantly highest nutrients (NPK) uptake was recorded with drip irrigation scheduled at 100% Epan compared with the rest of the treatments in both the years in both the crops.

Water deficits (Crop ET deficit) at different crop growth period of maize and sunflower (40% Epan and 60% Epan) caused significant reduction in grain/seed yield. The yield reduction in stress treatments varied from 171.66% to 38.90% in maize and 137.24% to 40.36% in sunflower relative to 80% Epan treatment on pooled basis. The reduction in yield observed was due to contemporaneous reduction in growth and yield traits in these treatments. Similarly, the extent of reduction in yield due to surface irrigation was to the tune of 40.86% and 36.84% lower than 100% Epan and 80% Epan, respectively in maize and 82.80% and 77.97% lower than 100% Epan and 80% Epan, respectively in sunflower.

The highest seasonal crop ET (421.7 mm and 343.0 mm in maize and sunflower, respectively) and crop ET rates (3.61 and 2.94 mm day$^{-1}$ in maize and sunflower, respectively) were recorded in surface furrow irrigation treatment than rest of the drip irrigation treatments. Among the drip irrigation, 120% Epan treatment wherein the seasonal crop ET was 382.3 mm and crop ET rate of 3.27 mm day$^{-1}$ in maize and 312.7 mm and 2.68 mm day$^{-1}$ in sunflower were the highest compared to remaining drip treatments. Water productivity in both maize and
sunflower was significantly higher in deficit irrigation treatment viz., drip irrigation at 80% pan evaporation replacement compared to rest of the treatments owing to on par yield relative to 100% Epan treatment.

The crop ET was significantly (P = 0.01) and positively correlated to LAI and LAD in both the crops. The regression of crop evapotranspiration on reference crop evapotranspiration showed significant and positive correlation with coefficient of determination ($R^2$) of 0.895**, 0.685* and 0.826* for maize and 0.961**, 0.854* and 0.928** for sunflower during 2012-13, 2013-14 and on pooled basis, respectively.

Crop coefficient (ETc/ETo) was highest with surface furrow irrigation at all the crop growth stages in both the crops. Optimum crop coefficient was registered with drip irrigation at 80% Epan. Further this (80% Epan) was the treatment wherein optimum yield production was observed and Kc values recorded at this treatment were close to FAO Kc values.

Maize crop net irrigation requirement ranged between 21.42 to 98.42 mm at different crop growth stages with seasonal requirement of 311.81 mm and the peak gross irrigation requirement at source point amounted to 1093.50 m$^3$. In case of sunflower, the net irrigation requirement ranged between 20.5 mm to 102.3 mm at different crop growth stages with seasonal requirement of 248.4 mm and the peak gross irrigation requirement at source point amounted to 1136.8 m$^3$.

Among all the production functions, the seasonal water production function expressed by quadratic or second order polynomial for both grain/seed yield and dry matter yield in both maize and sunflower crops were found to be statistically good enough with regard to fitting of the measured data and F-value for testing $R^2$ were highly significant at $P = 0.01$.

The predicted maximum grain yield of maize was 8565 kg ha$^{-1}$ during 2012-13 with crop ET of 388.1 mm and 8092 kg ha$^{-1}$ during 2013-14 with crop ET of 317.1 mm beyond which the yield decrease. The quantity of irrigation water that is economically optimum level (Economic optima) which will maximize the net return under prevailing market prices (~13.0 kg$^{-1}$) worked out to be 352.4 ha-mm with the resultant grain yield of 8303 kg ha$^{-1}$. In case of sunflower, the predicted maximum seed yield was 2821 and 2843 with crop ET of 305.9 mm and 270.3 mm during 2012-13, 2013-14, respectively and the economic optima with net return under prevailing market prices (~35.0 kg$^{-1}$) worked out to be 288.3 ha-mm with the resultant seed yield of 2845 kg ha$^{-1}$.

At lower levels of crop ET, maximum profit of sunflower can be achieved when compared to maize. However, in terms of tonnage, maize out yielded sunflower at all seasonal water supply levels through drip. But the cost of the produce play very important role for the final profit, which in turn depends on selection of the crop, available resources and prevailing weather conditions during crop growth period.
ABSTRACT

The present study was conducted during rabi, 2014-15 at the College Farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana. Treatments consisted of three varieties (30V92, Seed Tech-740 and VL-42) along with four planting geometries (45 cm x 15 cm, 45 cm x 20 cm, 60 cm x 10 cm and 60 cm x 15 cm). The experiment was laid out in a randomized block design with factorial concept in three replications.

Plant height, number of leaves per plant, Leaf Area Index, total dry matter production were significantly higher in 30V92 compared to Seed Tech-740 and VL-42. Days to tasselling and 50% silking between 30V92 and Seed Tech-740 were comparable and it was significantly lower for VL-42. Growth analysis parameters viz., Crop Growth Rate, Leaf Area Duration and Biomass Duration were significantly higher in 30V92. Net Assimilation Rate at harvest was higher in VL-42. Number of cobs per plant, cob and corn length, cob and corn diameter and harvest duration were significantly higher in VL-42 than 30V92 and Seed Tech-740. Cob and corn weights were significantly higher in 30V92 than Seed Tech-740 and VL-42. Cob and corn yields were significantly higher in VL-42 followed by 30V92 but significantly lower in Seed Tech-740. Cob:corn ratio was higher in Seed Tech-740. Green fodder yield was significantly higher in 30V92 than Seed Tech-740 and VL-42. Cost of cultivation, gross and net returns and benefit-cost ratio were higher in VL-42.

Plant height, Leaf Area index and total dry matter production were significantly higher with the planting geometry of 60 cm x 10 cm having 1,66,666 plants ha-1 whereas number of leaves per plant was significantly higher with the planting geometry of 45 cm x 20 cm which was on par with 60 cm x 15 cm having the same population of 1,11,111 plants ha-1. Crop Growth Rate, Net Assimilation Rate and Biomass Duration were significantly higher with the planting geometry of 45 cm x 20 cm whereas Leaf Area Duration was higher with the planting geometry of 60 cm x 10 cm. Yield attributes viz., cob and corn length, cob and corn diameter, cob and corn weights were significantly superior with the planting geometry of 45 cm x 20 cm which were on
par 60 cm x 15 cm. Cob and corn yields were significantly higher with 45 cm x 15 cm, whereas green fodder yield was higher with 60 cm x 10 cm. Significantly higher nutrient uptake in plants was recorded with 60 cm x 10 cm whereas nutrient uptake by cobs was significantly higher with 45 cm x 15 cm. Cost of cultivation was significantly higher with 60 cm x 10 cm whereas gross and net returns and benefit cost ratio were higher with the planting geometry of 45 cm x 15 cm.

Significantly higher plant height, Leaf Area Index and dry matter production was recorded in 30V92 with the planting geometry of 60 cm x 10 cm. Yield attributes *viz.*, cob and corn length and cob and corn diameter were significantly higher in VL-42 with the planting geometry of 45 cm x 20 cm which were on par with 60 cm x 15 cm of the same variety. Cob and corn weights were significantly higher in 30V92 with the planting geometry of 45 cm x 20 cm. Cob and corn yields were higher in VL-42 with 45 cm x 15 cm. Nitrogen, phosphorus and potassium uptake in plants was significantly higher in 30V92 whereas VL-42 with the planting geometry of 45 cm x 15 cm recorded higher uptake of nutrients in cobs. Cost of cultivation was significantly higher in VL-42 with the planting geometry of 60 cm x 10 cm whereas gross and net returns and benefit cost ratio were higher in VL-42 with 45 cm x 15 cm.

This study has shown that VL-42 with a planting geometry of 45 cm x 15 cm with a population of 1,48,148 plants ha-1 can be profitably grown on sandy loam soils of Southern Zone of Telangana state during *rabi* season.
AGRONOMY

Author : LAXMAN, T.
Title of the thesis : BIOFERTILIZERS CONSORTIA AND FOLIAR NUTRITION ON GROWTH AND YIELD OF RAINFED Bt COTTON (Gossypium hirsutum L.)
Major Advisor : Dr. A. SRINIVAS
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9786

ABSTRACT

The field experiment was carried out on sandy clay loam soil at College Farm, Rajendranagar during rainy season (kharif) 2014. The experimental site was low in the available N, medium in P and high in K. The experiment was laid out in a randomized block design (RBD) with 10 treatments replicated thrice T1- Control (RDF-150:60:60 N, P2O5 and K2O kg ha-1), T2- Consortia of microbes (PSB+KSB+VAM+Azotobactor) to soil @ 1 L ha-1, T3- Foliar application of urea @ 2 per cent, T4- Foliar application of KNO3 @ 2 per cent, T5- Consortia of microbes + foliar application of urea @ 2 per cent, T6- Consortia of microbes + foliar application of KNO3 @ 2 per cent, T7- Foliar application of 18:18:18 @ 1.5 per cent, T8- Foliar application of 17:44:0 @ 2 per cent, T9- Consortia of microbes + foliar application of 18:18:18 @ 1.5 per cent and T10- Consortia of microbes + foliar application of 17:44:0 @ 2 per cent. Consortia (PSB and Azotobactor liquids @ 250 ml; KSB and VAM powders @ 250 g) were mixed well and the mixture was spread uniformly on well decomposed FYM (100 kg ha-1) one day before application. FYM was incubated overnight by maintaining optimum moisture and applied to the soil at the time of sowing along with the seed. Foliar sprays were applied at 60, 90 and 120 DAS. Recommended dose of fertilizers and other package of practices were uniformly adopted in all the treatments for growing healthy crop.

The growth parameters viz., plant height, LAI, SAPD, dry matter (kg ha-1), monopodial and sympodial branches-1 were recorded significantly higher with consortia of microbes applied to soil combined with foliar application of 18:18:18 @ 1.5 per cent followed by consortia of microbes combined with foliar application of KNO3 @ 2 per cent at 60, 90 and 120 DAS at all the growth stages. Significantly lower plant height, LAI, dry matter (kg ha-1) monopodial and sympodial branches-1 were recorded in control (RDF).
Significantly higher yield attributes per plant viz., number of squares, bolls (25.1), boll weight (6.62 g), seed cotton (98.2 g), number of seeds (32) and seed index (11.17) were recorded with the foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS when combined with soil application of consortia of microbes followed by foliar application of KNO₃ @ 2 per cent. Control recorded the significantly lower yield attributes.

Significantly higher seed cotton (1670 kg ha⁻¹), stalk (2409 kg ha⁻¹) and biological (4079 kg ha⁻¹) yields were recorded with foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS when combined with soil application of consortia of microbes. Lower seed cotton, stalk and biological yield (1004, 1331 and 2335 kg ha⁻¹, respectively) were recorded with control (RDF).

Quality parameter viz., ginning percentage (39.1 %), lint index (7.19 g), uniformity ratio (47.07) and fibre strength (24.26) recorded were significantly higher with consortia of microbes applied to soil combined with foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS. Control recorded significantly lower quality parameter (27.4%, 3.71, 42.59 and 21.43, respectively). Whereas, 2.5 % staple length and micronaire were not significantly influenced by either biofertilizer consortia, foliar nutrition of different macro nutrients and combined application of both when applied over and above the RDF.

Plant uptake of N, P and K (kg ha⁻¹) under consortia of microbes applied to soil combined with foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS was significantly higher than all other treatments. Lower nutrient uptake was noticed with control (RDF) at different growth stages of crop growth. Soil available N P and K (kg ha⁻¹) and micro nutrients (Fe, Zn, Mg and B) after harvest were not significantly influenced by either biofertilizer consortia, foliar nutrition of different macro nutrients and combined application of both when applied over and above the RDF.

Significantly higher enzymatic activity at flowering viz., dehydrogenase (11.3 µg TPF g⁻¹ day⁻¹), acid phosphatase (142.2 µg TPF g⁻¹ day⁻¹) and alkaline phosphatase (101.3 µg PNP g⁻¹ h⁻¹) and Urease (95.3 µg NH₄⁺ g⁻¹ 2 h⁻¹) were recorded at flowering stage with foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS when combined with soil application of consortia of microbes. Control recorded significantly lower enzymatic activity at flowering. Soil enzymatic activity decreased with the age of the crop after flowering and lower activity was recorded at harvest in all the treatments.

Significantly higher population of *Azotobacter* (4.26 log₁₀ CFU g⁻¹ soil), *P.suedomonas* (5.05 log₁₀ CFU g⁻¹ soil) and fungi (11.18 log₁₀ CFU g⁻¹ soil) was recorded at flowering (60 DAS) with consortia + foliar application of 18:18:18 @ 1.5 per cent and was on par with all other consortia treatments than control. Significantly lower population of *Azotobacter* (3.20 log₁₀ CFU g⁻¹ soil), *P.suedomonas* (4.03 log₁₀ CFU g⁻¹ soil) and fungi (7.8 log₁₀ CFU g⁻¹ soil).

The consortia of microbes + foliar application of 18:18:18 @ 1.5 per cent fetched more gross, net monetary returns and B:C ratio (Rs. 70961, Rs: 38540 ha⁻¹ and 2.19, respectively) compared to control (Rs: 42684, Rs: 12853 ha⁻¹ and 1.43, respectively) because of higher seed cotton yield hectare⁻¹ obtained.
Based on the results obtained in the present investigation, it can be concluded that soil application of biofertilizer consortia at sowing and foliar application of 18:18:18 @ 1.5 per cent at 60, 90 and 120 DAS was found remunerative for growing the Bt cotton under rain fed.

AGRONOMY

Author : MALVE SACHIN HIMMATRAO
Title of the thesis : PERFORMANCE OF WHEAT UNDER DRIP IRRIGATION AND N-FERTIGATION SCHEDULING
Major Advisor : Dr. V. PRAVEEN RAO
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9769

ABSTRACT

A field experiment was conducted on a sandy clay loam soil at Jain Hi-Tech Agri. Institute, Jain Irrigation Systems Ltd., Jalgaon district of Maharashtra during the rabi season of 2012 – 2013 and 2013 – 2014 to study the “Performance of wheat under drip irrigation and N-fertigation scheduling”. The treatments consisted of five irrigation levels involving both drip (DI - 0.6, 0.8, 1.0 and 1.2 pan evaporation replenishment) and surface control (SI- surface check basin irrigation at 1 IW:CPE ratio) as main treatments and four nitrogen fertigation levels (N0, N80, N120 and N160) as sub treatments summing up to 20 treatment combinations laid out in Split plot design with four replications. Surface drip irrigation system was used in the study and consisted of 16 mm integral dripper line laid out on the ground surface along the crop rows at 0.90 m apart with emitters spaced at 0.30 m apart delivering 4 L h⁻¹. The application rate was 14.8 mm h⁻¹. The irrigation volume as per treatment was adjusted by varying the irrigation duration.

Growth parameters viz., plant height, number of tillers m⁻², leaf area index, dry matter production, LAD, CGR, BMD and RGR were measured/determined at periodical intervals. Likewise yield attributes viz., ears m⁻², ear length, fertile spikelet ear⁻¹, grains ear⁻¹, test weight (1000-grain weight), grain yield, straw yield and harvest index were measured at harvest. Nutrient (NPK) uptake was estimated at harvest both in grain and straw and expressed as total NPK uptake. Water use studies included measurement of daily pan evaporation data from the USWB Class A pan evaporimeter situated at the Class B meteorological observatory at the research station, irrigation water applied and periodical monitoring of soil moisture content up to 0-60 cm depth. From the water use data seasonal crop evapotranspiration, water productivity, crop coefficient, water production functions, optimization of water and economic indices were generated. Weather elements viz., temperature, sunshine hours, wind velocity and day length were also measured during the crop growing
seasons. Nitrogen use studies include fertilizer use efficiencies *viz.*, AEN, REN, PEN and PFP with each level of nitrogen, nitrogen production function, optimization of nitrogen and economic optima were generated. The data generated on various aspects in this study on response of wheat to irrigation and nitrogen levels were analyzed through standard statistical methods and logical conclusions were drawn.

Drip irrigation at 1.0 Epan recorded significantly higher growth parameters, yield attributes, grain and straw yield over 0.6, 0.8 Epan and surface check basin irrigation at 1 IW:CPE ratio signifying the importance of frequent application of optimum amount of water in root zone of crop to maintain good soil moisture favourable to plant growth.

Application of 120 kg N ha⁻¹ (N₁₂₀) registered higher growth parameters, yield attributes and seed yield over its lower levels. However, application of 160 kg N ha⁻¹ (N₁₆₀) did not prove to be advantageous over N₁₂₀. On the other hand harvest index showed a negative relation with increased levels of N application.

Grain yield was found to be significantly and positively correlated to growth *viz.*, plant height ($R^2 = 0.935^{**}$), tiller m⁻² ($R^2 = 0.821^{**}$), leaf area index ($R^2 = 0.898^{**}$) and dry matter production ($R^2 = 0.938^{**}$); yield components *viz.*, ears m⁻² ($R^2 = 0.809^{**}$), ear length ($R^2 = 0.956^{**}$), fertile spikelet ear⁻¹ ($R^2 = 0.939^{**}$), test weight ($R^2 = 0.967^{**}$) and nutrient uptake *viz.*, N uptake ($R^2 = 0.971^{**}$), P₂O₅ uptake ($R^2 = 0.940^{**}$) and K₂O uptake ($R^2 = 0.974^{**}$). Similarly correlation studies between growth, yield traits and yield showed positive association among themselves.

NPK uptake was more with drip irrigation at 1.2 Epan but it was statistically on par with 1.0 Epan and significantly superior over 0.6 and 0.8 Epan. Each higher level of nitrogen significantly increased NPK uptake over its lower level up to 120 kg N ha⁻¹ (N₁₂₀). Application of 160 kg N ha⁻¹ (N₁₆₀) did not prove to be advantageous over N₁₂₀ in improving the nutrient uptake.

Fertilizer use efficiencies *viz.*, AEN, REN PEN and PFP markedly decreased with each higher level of nitrogen. The mean values of AEN, REN, PEN and PFP were 14.05 and 12.42 kg grain kg⁻¹ N, 0.73 and 0.64 kg N kg⁻¹ N, 19.25 and 19.24 kg grain kg⁻¹ N absorbed, 41.02 and 38.47 kg grain kg⁻¹ N applied, respectively.

Under different irrigation and nitrogen levels tested the seasonal ETc varied between 322.0 to 511.0 mm, 266.9 to 396.0 mm and 381.4 to 390.4 mm, 312.2 to 325.4 mm respectively.

Crop coefficient (Kc) in relation to reference crop evapotranspiration (ET₀) and pan evaporation (Epan) was highest with surface check basin irrigation at all growth stages. The Kc values calculated on reference crop evapotranspiration (ET₀) and on pan evaporation basis at drip irrigation at 1.0 Epan found to be good for local condition of Jalgaon.

Application of water through drip irrigation at 0.8 Epan registered significantly highest water productivity (1.14 kg m⁻³) in 2012-13. However in 2013-14, it was more with 1.0 pan evaporation replenishment (Epan) (1.36 kg m⁻³). Pertaining to nitrogen levels, highest water productivity was registered with N @ 160 kg ha⁻¹ (N₁₆₀) (1.24 and 1.37 kg m⁻³) which was superior over N₀, N₈₀ and N₁₂₀.
The seasonal net irrigation requirement was 366.6 mm, while the gross irrigation requirement (V) at field inlet and at water source amounted to 3858.7 m$^3$ and 4073.1 m$^3$ respectively. The peak gross irrigation requirement at water source amounted to 1258.6 m$^3$.

The seasonal water production function as expressed by linear, quadratic, third degree polynomial or cubic, power, Stewart $S_1$, Stewart $S_2$ (FAO) and Singh et al. performed well for the grain yield and dry matter yield of wheat were found acceptable with regard to fitting the measured data. The variance ratio (F value) for testing $R^2$ (0.999) were highly significant (P=0.01) at quadratic and cubic form for grain yield and dry matter in both the years and on pooled basis. The predicted maximum grain yield was 4780 kg ha$^{-1}$ in the 2012-13 with crop ET of 427 mm, 4647 kg ha$^{-1}$ in the 2013-14 with crop ET of 338 mm and 4693 Kg ha$^{-1}$ on pooled basis with crop ET of 383 mm, respectively beyond which the yield decreased. The economic optima of level of irrigation that will maximize the net return under prevailing prices considered above worked out to be 382.8 ha-mm with the resultant grain yield of 4693 kg ha$^{-1}$.

Fertilizer production functions i.e., response of grain yield to applied N was adequately explained by quadratic regression function in both years as indicated by the coefficient of determination ($R^2$) which varied between 99.8 to 99.9%. The predicted maximum grain yield was 4838 kg ha$^{-1}$ in the 2012-13 with an input level of 171.1 kg N ha$^{-1}$, 4451 kg ha$^{-1}$ in the 2013-14 with an input level of 154.7 kg N ha$^{-1}$ and 4642 kg ha$^{-1}$ on pooled basis with an input level of 162.6 kg N ha$^{-1}$, respectively, beyond which the yield decreased. However, the maximum grain yield ($Y_{max}$) in 2012-13 and on pooled basis was not bracketed within the tested range of nitrogen levels (0 to 160 kg ha$^{-1}$). The economic optima of N level that will maximize the net return under prevailing prices considered above worked out to be 156.8 kg N ha$^{-1}$ with the resultant grain yield of 4640 kg ha$^{-1}$.
AGRONOMY

Author : MAMATHA, K.
Title of the thesis : SESAME RESPONSE TO SULPHUR AND BORON WITH OR WITHOUT USE OF FARMYARD MANURE.
Major Advisor : Dr. G. E. CH. VIDYA SAGAR
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9780

ABSTRACT

Experiment was conducted during kharif, 2014 at College farm, Rajendranagar, Hyderabad. The soil of the experimental site was sandy loam in texture, neutral in reaction, low in available nitrogen, medium in available phosphorus, high in available potassium, low in available boron and sulphur. The experiment was laid out in split plot design with two main treatments viz., M₁: RDF, M₂: RDF along with application of farmyard manure and three sub treatments viz., S₁: 10 kg S ha⁻¹, S₂: 20 kg S ha⁻¹ and S₃: 30 kg S ha⁻¹ and replicated four times.

With respect to application of RDF along with 25 % N through farmyard manure, more plant height, dry matter production per plant, number of branches per plant, leaf area index (LAI), Crop growth rate (CGR), Relative growth rate (RGR), yield attributes, grain yield (631 kg ha⁻¹) and stover yield (1289 kg ha⁻¹) were recorded and it was significantly higher than application of RDF alone.

Significantly higher oil yield and nutrient uptake was observed with application of RDF along with 25 % N through farmyard manure than RDF alone. Highest net returns of ₹ 34470 and B: C ratio of 3.15 was obtained with application of RDF along with application of farmyard manure.

With respect to sulphur levels the more plant height, dry matter production per plant, number of branches per plant, leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR), yield attributes, grain yield (626 kg ha⁻¹) and stover yield (1283 kg ha⁻¹) were recorded highest with S₃ (application of 30 kg S ha⁻¹) and it was significantly superior over S₂ (application of 20 kg S ha⁻¹). And lowest values recorded with S₁ treatment i.e., application of 10 kg S ha⁻¹.

Significantly higher oil yield, protein content and nutrient uptake was observed with S₃ (application of 30 kg S ha⁻¹) than rest of the treatments and also highest net returns of ₹ 35020 and B: C ratio of 3.32.
Interaction effect of plant height, dry matter production per plant, number of branches, leaf area index, crop growth rate (CGR), relative growth rate (RGR), yield attributes, seed yield, stover yield, quality parameters and net returns of sesame crop influenced by main and sub treatments were significantly found to be non significant.

The second experiment was also conducted with two main treatments (M₁-RDF and M₂-RDF along with 25 % N through FYM) and three sub treatments (S₁-2.5 kg B ha⁻¹, S₂-5.0 kg B ha⁻¹ and S₃-7.5 kg B ha⁻¹) replicated four times. The main treatment with application of RDF along with 25 % N through farmyard manure, more plant height, dry matter production per plant, number of branches per plant, leaf area index (LAI), Crop growth rate (CGR), Relative growth rate (RGR), yield attributes, grain yield (540 kg ha⁻¹) and stover yield (1087 kg ha⁻¹) were recorded and it was significantly higher than application of RDF alone.

Significantly higher oil yield (276 kg ha⁻¹) and nutrient uptake was observed with application of RDF along with 25 % N through farmyard manure than RDF alone. Highest net returns of ₹ 27190 and B: C ratios of 2.69 were obtained with application of RDF along with application of farmyard manure.

With respect to sub treatments plant height, dry matter production per plant, number of branches per plant, leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR), yield attributes, grain yield (521 kg ha⁻¹) and stover yield (1283 kg ha⁻¹) were recorded highest with S₃ (application of 7.5 kg B ha⁻¹) and it was on par with S₂ (application of 5.0 kg B ha⁻¹). And lowest values recorded with in S₁ treatment i.e., application of 2.5 kg B ha⁻¹.

Significantly higher oil yield, protein content and nutrient uptake was observed with S₃ (application of 7.5 kg B ha⁻¹) and it was on par with S₂ (5.0 kg B ha⁻¹). The highest net returns of ₹ 23625 and B: C ratio of 2.35 was obtained with S₂.

Interaction effect of plant height, dry matter production per plant, number of branches, leaf area index, crop growth rate (CGR), relative growth rate (RGR), yield attributes, seed yield, stover yield, quality parameters and net returns of sesame crop influenced by main and sub treatments were found non significant.
AGRONOMY

Author : MUKHESH GIRI RAJA, G.

Title of the thesis : PERFORMANCE OF SUNFLOWER (*Helianthus annuus* L.) UNDER VARIABLE DATES OF SOWINGS AND IRRIGATION

Major Advisor : Dr. G. MANOJ KUMAR

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9787

ABSTRACT

A field experiment was carried at Water Technology Centre, College farm, College of Agriculture, Rajendranagar, Hyderabad, during rabi, 2013-14. The soil of the experimental site was sandy clay loam in texture, medium alkaline in reaction, non saline and low in available nitrogen and high in available phosphorous and potassium. The experiment was laid out in a split plot design with three main treatments viz., 9th October (D1), 6th November (D2) and 21st November (D3) and three sub treatments viz., I1-40 % Available soil moisture (ASM), I2-60% ASM and I3-80% ASM and treatments were replicated in thrice.

Results obtained indicated that plant height, dry matter, leaf area, leaf area index (LAI), days to 50% flowering, maturity and stalk yield of rabisunflower was not influenced significantly by the dates of sowing. Seed yield, yield attributes and harvest index recorded were significantly higher under 21st November. However, Oil content was significantly higher at 6th November sowing.

Crop water requirement of rabisunflower was higher at the late sown crop i.e., 21st November (290.6 mm) than the early sown crop of 9th October (217.6 mm). Water productivity (kg ha-1 mm-1) recorded was significantly higher (6.72) at 6th November sowing and significantly lower (5.65) with 9th October than other dates of sowing. The gross, net returns and B:C ratio of irrigated rabi sunflower were significantly higher (Rs.60968 and 33111 ha-1) under 21st November over other dates of sowing.

Among irrigation schedules in rabi sunflower, significantly higher plant height, leaf area index (LAI) at 60DAS and dry matter (kg ha-1) were 80% ASM than 40% ASM and was on par with 60% ASM at all growth stages. Seed yield (1744 kg ha-1) and stalk yield (3452 kg ha-1) were significantly higher with 80% ASM whereas significantly lower yields recorded at 40% ASM.
Different irrigation regimes did not significantly influence 50% flowering and maturity irrespective of dates of sowing. Whereas yield attributes viz., number of seeds head-1(683), head diameter (11.8 cm), head weight and 100 seed weight (4.80 g) were recorded with 80% ASM and were significantly higher than 40% ASM than other moisture treatments. Significantly higher oil content was recorded at 40% ASM. Dry matter, leaf area index and yield attributes showed a significantly positive correlation with yield of rabi sunflower at different dates of sowings.

Water applied was 227.9 mm at 40% ASM, 248.3 mm at 60% ASM and 270.1 mm at 80% ASM. Irrigation scheduled at 80% ASM has recorded significantly higher water productivity (6.48) than irrigation scheduled at 40% ASM (6.05) and was on par with 60% ASM, irrigation at 40% has recorded significantly lower water productivity. Higher number of irrigations were required at 80% ASM over 40% ASM where as quantity of water applied at each irrigation was more at 40% ASM (61 mm) when compared to 60% (40 mm) and 80% ASM (22 mm).

Gross returns and net returns were significantly higher at 80% ASM and was on par with 60% ASM and significantly lower at 40% ASM. The B:C ratio was found to be significantly higher at 80% ASM over all other treatments.

Interaction effect between dates of sowing and irrigation schedules on plant height, leaf area index, dry matter, yield attributes, seed yield and oil content were found to be non-significant.

Soil moisture depletion at 0-15 cm layer was higher than that in 30-45 cm soil layer at 80% ASM irrigation scheduling, but the relative depletion in 30-45 cm layer was more in 40% ASM due to penetration of roots in search of soil moisture, soil moisture depletion in different layers at 60% ASM was intermediate when compared with 80% ASM.

It can be concluded that significantly higher seed yield, returns, and benefit cost ratio were recorded with crop sown on 21st November and irrigation scheduled at 80% ASM and water productivity were higher with irrigation scheduled at 60% ASM. However oil content was recorded at 40% ASM.

The results obtained were used to evaluate the AquaCrop model and it was found that, AquaCrop has simulated the canopy cover, biomass and seed yield under three different dates of sowing and irrigation schedules accurately (R2=0.98).
AGRONOMY

Author : NAVATHA, N.

Title of the thesis : RESPONSE OF QUALITY PROTEIN MAIZE (QPM) TO SULPHUR FERTILIZATION

Major Advisor : Dr. K. P. VANI

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9776

ABSTRACT

A field experiment was carried out during Kharif season, 2014 at College Farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, to evaluate the effect of sulphur levels and method of application on growth, yield and quality of quality protein maize. The soil of the experimental site was sandy loam in texture, neutral in reaction, low in organic carbon, available nitrogen and sulphur, medium in available phosphorous and high in available potassium. The experiment was carried out with four sulphur levels \( S_1 \): 10 kg ha\(^{-1} \), \( S_2 \): 20 kg ha\(^{-1} \), \( S_3 \): 30 kg ha\(^{-1} \) and \( S_4 \): 40 kg ha\(^{-1} \) as first factor and method of sulphur application \( M_1 \): 100% basal as single dose; \( M_2 \): Two split applications:- 50% each at basal and knee heigh stage) as second factor comprising eight treatment combinations, laid out in randomized block design with factorial concept, replicated thrice.

The highest plant height, leaf area index (LAI), dry matter production, yield attributes like cob length, cob girth, number of grains row\(^{-1} \), number of grains cob\(^{-1} \), grain weight cob\(^{-1} \), test weight, grain and stover yield were recorded with 40 kg S ha\(^{-1} \) (\( S_4 \)) and was significantly higher than 30 kg S ha\(^{-1} \) (\( S_3 \)), followed by 20 kg S ha\(^{-1} \) (\( S_2 \)) and 10 kg S ha\(^{-1} \) (\( S_1 \)). The number of days taken to attain 50% flowering (50% tasseling & 50% silking) increased with increasing sulphur levels.

Significantly higher nutrient uptake (N, P, K and S) and crude protein content in grain was observed with 40 kg S ha\(^{-1} \) (\( S_4 \)) and lower with 10 kg S ha\(^{-1} \) (\( S_1 \)) and also highest net returns (₹ 40327 ha\(^{-1} \)) and B: C ratio (2.50) were obtained with 40 kg S ha\(^{-1} \) (\( S_4 \)).

With respect to method of sulphur application, the taller plants, higher leaf area index (LAI), dry matter production, yield attributes, grain and stover yield were recorded with split application (\( M_2 \)) of sulphur, which was significantly higher than basal application (\( M_1 \)). The number of days taken to attain 50% flowering was not influenced by method of sulphur application. Significantly higher nutrient uptake (N, P, K and S) and crude protein content in grain,
highest net returns (₹ 36670 ha\(^{-1}\)) and B: C ratio (2.39) was observed with split application (M\(_2\)) than conventional method of sulphur application (M\(_1\)).

Interaction effect of sulphur levels and method of application of QPM was non-significant on growth, yield and yield attributes, protein content, nutrient uptake and economics.

From this investigation it can be concluded that, out of four levels of sulphur and two methods of sulphur application tested, application of 40 kg S ha\(^{-1}\) (S\(_4\)) and split application of sulphur (M\(_2\)) was ideal for realizing growth parameters, yield attributes, grain yield, stover yield, protein content, nutrient uptake and economic returns.
AGRONOMY

Author : PRADEEP RAM
Title of the thesis: IMPACT OF SUSTAINABLE WEED MANAGEMENT PRACTICES ON GROWTH AND YIELD OF MAIZE (Zea mays L.)
Major Advisor : Dr. G. SREENIVAS
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9779

ABSTRACT

A field experiment was conducted during rabi, 2014-15 at college farm, Collage of Agriculture, Rajendranagar, Hyderabad, comprised of eight weed management practices (farmers practice (HW at 20 &40 DAS), atrazine @ 1 kg a.i ha⁻¹ as pre.em. fb 2, 4- D sodium salt @ 1.0 kg a.i ha⁻¹ at 30 DAS, live mulch (vegetable cowpea), brown manuring (desiccation of cowpea live mulch at 50% flowering with 2, 4-D sodium salt @ 1 kg a.i ha⁻¹), black polythene mulch (25 µm thickness UV resistant), white polythene mulch (25 µm thickness UV resistant), high density planting (planting on either side of the ridge) + halosulfuron methyl @ 67.5 g ha⁻¹ at 20 DAS and weedy check) in randomized block design, replicated thrice.

Based on importance value index values, among the broad leaf weeds Parthenium hysterophorus, in grasses Cynodon dactylon and in sedges Cyperus rotundus were found to be more ecologically dominant. Higher weed control efficiency was noticed with farmers practice (78%) and was followed by black polythene mulch (70.77%) and white polythene mulch (66.46%) at physiological maturity. The lowest weed index values were associated with black polythene mulch (0.00%), white polythene mulch (1.28%), farmers practice (7.64%) and pre emergence application of atrazine @ 1 kg a.i ha⁻¹ fb 2, 4- D sodium salt @ 1.0 kg a.i ha⁻¹ at 30 DAS (9.69%).

Application of black polythene mulch recorded the highest grain yield (7657 kg ha⁻¹) and was on a par with white polythene mulch, farmers practice and and pre emergence application of atrazine @ 1 kg a.i ha⁻¹ fb 2, 4- D sodium salt @ 1.0 kg a.i ha⁻¹ at 30 DAS due to significant reduction in weed population and increase in growth and yield attributes of maize. Stover yield also showed the similar trend as grain yield but slight increase in stover yield was observed with white polythene mulch (8684 kg ha⁻¹) compared to black polythene mulch. However,
significantly higher net returns of Rs. 68,774, 67,160, 60,984 and 60,873 ha\(^{-1}\) were obtained with pre-emergence application of atrazine \@ 1 kg a.i ha\(^{-1}\) fb 2, 4- D sodium salt \@ 1.0 kg a.i ha\(^{-1}\) at 30 DAS, farmers practice i.e. HW at 20&40DAS, white polythene mulch and black polythene mulch, respectively. While, highest B: C ratio (3.13) was recorded with pre emergence application of atrazine \@ 1 kg a.i ha\(^{-1}\) fb 2, 4- D sodium salt \@ 1.0 kg a.i ha\(^{-1}\) at 30 DAS. The reduced B:C ratio of black and white polythene mulch (2.21) was due to the increased cost of cultivation (Rs. 50306 ha\(^{-1}\)).

Significantly higher nitrogen uptake (kg ha\(^{-1}\)) was observed in maize plant with black polythene mulch, white polythene mulch and farmers practices. While, significantly higher phosphorus and potassium uptake (kg ha\(^{-1}\)) in maize plant was noticed with black polythene mulch, white polythene mulches. However, significant reduction in nutrient (N, P and K) uptake (kg ha\(^{-1}\)) of weeds was observed with farmers practice.

Significant negative correlation of weed density (-0.93**, -0.77*) and weed drymatter (-0.85**, -0.86**) was noticed with grain yield at 30DAS and 60 DAS. While, significant positive correlation observed between crop drymatter and grain yield at 30 DAS (0.94**), 60 DAS(0.97**), 90 DAS(0.90**) and at physiological maturity (0.88**), LAI at 30 DAS(0.79*), yield attributes viz., cob length (0.93**), cob girth (0.82*), no. of rows cob\(^{-1}\) (0.86**), no. of grains row\(^{-1}\) (0.93**), no. of grains cob\(^{-1}\) (0.94**) and 100 grain weight (0.94**) with grain yield.
AGRONOMY

Author : PRASANNA, B.
Title of the thesis : BIOEFFICACY OF HERBICIDES AND INTEGRATED WEED MANAGEMENT PRACTICES IN KHARIF GROUNDNUT
Major Advisor : Dr. M.GOVERDHN
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9773

ABSTRACT

A Field experiment was carried out during kharif, 2014 at College Farm, Professor Jayashankar Telangana State Agricultural University, Rajendranagar to evaluate the bioefficacy of herbicides and integrated weed management practices in kharif groundnut.

Different herbicidal combinations and IWM practices tested were, pendimethalin @ 1 kg a.i ha\(^{-1}\) (pre) \(fb\) cycloxydim @ 80 g a.i. ha\(^{-1}\) at 20 DAS, pendimethalin @ 1 kg a.i. ha\(^{-1}\) (pre) \(fb\) fenoxaprop-p-ethyl @ 100 g a.i. ha\(^{-1}\) at 20 DAS, Oxyflourfen 118 g a.i. ha\(^{-1}\) (pre) \(fb\) cycloxydim @ 80 g a.i. ha\(^{-1}\) at 20DAS, Oxyflourfen 118 g a.i. ha\(^{-1}\) (pre) \(fb\) fenoxaprop-p-ethyl @ 100 g a.i. ha\(^{-1}\) at 20 DAS, Imazethapyr @ 100 g a.i. ha\(^{-1}\) at 20 DAS, Imazethapyr + imazamox @ 70 g a.i. ha\(^{-1}\) at 20 DAS, Pendimethalin @ 1 kg a.i. ha\(^{-1}\) (pre) \(fb\) hand weeding at 30 DAS, Oxyflourfen 118 g a.i. ha\(^{-1}\) (pre) \(fb\) hand weeding at 30 DAS, Hand weeding at 20 and 40 DAS, Unweeded Check. The experiment was conducted on a sany loam soil in RBD with three replications. The recommended fertilizer dose was 20-40-30 kg of N, P\(_2\)O\(_5\) and K\(_2\)O ha\(^{-1}\) respectively.

In the experimental field, five species of grasses, one species of sedge and eight species of broad leaved weeds were identified and they belonged to 8 families. Among the grasses, Cynodon dactylon, Digitaria sanguinalis, Rotabolia exaltata, Echinochloa colonum and Dactyloctenium aegyptium were predominant. Cyperus rotundus was the only one predominant sedge observed during the crop period. Among the broad leaved weeds, Parthenium hysterophorus, Commelina bengalensis, Amaranthus viridis, Amaranthus polygamus, Trianthema portulacastrum, Digeria arvensis, Euphorbia sp. and Celosia argentia were the major weeds in the experimental field.

At 20 DAS, the weed density (number/sq.m) was lowest. Treatments having pre-emergence applications of pendimethalin or oxyflourfen effectively controlled broad leaved weeds and certain grasses due to prevention of weed emergence during germination itself and recorded high weed control efficiency.
At 40 DAS, significantly lower weed density was recorded in the treatments oxyflourfen (pre) fb hand weeding at 30 DAS and pendimethalin (pre) fb Hand weeding at 30 DAS. Supplementing with hand weeding at 30 DAS has shown effective control of all the weeds including sedges and higher WCE of 79-85%. Application of imazethapyr + imazamox, hand weeding at 20 and 40 DAS and imazethapyr were next best treatments and were significantly superior in recording less weeds. Significantly higher total weed density (80/sq.m) was recorded in weedy check.

At 60 DAS and at harvest, total weed density was significantly lower in the treatments where second hand weeding at 40 DAS was adopted as in case of hand weeding at 20 and 40 DAS. Next best treatment was oxyflourfen fb hand weeding at 30 DAS and was found par with pendimethalin fb hand weeding at 30 DAS and imazethapyr + imazamox treatments with more weed control efficiency. Weedy check recorded significantly higher density of weeds at both the stages.

Growth parameters like plant height LAI and dry matter production were higher with hand weeding twice (20 and 40 DAS) and were comparable with oxyflourfen fb hand weeding at 30 DAS, pendimethalin fb hand weeding at 30 DAS and imazethapyr + imazamox at 20 DAS which were on par with each other. Where as control (no weeding), pendimethalin fb cycloxydim and pendimethalin fb fenoxaprop –p- ethyl had lower values for all the above characters.

Herbicidal treatments significantly influenced the weed control efficiency, weed dry matter, pod yield and haulm yield at harvest also. Yield components like the total number of pods per plant, filled pods per plant, 100 pod weight, test weight and shelling percentage were more with hand weeding twice (20 and 40 DAS) followed by oxyflourfen @ 1 kg a.i ha⁻¹ fb hand weeding (30 DAS), pendimethaline fb hand weeding (30 DAS) and imazethapyr + imazamox.

Lowest weed dry matter (10.05) as well as higher WCE (88%), pod yield (1840 kg ha⁻¹) and haulm yield (2192 kg ha⁻¹) was recorded with hand weeding twice at 20 and 40 DAS. Which was at par with Oxyflourfen (pre) followed by hand weeding at 30 DAS and Pendimethlin (pre) fb Hand weeding at 30 DAS with high WCE and grain yield indicating that weeds are controlled efficiently with sequential application of herbicides and resulted in higher grain yield over the control.

The gross returns were the highest with hand weeding twice treatment and were comparable with the treatments oxyflourfen as pre-emergence fb hand weeding, pendimethalin as pre-emergence fb hand weeding. The net returns and B:C ratio were highest with oxyflourfen fb hand weeding ( ₹ 60834 ha⁻¹ and 3.55), which was comparable with imazethapyr + imazamox ( ₹ 57222 ha⁻¹ and 3.32), hand weeding twice at 20 and 40 DAS ( ₹ 55573 ha⁻¹ and 3.26) and pendimethaline fb hand weeding ( ₹ 45732 ha⁻¹ and 2.67).
AGRONOMY

Author: PRASHANTHI, CH.
Title of the thesis: “EFFECT OF WEED MANAGEMENT PRACTICES IN AEROBIC RICE UNDER DIFFERENT SEEDING METHODS”.
Major Advisor: Dr. P. LAXMINARAYANA
Degree: M.Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9772

ABSTRACT

A field experiment was conducted at College Farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad, during kharif, 2014. The soil of the experimental field was sandy loam in texture with pH of 7.6. The experiment was laid out in factorial randomized block design with two factors. Factor I: seeding methods, broadcasting (S1) and line sowing (S2) Factor II: weed management practices, T1-Pretilachlor 50% EC as PE fb Metsulfuron methyl + Chlorimuron ethyl 20% WP as PoE + Cyhalofop butyl 10% EC as PoE at 15-20 DAS, T2-Pretilachlor 50% EC as PE fb Azimsulfuron 50% WP + Cyhalofop butyl 10% EC as PoE 15-20 DAS, T3-Pretilachlor 50% EC @ 0.75 kg ai ha\(^{-1}\) as PE fb Pyrazosulfuron ethyl 10% WP + Cyhalofop butyl 10% EC as PoE at 15-20 DAS, T4-Bispyribac sodium 10% EC @ 25 g ai ha\(^{-1}\) as early PoE fb 2-4-D 80% WP @ 0.5 kg.ai ha\(^{-1}\) at 40 DAS, T5-T1 followed by HW at 50 DAS, T6-T2 followed by HW at 50 DAS, T7-T3 followed by HW at 50 DAS, T8-T4 followed by HW at 50 DAS, T9-HW at 20, 40 and 60 DAS, T10-unweeded control.


At 20 DAS, Pretilachlor 50% EC as PE fb Azimsulfuron 50% WP + Cyhalofop butyl 10% EC as PoE 15-20 DAS fb HW at 50 DAS recorded lowest weed density, weed dry matter and highest weed control efficiency compared to the other treatments in broadcasting than line sowing. At 60 DAS and at harvest, hand weeding at 20,40 and 60 DAS recorded lowest weed density, weed dry matter and highest weed control efficiency.
and was found to be effective in limiting the weed growth under line sowing. This treatment also recorded highest nutrient uptake by crop at harvest and lowest uptake by weeds.

Regarding the effect of weed control treatments on growth parameters and yield attributes it was found that plant height, number of tillers, dry matter production, panicle length, panicle weight, number of grains panicle\(^{-1}\), test weight were significantly higher in line sowing with hand weeding at 20, 40 and 60 DAS followed by Pretilachlor 50% EC as PE fb Azimsulfuron 50% WP + Cyhalofop butyl 10% EC as PoE 15-20 DAS fb hand weeding.

Hand weeding at 20, 40 and 60 DAS recorded higher grain yield (3526 kg ha\(^{-1}\)) which was followed by Pretilachlor 50% EC as PE fb Azimsulfuron 50% WP + Cyhalofop butyl 10% EC as PoE 15-20 DAS fb hand weeding (3218 kg ha\(^{-1}\)) and Pretilachlor 50% EC as PE fb Metsulfuron methyl + Chlorimuron ethyl 20% WP as PoE + Cyhalofop butyl 10% EC as PoE at 15-20 DAS fb hand weeding (3150 kg ha\(^{-1}\)). Straw yield and harvest index was also higher in hand weeding at 20, 40 and 60 DAS with line sowing.

In terms of economics, the highest gross returns (Rs 52239 ha\(^{-1}\)) were obtained with hand weeding at 20,40 and 60 DAS or Pretilachlor 50% EC as PE fb Azimsulfuron 50% WP + Cyhalofop butyl 10% EC as PoE 15-20 DAS fb hand weeding (Rs 47770 ha\(^{-1}\)) in line sowing. Highest net returns were obtained with Pretilachlor 50% EC as PE fb Metsulfuron methyl + Chlorimuron ethyl 20% WP as PoE + Cyhalofop butyl 10% EC as PoE at 15-20 DAS fb hand weeding (Rs 15826 ha\(^{-1}\)), hand weeding at 20,40 and 60 DAS (Rs 15664 ha\(^{-1}\)). However the highest benefit: cost ratio of 1.56 was realized due to application of Pretilachlor 50% EC @ 0.75 kg ai ha\(^{-1}\) as PE fb Pyrazosulfuron ethyl 10% WP + Cyhalofop butyl 10% EC as PoE at 15-20 DAS and Bispyribac sodium 10% EC @ 25 g ai ha\(^{-1}\) as early PoE fb 2-4-D 80% WP @ 0.5 kg,ai ha\(^{-1}\) at 40 DAS.
AGRONOMY

Author : RAMAKRISHNA, K.
Title of the thesis : GROWTH, YIELD AND QUALITY OF ORGANICALLY GROWN GROUNDNUT AS INFLUENCED BY ORGANIC MANURES
Major Advisor : Dr. K. B. SUNEETHA DEVI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9775

ABSTRACT

A field experiment was conducted during kharif, 2014 on sandy loam soil at Student farm, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Hyderabad to evaluate the performance of different organic manures (vermicompost, FYM, vermi compost prepared from mushroom spent substrate and vermicompost enriched with rock phosphate 3%) at two levels (100% and 75% RDN ha⁻¹) of nutrition on organically grown export quality groundnut variety Bheema (TG-47). The crop was sown on 12-07-2014 with a seed rate of 150 kg ha⁻¹ and at a spacing of 30 × 10 cm. The crop was harvested on 12-11-2014 at 120 DAS.

The weekly mean maximum and minimum temperature during crop growth was 34.1 and 27.50°C respectively and total rainfall received during crop growth period was 379.9 mm in 28 rainy days. The experiment was laid out in randomized block design with three replications. Vermicompost enriched with rock phosphate 3 per cent showed higher nutrient composition (1.95, 2.15 and 2.66 % NPK) followed by vermicompost prepared from mushroom spent substrate (1.93, 1.44 and 2.74 %) compared to FYM.

Initial and final plant population was not influenced by different organic manures at 100% and 75% RDN and with control (only gypsum @ 500 kg ha⁻¹ at flower initiation). The plant height, number of branches, dry matter production, leaf area index, nodule number and dry weight of nodule and days to 50 % flowering of plants supplied with 100 per cent RDN through vermicompost enriched with rock phosphate was significantly higher and at par with 100 per cent RDN through vermicompost prepared from mushroom spent substrate. Among the yield attributes, number of pods plant⁻¹, number of kernels pod⁻¹, shelling percentage, 100 kernel weight, pod yield, haulm yield and harvest index was higher with the application of 100 and 75 per cent RDN through vermicompost enriched with rock phosphate and at par with 100 per cent RDN through vermicompost prepared with mushroom spent substrate. Application of 100 per cent RDN through vermicompost produced similar pod yield as that of 75 per cent RDN through
phosphorus enriched vermicompost using rock phosphate 3 per cent and 100 per cent RDN through FYM and 75 per cent through vermicompost and mushroom spent substrate based vermicompost. Absolute control produced lower yield attributes and yield.

Higher oil content and oil yield was recorded with application of 100 per cent RDN through vermicompost enriched with rock phosphate and vermicompost prepared from mushroom spent substrate. Lowest oil content (37.5 %) was obtained with absolute control and was at par with control (no NPK with gypsum application) with (39.1 per cent), application of 100 and 75 per cent RDN through FYM respectively.

Higher N, P, K, S and Ca uptake was recorded with application of 100 and 75 per cent RDN through phosphorus enriched vermicompost. Bulk density, pH and EC (ds m-1) of soil was not influenced by the organic nutrient management. Per cent of organic carbon and nutrient availability of N, P, K, S and Ca of soil was significantly higher with application of 100 and 75 per cent RDN through vermicompost enriched with rock phosphate and 100 per cent RDN through vermicompost prepared from mushroom spent substrate.

Application of 100 per cent RDN through organic manures produced higher evapotranspiration of crop compared to 75 per cent RDN. However it was at par with application of 100 per cent RDN through vermicompost prepared from mushroom spent substrate, vermicompost and FYM respectively.

Higher gross returns, Net returns ( ha-1) and Benefit-cost ratio were realized with application of 100 per cent RDN through vermicompost enriched with rock phosphate and was at par with application of 100 per cent RDN through mushroom spent substrate.
AGRONOMY

Author : REVANTH NATHAN, J.K.
Title of the thesis : NITROGEN AND SULPHUR STUDIES IN SPINELESS SAFFLOWER VARIETY UNDER IRRIGATED CONDITION
Major Advisor : Dr. A. MADHAVI LATA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9774

ABSTRACT

The experiment was conducted during Rabi, 2014 at College farm, College of Agriculture, Rajendranagar, Hyderabad to find out the optimum dose of nitrogen and sulphur in safflower and to evaluate the effect of levels of nitrogen and sulphur on growth, yield, oil content and nutrient uptake of safflower. The experiment was carried out with three nitrogen levels (N0: Control (0 kg N ha\(^{-1}\)), N1: 40 kg N ha\(^{-1}\) and N2: 60 kg N ha\(^{-1}\)) and three sulphur levels (S0: 0 kg S ha\(^{-1}\), S1: 25 kg S ha\(^{-1}\), S2: 45 kg S ha\(^{-1}\)) as second factor comprising nine treatment combinations were laid out in randomized block design with factorial concept and replicated thrice.

The soil under study was sandy loam in texture, slightly alkaline (pH= 7.3) in reaction, non saline (0.24 dS m\(^{-1}\)) in nature, low in organic carbon (0.41%), low in available nitrogen (207.63 kg N ha\(^{-1}\)), medium in available phosphorus (40.93 kg P\(_{2}O_{5}\) ha\(^{-1}\)) and high in available potassium (370.7 kg K\(_{2}O\) ha\(^{-1}\)) and low available sulphur (15.7 kg S ha\(^{-1}\)).

With respect to nitrogen levels, plant height, leaf area index (LAI), dry matter production, yield attributes, seed, stalk yield, oil yield, protein content and nutrient uptake of N, P, K and S in seed were recorded highest with N2 (60 kg N ha\(^{-1}\)) and it was significantly higher than N1 (40 kg N ha\(^{-1}\)) and N0 (0 kg N ha\(^{-1}\)). Similarly soil available nutrients viz., N, P\(_2\)O\(_5\), K\(_2\)O and S were highest with N2 (60 kg N ha\(^{-1}\)).

Among sulphur levels, plant height, leaf area index (LAI), dry matter production, yield attributes, seed, stalk yield, oil content, oil yield, protein content and nutrient uptake of N, P, K and S in stalk and seed were recorded highest with S2 (45 kg S ha\(^{-1}\)) and it was significantly higher than S1 (25 kg S ha\(^{-1}\)) and S0 (0 kg S ha\(^{-1}\)).
Soil available nutrients viz., N, P2O5, K2O and S were increased with increase in the nitrogen levels upto 60 kg N ha-1 (N2) and sulphur levels upto 45 kg S ha-1 (N2).

With respect to nitrogen levels, the highest net returns of 36,777 and B: C ratio of 2.97 was obtained with N2 (60 kg N ha-1) and significantly superior to N1 (40 kg N ha-1) and N0 (0 kg N ha-1).

With respect to sulphur levels, the highest net returns of 34,922 and B: C ratio of 2.75 was obtained with S2 (45 kg S ha-1) and significantly superior to S1 (25 kg S ha-1) and S0 (0 kg S ha-1).

With regard to interaction effect between the nitrogen and sulphur levels, the interaction did not show significant effect on plant height, leaf area index (LAI), dry matter production, yield attributes, yield, quality, nutrient uptake, soil available nutrients and economics of safflower.

It is concluded that application of nitrogen at 60 kg N ha-1 (N2) and application of sulphur at 45 kg S ha-1 (S2) found economical in obtaining higher yield with higher net return and B: C ratio.
AGRONOMY

Author : SAI KUMAR, T.
Title of the thesis : RESPONSE OF RAINFED SUNFLOWER (*Helianthus annuus* L.) TO HUMIC ACID UNDER NUTRIENT MANAGEMENT PRACTICES IN ALFISOLS
Major Advisor : Dr. K. BHANU REKHA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9771

ABSTRACT

A field experiment was conducted during kharif 2014 at College farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. The farm is geographically located at an altitude of 542.3 m above mean sea level at 17019’N latitude, 78028’E longitude and falls under the Southern Telangana Agro-climatic region. The soil of the experimental site was sandy loam with pH of 7.1, electrical conductivity 0.23 dSm-1, low in organic carbon (0.28 %), low in available nitrogen (188.1 kg ha-1), medium in available phosphorus (49.3 kg ha-1) and high in available potassium (577.7 kg ha-1). The experiment was laid out in split plot design with eighteen treatments (six main and three sub treatment and replicated thrice. The six main treatments consisted of (M1) - Absolute control, M2 - compost @ 2.5 t ha-1, M3 - compost @ 5.0 t ha-1, M4 - RDF alone (60-60-30 kg N, P2O5 and K2O) M5 - RDF + compost @ 2.5 t ha-1, and M6 - RDF + compost @ 5.0 t ha-1 and the three sub plot treatments consisted of application of varying levels of humic acid granules (basal) viz., S1 - 5.0 kg ha-1, S2 - 10.0 kg ha-1 and S3 - 15.0 kg ha-1. Sunflower hybrid (DRSH-1) was sown on 9th July 2014 and cultivated entirely under rainfed conditions. During the crop growth period (July 9th to October 9th) a total of 329.7 mm rainfall was received in 24 rainy days and it was deficit by 57.14% in comparison to the decennial average of 519.1 mm received in 30 rainy days. A total of 11 dry spells occurred during crop growth period coinciding with the vegetative (5) and reproductive phase (6).

The nutrient management practices significantly influenced the growth parameters viz., plant height at 30 and 45 DAS, leaf area index, total dry matter accumulation, stem girth (harvest) and SPAD chlorophyll meter readings at 30 DAS were significantly higher with the application of RDF + compost @ 5.0 t ha-1. Among the sub plots treatments, application of humic acid @ 15 kg ha-1 recorded significantly higher leaf area index (30 and 60 DAS) over 5 and 10 kg ha-1. However there were no significant differences in the plant height, dry matter accumulation stem girth (harvest) and SPAD chlorophyll meter readings. The interaction effect
of nutrient management practices and humic acid was found to be non-significant except on the plant height at harvest.

The yield attributes *viz.*., head diameter (14.84 cm), filled seeds head-1 (677) and thousand seed weight (50.30 g) were significantly higher with the combined application of RDF + compost @ 5 t ha-1 and it was comparable with RDF + compost @ 2.5 t ha-1. While the number of unfilled seeds head-1 was not significantly influenced by different treatments. The effect of humic acid and interaction was significant only on head diameter and it was found to be non-significant on test weight, filled and unfilled seeds head-1.

Application of RDF along with compost @ 5.0 t ha-1 registered significantly higher seed (1859 kg ha-1), stalk yield (3555 kg ha-1) and harvest index (26.30 %) over other treatments and it was on par with the application of RDF + compost @ 2.5 t ha-1 with respect to seed (1704 kg ha-1), stalk yield (3453 kg ha-1) and harvest index (25.53 %). However the effect of varying levels of humic acid and interaction was found to be non-significant on seed, stalk yield and harvest index.

Quality parameters *viz.*., oil and protein yield were significantly influenced by different nutrient management practices. Combined application of RDF + compost @ 5.0 t ha-1 recorded highest oil (741 kg ha-1) and protein yield (224 kg ha-1) over rest of the treatments and it was on par with RDF + compost @ 2.5 t ha-1 that recorded oil and protein yield of 670 and 205 kg ha-1 respectively. The effect of varying levels of humic acid and interaction was found to be non-significant on oil and protein yield.

Nutrient uptake was significantly higher with combined application of RDF along with 5.0 t ha-1 at all stages of crop growth except N and P uptake by stalk at harvest and K uptake by thalamus at harvest. Application of humic and did not significantly influence the nutrient uptake except the N uptake at 60 DAS. At all the crop growth stages the interaction effect on nutrient uptake was found to be non-significant.

Post-harvest soil chemical properties (pH, EC and OC) and available soil nutrient status pertaining to N, P and K status were not significantly altered by nutrient management practices, varying levels of humic acid and due to their interaction.

The monetary returns *viz.*., gross returns (78680 ha-1) and net returns (43930 ha-1) were highest with the combined application of RDF along with compost @ 5.0 t ha-1 and 15.0 kg ha-1 humic acid. However highest B : C ratio (2.41) was accrued from application of RDF + compost @ 2.5 t ha-1 + humic acid 15.0 kg ha-1.

Among the nutrient management practices, crop applied with RDF + compost @ 5.0 t ha-1 recorded higher growth parameters (plant height, leaf area index, dry matter accumulation, SPAD chlorophyll meter readings and stem girth), yield attributes *viz.*., head diameter, number of filled seeds head-1, seed yield plant-1, yield (seed and stalk), quality parameters (oil and protein yield).
Nutrient uptake (N, P and K) were also significantly higher with the same treatment and it is on par with the application of RDF + compost @ 2.5 t ha\(^{-1}\). The monetary returns (gross returns, net returns and B : C ratio) were higher with the application of RDF + compost @ 2.5 t ha\(^{-1}\).

From the present investigation, it can be concluded that during a drought year combined application of RDF (60-60-30 N, P\(_2\)O\(_5\) and K\(_2\)O kg ha\(^{-1}\)) + compost @ 2.5 t ha\(^{-1}\) along with the humic acid (granules) @ 15 kg ha\(^{-1}\) to sunflower crop was ideal for realizing higher seed and oil yield apart from fetching higher net returns and benefit cost ratio.
AGRONOMY

Author : SAI KIRAN, G.

Title of the thesis : IRRIGATION MANAGEMENT IN AEROBIC RICE

Major Advisor : Dr. M. SHIVA SHANKAR

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9785

ABSTRACT

The experiment was conducted at College farm, College of Agriculture, Rajendranagar, Hyderabad during rabi 2014-15 to study the ‘Irrigation management in aerobic rice’. The experiment was laid out in a randomized block design with five irrigation schedules viz., Irrigation scheduling at 1.00, 1.25, 1.50, 1.75 and 2.00 IW/CPE ratios with four replications. The experimental soil is sandy clay loam with low in available nitrogen, medium in available phosphorus and high available potassium.

The plant height of aerobic rice was obtained comparatively high with irrigation scheduled at IW/CPE ratio 2.00 to the remaining irrigation schedules. Irrigation scheduled at IW/CPE ratio 2.00 has recorded highest LAI values at all growth stages. However, at 50 DAS and 90 DAS the LAI values were statistically on par with irrigation scheduled at IW/CPE ratio 1.75. The tillers were significantly influenced by irrigation scheduling practices at all the stages of crop growth except 20 DAS. Among the irrigation schedules, significantly higher number of tillers and higher dry matter production at 50, 90, 110 DAS and harvest stages were recorded with irrigation scheduling at IW/CPE ratio 2.00 and which were statistically on par with irrigation scheduled at IW/CPE 1.50 and 1.75 ratios. The highest number of panicles m⁻² was observed with irrigation scheduling at IW/CPE ratio of 2.0 which was significantly higher than with the other irrigation scheduled. However, it was statistically on par with irrigation scheduled at IW/CPE ratio 1.50. Comparatively highest values of Number of days taken for 50 per cent flowering, panicle length, test weight and number of grains panicle⁻¹ were observed with irrigation scheduled at IW/CPE ratio 2.00. Significantly higher number of filled grains panicle⁻¹ and yield hil⁻¹ were observed with irrigation scheduled at IW/CPE ratio 2.00 and however, it was statistically on par with irrigation scheduled at IW/CPE 1.50 and 1.75 ratios. Irrigation scheduled at IW/CPE 2.00 ratio was obtained significantly highest grain yield and straw yield and were statistically on par with that of in irrigation scheduled at 1.75 and 1.50 IW/CPE ratios. Comparatively highest harvest index value and root volume was observed in case of aerobic rice scheduled at 2.00 IW/CPE ratio. Significantly highest N uptake of plant at harvesting stage was observed with irrigation scheduled at IW/CPE ratio 2.00.
In this study the total water used was in different irrigation schedules in the range of 540.20 to 990.20 mm including 40.20 mm of an effective rainfall. The highest WUE and water productivity was observed with irrigation scheduled at IW/CPE ratio 1.00 ratio and lowest for IW/CPE ratio 2.00 treatment. The crop coefficient values for total crop period in different irrigation schedules were ranged between 1.01 to 1.19. The highest crop coefficient values were observed with irrigation scheduled at IW/CPE ratio 2.00. Optimization of irrigation water for different irrigation treatments of aerobic rice was obtained at optimization equation \( y = 2.033x + 1241 \) and \( R^2 = 0.970 \).

The results of the present study clearly indicated that, perceptibly higher yields in aerobic rice could be obtained when irrigation was scheduled at 1.5 to 2.00 IW/CPE ratio and in limited water conditions when irrigation was scheduled at 1.50 IW/CPE ratio was found to be economically viable.
AGRonomy

Author : SATISH CHIDRAWAR

Title of the thesis : OPTIMIZATION OF DRIP IRRIGATION AND DEFICIT IRRIGATION FOR SORGHUM (Sorghum bicolor (L.) Moench) WATER REQUIREMENT USING FAO- AQUACROP MODEL

Major Advisor : Dr. K. AVIL KUMAR

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9766

ABSTRACT

A field experiment was conducted at Water Technology Centre, College of Agriculture, Rajendranagar, Hyderabad during rabi 2014-15 to study the effect of drip irrigation and deficit irrigation on sorghum (Sorghum bicolor (L.) Moench) growth, yield, water productivity and economics. The experiment was conducted in a randomized block design with ten treatments viz., drip irrigation at estimated 0.6 ETc throughout the life (I1), 0.8 ETc throughout the life (I2), 1.0 ETc throughout the life (I3), 1.2 ETc throughout the life (I4), 0.6 ETc up to flowering 0.8 ETc later on (I5), 0.6 ETc up to flowering 1.0 ETc later on (I6), 0.6 ETc up to flowering 1.2 ETc later on (I7), 0.8 ETc up to flowering 1.0 ETc later on (I8), 0.8 ETc up to flowering 1.2 ETc later on (I9) in addition to surface furrow irrigation at 0.8 IW/CPE ratio (I10) and replicated thrice. The experimental soil was sandy clay loam in texture, alkaline in reaction and non-saline, low in available nitrogen, high in available phosphorous and available potassium, medium in organic carbon content.

The results obtained indicated that significantly higher plant height and leaf area index were observed in drip irrigation at estimated 1.2ETc throughout the life closely followed by drip irrigation at estimated 0.8 ETc up to flowering and 1.2 ETc later on at all growth stages except at 30 DAS. Dry matter production of rabi sorghum was significantly higher at estimated 1.2 ETc drip irrigation at 60, 90 DAS and harvest and found superior to the remaining treatments though it was statically on par with deficit irrigation 0.8 or 0.6 ETc up to flowering and 1.2 ETc later on and 0.8 ETc up to flowering and 1.0 ETc later on at 90 DAS and harvest and also with irrigation at 1.0 ETc throughout the life at 90 DAS.

Sorghum grain and stover yield in rabi with drip irrigation at 1.2 ETc throughout the life was significantly higher than rest of the drip irrigation treatments except with irrigation at 1.0 ETc throughout the life, deficit irrigation 0.6 ETc up to flowering and 1.2 ETc later on, 0.8 ETc up to
lowering and 1.0 or 1.2 ETc later and 0.8 ETc throughout the life, 0.6 ETc up to flowering and 1.0 ETc later on in case of stover. Grain and stover yield obtained under surface furrow irrigation at 0.8 IW/CPE ratio was significantly lower than rest of drip irrigation treatments except irrigation at 0.8 ETc throughout the life, 0.6 ETc up to flowering and 0.8 or 1.0 ETc later on. Significantly lower grain yield was observed with deficit drip irrigation at 0.6 ETc throughout the life over rest of the treatments. Similar trend was observed with yield attributes.

Significantly higher N, P and K uptake at different growth stages was recorded by drip irrigation at estimated 1.2 ETc throughout the life and significantly lower nutrient uptake was observed with irrigation at 0.6 ETc throughout life. Surface furrow irrigation with 0.8 IW/CPE ratio, though recorded higher nutrient uptake than at 0.6 ETc throughout life, it was significantly lower than drip irrigation at estimated 1.2 ETc throughout the life and 0.8 ETc up to flowering and 1.0 or 1.2 ETc later on.

The seasonal ETc requirement of *rabi* sorghum varied from 195.7 mm to 308.6 mm among different drip irrigation treatments and highest was in 1.2 ETc throughout the crop life (14). The seasonal ETc under surface furrow irrigation at 0.8 IW/CPE ratio was the highest (331.3). The average daily ETc rate varied from 1.48 mm to 2.43 mm under different treatments. The quadratic water production function indicated that the predicted maximum yield (Ymax) of 7981.8 kg ha\(^{-1}\) was obtained at 283.8 mm of seasonal water requirement. Water productivity recorded with deficit drip irrigation at estimated 0.8 ETc up to flowering and 1.0 later on (3.07 kg m\(^{-3}\)) was significantly higher and significantly lower water productivity (1.91 kg m\(^{-3}\)) was observed with surface irrigation 0.8 IW/CPE ratio. The correlation coefficient (r=0.98) between observed and simulated yield by using AquaCrop was significant indicating that the model can be used for prediction of *rabi* sorghum yield under varying moisture levels. Growing of *rabi* sorghum was economically viable as net returns and B: C ratio (1, 29,774 and 3.85, respectively) were significantly higher with drip irrigation at estimated ETc of 1.2 throughout the life compared to surface furrow irrigation at 0.8 IW/CPE ratio (96,014 and 3.49, respectively).

It can be concluded from the results of the present study that for achieving maximum grain yield, net returns and optimum water productivity, the *rabi* sorghum crop can be drip irrigated at 1.2 ETc throughout the life and under limited water supply situations, deficit drip irrigation at estimated 0.8 ETc up to flowering and 1.0 or 1.2 ETc later on followed by 0.6 ETc up to flowering and 1.2 ETc later on can be adopted for higher water productivity. Further, it was observed that growing of *rabi* sorghum under drip irrigation was economically viable and AquaCrop model can be used for prediction of yield for optimization under varying moisture levels.
AGRONOMY

Author : SREEDHAR CHAUHAN
Title of the thesis : FERTIGATION MANAGEMENT IN TURMERIC (CURCUMA LONGA L.) BASED CROPPING SYSTEM
Major Advisor : Dr. V. PRAVEEN RAO
Degree : Ph.D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9784

ABSTRACT

A field experiment was conducted during kharif 2010-11 and 2011-12 on a red sandy loam soil at Regional Agricultural Research Station, Jagtial, Karimnagar district of Telangana.

The experiment was laid out in split plot design with three replications and the main treatments consists of five irrigation schedules based on pan evaporation replenishment factor viz., 100, 80, 60 and 40% Epan was kept constant throughout the crop life in turmeric + maize – sesame cropping system, besides a surface check basin irrigation at an 1.0 IW/CPE ratio with an irrigation water depth of 50 mm was included (I5). The sub treatments consisted of three varied levels of recommended dose of nitrogen (RDN) viz., 100, 75 and 50% RDN applied to the turmeric + maize intercropping; 50, 25 and 0% RDN applied to the sesame as a sequence crop. Drip irrigation scheduled through surface drip in the study consisted of 16 mm integral dripper lines laid out 1.2 m lateral spacing with emitters kept at 0.40 m apart delivering 2.0 lph.

During maize growing period, the precipitation received was relatively higher than the seasonal crop Etc there by the irrigation treatments were not imposed during both the years, hence response to irrigation schedules found non-significant in both the years. However, application of 100% RDN recorded significantly higher growth, yield attributing characters and grain yield with respect to N application.

In turmeric, drip irrigation scheduled at 100% Epan recorded significantly higher growth and yield attributing characters viz., mother, finger and total rhizome fresh weight compared to the lower irrigation regimes. However, these attributes recorded with 80% Epan was found to be at par with the drip irrigation scheduled at 100% Epan. Likewise, the lowest yield was recorded with drip irrigation scheduled at 40% Epan. Whereas, application of 100% RDN produced significantly higher fresh yield of mother, finger and total rhizome fresh yield. With respect to
interaction effect, drip irrigation scheduled at 100% Epan coupled with 100% RDN; drip irrigation scheduled at 100% Epan combined with 75% RDN or drip irrigation scheduled at 80% Epan along with 100% RDN recorded higher rhizome fresh weight.

The succeeding sesame crop after turmeric + maize do respond to the higher levels of water replenishment and registered highest seed yield with drip irrigation scheduled at 100% Epan over its lower levels and found incomparable with drip irrigation scheduled at 80% Epan. Similarly, increase in N dose from 0-50% RDN, enhanced the seed yield with application of 50% RDN. Regarding interaction, drip irrigation scheduled at 100% Epan coupled with 50% RDN resulted in production of higher seed yield over rest of the treatmental combinations. However, the seed oil content was not influenced by varying irrigation regimes and N levels.

Soil pH, EC and organic carbon levels during post soil analysis were not markedly influenced as compared to their initial values. Drip irrigation scheduled at 100% Epan and application of 100% RDN enhanced the higher N, P and K uptakes both in rhizome and stalk of turmeric; seed and stalk yield of sesame. However, the residual effect of nitrogen on sesame as a sequence crop to the turmeric + maize cropping system is not profoundly noticed.

Higher TEY in Turmeric + Maize and in Turmeric + Maize – Sesame was recorded with drip irrigation scheduled at 100% Epan and the lowest was recorded with drip irrigation scheduled at 40% Epan. However, the TEY noticed with drip irrigation scheduled at 80% Epan is found to be at par with 100% Epan. On the other hand, fertigation with 100% RDN to turmeric + maize and 50% RDN to the sesame was recorded higher TEY. The same treatments registered higher gross, net returns and BCR.

Though the water productivity was realised with lower water regime but the economical yield was obtained with higher water regimes observed in turmeric + maize or turmeric + maize – sesame cropping system.

Surface irrigation scheduled at 1.0 IW/CPE ratio or drip irrigation scheduled at 100% Epan registered highest ETc in turmeric + maize (748 and 727 mm), sesame (403 and 360 mm) and turmeric + maize – sesame cropping system (1152 and 1086 mm). The seasonal ETc was markedly affected by different N levels and noticed highest with the application of 100% RDN in maize + turmeric (597 mm); with 50% RDN to sesame (345 mm).

Highest Kc values at rhizome development stage of turmeric (1.14 - 2.22) and capsule development stage in sesame (0.96 - 1.35) were recorded across the irrigation schedules. Similarly, the higher Kc values were noticed with the application of 100% RDN in turmeric + maize (1.92) and 50% RDN in sesame (1.11) at rhizome development and capsule development stages of turmeric and sesame, respectively.

The response to optimum water level and maximum yield was best explained by quadratic production function. However, optimization with N levels was best fit in linear water production function only and required further studies. Similarly, the optimum level of irrigation water was inversely related to increase in the price of water (Pw), whereas it (W opt) had a direct positive relationship with the price of rhizome yield.
Though higher yields were realised with drip irrigation scheduled either at 100% Epan coupled with 75 or 100% RDN in turmeric + maize – sesame but drip irrigation scheduled at 80% Epan coupled with 100% RDN in turmeric + maize and 80% Epan with 50% RDN for succeeding sesame was recommended for realizing higher TEY, B:C ratio and WUE in turmeric + maize – sesame.
AGRONOMY

Author: SUDHAKARA, T. M.

Title of the thesis: EVALUATION OF IRRIGATION REGIMES AND NITROGEN MANAGEMENT PRACTICES ON PRODUCTION POTENTIAL OF RICE (Oryza sativa (L.)) UNDER MECHANIZED SRI AND SRI METHODS

Major Advisor: Dr. A. SRINIVAS

Degree: Ph.D.

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D 9781

ABSTRACT

A field experiment was conducted on a clay loam soil at Indian Institute of Rice Research (IIRR) formerly Directorate of Rice Research (DRR), Rajendranagar, Hyderabad, Telangana during the kharif seasons of 2013 and 2014 to study the “Evaluation of irrigation regimes and nitrogen management practices on production potential of rice (Oryza sativa (L.)) under mechanized SRI and SRI methods”. The treatments consisted of two planting methods (Mechanized system of rice intensification (MSRI) and system of rice intensification (SRI)) as main plot treatments, three irrigation regimes (saturation, 5 cm irrigation at three and five days after disappearance of ponded water) as sub plot treatments and four nitrogen management practices (RDN - 100 % through inorganic, RDN - 75 % inorganic and 25 % organic, Leaf Colour Chart (LCC) based nitrogen application and Soil Test Crop Response (STCR) based nitrogen application with target yield of 6.5 t ha\(^{-1}\)) as sub-sub plot treatments summing up to 24 treatment combinations laid out in split-split plot design with three replications.

Growth parameters \(\text{viz.}\), plant height, number of tillers m\(^{-2}\), leaf area hill\(^{-1}\), leaf area index, leaf area duration, dry matter production and partitioning, crop growth rate, relative growth rate and SPAD values were measured at periodical intervals. Root studies \(\text{viz.}\), root length, root volume and root dry weight were also measured at specified intervals. Days to panicle initiation and days to flowering was also recorded. Likewise, yield attributes \(\text{viz.}\), number of panicles m\(^{-2}\), panicle length, panicle weight, number of filled and unfilled grains panicle\(^{-1}\), sterility percentage, test weight, grain yield, straw yield and harvest index were measured/determined at harvest. Water use studies \(\text{viz.}\), applied water, effective rainfall, irrigation water productivity and water productivity were measured/determined. Nutrient (NPK) uptake was estimated at all the growth stages and expressed as total NPK uptake. Partial factor productivity of NPK was determined.
Economics (cost of cultivation, gross returns, net returns and B:C ratio) and energetics (input energy, gross output energy, net energy, energy efficiency, energy productivity and energy intensity in economic terms) were worked out. The data generated on various aspects in this study on response of rice to different planting methods, irrigation regimes and nitrogen management practices were analyzed thorough standard statistical methods and logical conclusions were drawn.

System of rice intensification recorded significantly superior in terms of growth parameters, root growth characteristics, yield attributes, grain and straw yield over mechanized system of rice intensification except number of tillers $m^{-2}$, panicles $m^{-2}$ and test weight. Days to panicle initiation and 50 % flowering were early by 5-6 days and 4 - 5 days, respectively in SRI as compared to MSRI.

Irrigation maintained at saturation level produced significantly higher growth parameters, SPAD values, yield attributes, grain and straw yield which were comparable with irrigation at 3 DADPW. Irrigation at 3 DADPW resulted in significantly superior with root growth and lesser number of days taken for panicle initiation and 50 % flowering which was on par with saturation treatment. The number of unfilled grains and sterility percentage were registered higher with irrigation at 5 DADPW.

Application of nitrogen based on LCC registered significantly higher growth parameters, root growth, yield attributes, grain and straw yield which were at par with STCR based nitrogen management practice. Panicle initiation and 50 % flowering were early in LCC based nitrogen management practices as compared to other nitrogen management practices.

Grain yield was found to be significantly ($P = 0.01$) and positively correlated with plant height ($r = 0.896 \ast\ast$), number of tillers $m^{-2}$ ($r = 0.967 \ast\ast$), leaf area index ($r = 0.924 \ast\ast$), leaf area duration ($r = 0.948 \ast\ast$), dry matter production ($r = 0.928 \ast\ast$), crop growth rate ($r = 0.840 \ast\ast$), panicle number ($r = 0.974 \ast\ast$), panicle length ($r = 0.873 \ast\ast$), panicle weight ($r = 0.891 \ast\ast$), filled grains panicle$^{-1}$ ($r = 0.934 \ast\ast$), test weight ($r = 0.810 \ast\ast$), straw yield ($r = 0.912 \ast\ast$), total water applied ($r = 0.835 \ast\ast$) and nitrogen uptake ($r = 0.860 \ast\ast$). The grain yield was found to be significantly and negative correlated with sterility percentage ($r = -0.907 \ast\ast$). Similarly regression of grain yield on plant height ($R^2 = 0.802 \ast\ast$), number of tillers $m^{-2}$ ($R^2 = 0.932 \ast\ast$), LAI ($R^2 = 0.853 \ast\ast$), LAD ($R^2 = 0.898 \ast\ast$) total dry matter production ($R^2 = 0.861 \ast\ast$), CGR ($R^2 = 0.704 \ast\ast$), number of panicles $m^{-2}$ ($R^2 = 0.948 \ast\ast$), panicle length ($R^2 = 0.761 \ast\ast$), panicle weight ($R^2 = 0.793 \ast\ast$), filled grain panicle$^{-1}$ ($R^2 = 0.889 \ast\ast$), test weight ($R^2 = 0.701 \ast\ast$), sterility percentage ($R^2 = 0.823 \ast\ast$), straw yield ($R^2 = 0.823 \ast\ast$), nitrogen uptake ($R^2 = 0.739 \ast\ast$), phosphorus uptake ($R^2 = 0.694 \ast\ast$) and potassium uptake ($R^2 = 0.745 \ast\ast$) showed a significant and positively associated between them.

Higher amount of water was applied to MSRI plot and effective rainfall recorded higher in SRI plot. Irrigation water productivity and water productivity recorded significantly higher with system of rice intensification. Among irrigation regimes, higher quantity of water was applied to saturation treatment. Higher effective rainfall was recorded with irrigation at 5 DADPW. Irrigation at 5 DADPW recorded significantly higher irrigation water productivity and did not differ significantly among irrigation regimes with respect to water productivity. Nitrogen application based on LCC recorded significantly higher irrigation water productivity and water
productivity which were comparable with nitrogen application based on STCR management practice.

Uptake of nitrogen, phosphorus and potassium was found to be non significantly different between MSRI and SRI at 30 DAT. At 60, 90 DAT and at harvest significantly higher uptake of N, P and K in both grain and straw was recorded in SRI. Saturation and irrigation at 3 DADPW treatments recorded significantly higher N, P and K uptake at 60, 90 DAT and at harvest. The grain and straw uptake of N, P and K was higher with saturation and irrigation at 3 DADPW. LCC based nitrogen management practice recorded significantly higher N and K uptake at all the crop growth stages, grain and straw also. In case of P, uptake was higher with RDN (75 % inorganic and 25 % organic) at all the crop growth stages.

Higher partial factor productivity of nitrogen, phosphorus and potassium was observed with SRI. Among irrigation regimes, saturation recorded significantly higher partial factor productivity of N, P and K which was comparable with irrigation at 3 DADPW. Irrigation at 5 DADPW registered lower N, P and K partial factor productivity. Significantly higher nitrogen partial factor productivity was with RDN (75 % inorganic and 25 % organic) and lowest N Pfp was in STCR based nitrogen application. LCC based nitrogen application recorded significantly higher P and K partial factor productivity which was at par with nitrogen application based on STCR.

MSRI and SRI performed equally better with respect to B:C ratio. Significantly higher gross and net returns were recorded with system of rice intensification over MSRI. The total labour saving was 21 - 25 % in MSRI as compared to SRI. Irrigation at 3 DADPW recorded significantly higher net returns and B:C ratio which was comparable with saturation treatment. Gross returns, net returns and B:C ratio were significantly higher with nitrogen application based on LCC and which was comparable with STCR based nitrogen application. The lowest net returns and B:C ratio was recorded with RDN (75 % inorganic and 25 % organic) management practice.

The gross energy output, net energy, energy use efficiency, energy productivity and energy intensity in economic terms recorded significantly higher with SRI. MSRI required higher input energy as compared to SRI. Energy use efficiency, energy productivity and energy intensity in economic terms recorded were significantly higher with irrigation at 3 DADPW and these were at par with saturation treatment. Nitrogen application based on LCC recorded higher gross energy output, net energy, energy use efficiency, energy productivity and energy intensity in economic terms as compared to other nitrogen management practices.
Author: SWETHA, K.
Title of the thesis: “WEED MANAGEMENT WITH NEW GENERATION HERBICIDES IN KHARIF MAIZE (Zea mays L.)”
Major Advisor: Dr. M. MADHAVI
Degree: M.Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9768

ABSTRACT

A field experiment was conducted at College Farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University (PJTSUA), Rajendranagar, Hyderabad, during kharif 2014. The soil of the experimental field was sandy loam in texture with pH of 7.6. The soil was low in available nitrogen (255.4 kg ha$^{-1}$), medium in available phosphorus (25.1 kg ha$^{-1}$) and potassium (263.2 kg ha$^{-1}$). The experiment was laid out in randomized block design with ten treatments replicated thrice. The weed management practices tested were atrazine 50 % WP @ 1.0 kg a.i ha$^{-1}$ as pre-emergence fb intercultivation at 30 DAS, topramezone 33.6 % SC @ 25.2 g a.i ha$^{-1}$ along with methylated seed oil (adjuvant) as post-emergence at 15 DAS, tembotrione 42 % SC @ 105 g a.i ha$^{-1}$ along with stefes mero (adjuvant) as post-emergence at 15 DAS, topramezone + atrazine @ 25.2 + 250 g a.i ha$^{-1}$ with methylated seed oil (adjuvant) as post-emergence at 15 DAS, tembotrione + atrazine 105+250 g a.i ha$^{-1}$ with stefes mero (adjuvant) as post-emergence at 15 DAS, tembotrione 42 % SC @105 g a.i ha$^{-1}$ at 15 DAS as post-emergence, intercropping of maize with cowpea and pendimethalin 30 % EC @ 1.0 kg a.i ha$^{-1}$ as pre-emergence, hand weeding at 20 and 40 DAS, intercultivation at 20 and 40 DAS and unweeded control.

The weed spectrum of the experimental field consisted of all three groups of weeds viz., grasses, sedges and broad leaved weeds. Cynodon dactylon L., Digitaria sanguinalis L., Dactyloctenium aegyptium L., Echinocloa spp and Rottboellia exaltata L among grasses, Parthenium hysterophorus L., Commelina benghalensis L., Amaranthus viridis L., Euphorbia geniculata L., Digera arvensis L and Trianthema portulacastrum L among the broadleaved weeds and the sedge Cyperus rotundus L.

At 20 DAS, topramezone + atrazine @ 25.2 + 250 g a.i ha$^{-1}$ + MSO as PoE and tembotrione + atrazine @ 105 + 250 g a.i ha$^{-1}$ + stefes mero as PoE recorded lowest weed density; weed dry matter and highest weed control efficiency compared to the other treatments. At 60 DAS and at harvest, hand weeding at 20 and 40 DAS recorded lowest weed density, weed dry matter and highest weed control efficiency and was found to be effective in limiting the weed...
growth. This treatment also recorded highest nutrient uptake by grain and stover at harvest and lowest uptake by weeds.

Regarding the effect of weed control treatments on growth parameters and yield attributes it was found that plant height, number of leaves, leaf area index (LAI), dry matter production, days to 50% silking, girth of cob, number of grains in a row, total number of grains, 100 grain weight and cob weight were significantly higher in hand weeding at 20 and 40 DAS followed by topramezone + atrazine @ 25.2 + 250 g a.i ha⁻¹ + MSO as PoE and tembotrione + atrazine @ 105 + 250 g a.i ha⁻¹ + stefes mero as PoE.

Hand weeding at 20 and 40 DAS recorded higher grain yield (6580 kg ha⁻¹) which was on par with topramezone + atrazine @ 25.2 + 250 g a.i ha⁻¹ as PoE (6436 kg ha⁻¹) and tembotrione + atrazine @ 105 + 250 g a.i ha⁻¹ + stefes mero as PoE (6282 kg ha⁻¹). Stover yield and harvest index was also higher in hand weeding at 20 and 40 DAS.

In terms of economics, the highest gross returns (Rs 93724 ha⁻¹) were obtained with hand weeding at 20 and 40 DAS or topramezone + atrazine @ 25.2 + 250 g a.i ha⁻¹ + MSO as PoE (Rs 91389 ha⁻¹) and tembotrione + atrazine @ 105 +250 g a.i ha⁻¹ + stefes mero as PoE (Rs 88962 ha⁻¹). Highest net returns were obtained with topramezone + atrazine @ 25.2 + 250 g a.i ha⁻¹ + MSO as PoE (Rs 62608 ha⁻¹), tembotrione + atrazine @ 105 + 250 g a.i ha⁻¹ + stefes mero as PoE (Rs 60181 ha⁻¹) and intercultivation at 20 and 40 DAS (Rs 59368 ha⁻¹). However the highest benefit: cost ratio of 3.17 was realized due to application of topramezone + atrazine @ 25.2 + 250 g a.i ha⁻¹ + MSO as PoE and atrazine @ 1.0 kg a.i ha⁻¹ as PE fb intercultivation at 30 DAS (3.11).
AGRONOMY

Author: ZENEBE MEKONNEN ADARE
Title of the thesis: INFLUENCE OF SOWING TIME AND DEFICIT IRRIGATION IN RELATION TO TEMPERATURE AND SOLAR RADIATION ON GROWTH AND YIELD OF COTTON (Gossypium hirsutum L.)
Major Advisor: Dr. A. SRINIVAS
Degree: Ph.D.
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9788

ABSTRACT

Growth and development of cotton is influenced by several environmental factors such as change in temperature, amount and distribution of rainfall and carbon dioxide concentration which attribute to climate change. A field experiment was conducted to study the impact of sowing time and deficit irrigation on crop growth, yield and quality traits of cotton, to identify the critical weather variables affecting phenology and yield of cotton and work out economics of cotton cultivation during 2013-14 and 2014-15 kharif season at College Farm, Hyderabad, Rajendranagar located at 78°24’18” E and 17°19’30” N. The experiment was set out with three sowing times (24, 26 and 28th standard week) and four deficit irrigation schedules (0.8 IW/CPE, 0.6 IW/CPE, 0.4 IW/CPE and rain fed) arranged in split plot design. Crop growth parameters (plant height, monopodial and sympodial branches per plant, leaf area index, dry matter production, number of main stem nodes, number of flower, crop growth rate), yield and yield components (number of squares per plant, number of bolls per plant, boll weight, hundred seed weight, seed cotton yield, ginning per cent at pickings), fibre properties (2.5% fibre span length, micronaire, fibre strength, fibre uniformity ratio at picking two and four) and daily weather variables were recorded during the study season.

The results showed that crop growth parameters, yield and its components, fibre quality traits were significantly (P ≤ 0.05) influenced due to sowing time and deficit irrigation at various cotton phenophases. Early sowing of cotton at 24 standard week (June 17 and June 14) and 26 standard week (June 30 and July 03) along with temperature at all phenophases and solar radiation during flower and boll opening, and irrigation schedule at 0.8 IW/CPE followed by 0.6 IW/CPE resulted significantly higher crop growth parameters, yield, yield components and fibre properties. Significantly high mean seed cotton yield of 1970 kg ha⁻¹ and 1825 kg ha⁻¹ was achieved when the cotton was shown on 24 and 26th standard week, respectively and seed cotton
yield of 1842 kg ha\(^{-1}\) and 1770 kg ha\(^{-1}\) with irrigation scheduling at 0.6 IW/CPE and 0.8 IW/CPE, respectively.

On the study of significance of weather variables on days to attain phenophases, crop growth parameters and yield and yield components, weather variables such as rainfall, maximum temperature, minimum relative humidity, stress degree day, maximum relative humidity and pan evaporation were found to be influential on cotton growth and yield at various phenophases.

Significantly high mean gross income (₹ 89,416 and ₹ 82,871), net income (₹ 72,148 and ₹ 65,622) and B:C ratio (4.2 and 3.8) were observed on cotton sown at 24\(^{th}\) standard week followed by 26\(^{th}\) standard week, respectively. The gross income, net income and benefit to cost ratio of cotton sown at 24 standard week during first year was onpar with cotton sown at 26 standard week. Irrigation scheduling at 0.6 followed by 0.8 IW/CPE recorded significantly higher gross income (₹ 72,977 and ₹ 70,408), net income (₹ 55,835 and ₹ 53,015) per hectare and B:C ratio (3.2 and 3.1) during first year, whereas during second year irrigation scheduled at 0.8 IW/CPE ratio followed by 0.6 IW/CPE ratio showed maximum gross income (₹ 95,878 and ₹ 94,295) and net income (₹ 78,245 and ₹ 76,963) and B:C (4.4 and 4.4). The amount of gross income and net income attained due to 0.4 IW/CPE was onpar with rainfed plot.

It can be concluded that early sowing at 24 SW when combined with irrigation schedule at 0.6 IW/CPE and when cotton sown at 26 SW combined with irrigation schedule at 0.8 IW/CPE in association with temperature within a range of 28.04 to 35.74 °C at different phenophases and incoming solar radiation within a range of 145.1 x 10\(^{3}\) to 168.2 x 10\(^{3}\) lx during reproductive phenophase were found to be suitable for cotton growth, yield, quality and higher economical returns.
CROP PHYSIOLOGY

Author : GODAWARI SHIVAJI PAWAR
Title of the thesis : VARIABILITY IN PHOTOSYNTHETIC TRAITS AND ACCUMULATED BIOMASS AMONG DIVERSE RICE (Oryza sativa L.) GENOTYPES
Major Advisor : Dr. V. PADMA
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9849

ABSTRACT

A field experiment was conducted in two consecutive years during rabi, 2012-13, 2013-14, kharif, 2013 and 2014 at research farm, ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad. The experiment was laid out in a randomized block design with three replications. The present investigation was undertaken to assess the genotypic variation for photosynthetic traits, to evaluate the radiation use efficiency of various genotypes, to identify the relationship between leaf gas exchange traits and photosynthetic efficiency and to study the relationship of photosynthetic efficiency with rice grain yield and biomass.

To test the performance of different promising genotypes for grain yield, yield contributing characters, leaf photosynthetic traits, accumulated photosynthetically active radiation (APAR) and radiation use efficiency (RUE), diverse rice genotypes were selected. The selected material comprised of 43 genotypes drawn from different groups, viz., advance breeding group (two), germplasm group (two), wild introgression group (two), tropical japonica group (two), land race group (nine) and released variety group (twenty six) popular in their respective states/zones of India.

Results indicated significant differences in morpho-phenological character viz., plant height, number of effective tillers per plant, number of leaves per hill, leaf area, leaf area index, flag leaf area, total dry matter, days to flag leaf emergence, days to heading, days to 50 % flowering, days to maturity and yield parameters viz., number of panicles/ m², number of spikelets per panicle, number of filled grains per panicle, number of unfilled grains per panicle, 1000 grain weight and grain yield per hill. Effective tillers were registered maximum in released variety Jaya as compared to other and were lowest in land race Surja during both the seasons. Released variety Jaya had maximum culm dry matter translocation followed by RNR 6378 and
Rasi as compared to land race Surja and Sonkaichi from flowering to maturity stage during both the seasons.

Significant variation was noticed in important chlorophyll fluorescence traits, except the Fv/Fm ratio, which did not differ significantly among the genotypes but the values are within the range reported in healthy plants. Significant genotypic variations were also observed in photochemical quantum yield and in apparent electron transport rate. Among the genotypes the significant seasonal and genotypic variation in photochemical quantum yield was observed and it was recorded maximum in Sonkaichi and Sugandha samba followed by Jyoti, ADT 43 and TJP 82, during rabi while during kharif Pantdhan 12, BPT 5204 and Jaya recorded maximum photochemical quantum yield. Highest apparent electron transport rate was recorded in Sonkaichi followed by Sugandha samba and Jyoti during rabi, while BPT 5204 and Jaya had recorded highest apparent electron transport rate during kharif. Significant variations were also observed in all the major gas exchange traits among the genotypes in all the seasons.

In order to understand the relationship between different leaf gas-exchange traits, Pearson’s correlation analysis was performed with mean value for all the four seasons and separately for dry (rabi) and wet (kharif) seasons. A strong positive association (P<0.01) between photosynthetic rate and stomatal conductance, transpiration rate and carboxylation efficiency was observed in both rabi and kharif seasons. Significant variation was also observed among the tested genotypes for radiation use efficiency. Leaf nitrogen percent varied among the entries and had positive but non-significant association with PN. The relationship between leaf nitrogen and photosynthesis was relatively stronger in rabi season than kharif season. The correlation analysis indicate that the variation in leaf photosynthetic efficiency is pre-dominantly due to variation in carboxylation efficiency (PN/Ci), stomatal conductance (gs) and to a lesser extent due to leaf N content. The relationship between chlorophyll fluorescence parameters i.e. Fv/Fm, ETR and quantum yield was found to be non-significant in the present investigation.

Stability analysis showed that for Rasi, Neveripeeli, Jaya, TPJ 82, Surja and Jyoti recorded relatively high PN and the stability variance (σ²) was non-significant and hence these genotypes performed well across the seasons as far as photosynthetic efficiency is concerned. These genotypes can be used as donors for improving photosynthetic efficiency.

The non structural carbohydrates (NSC) content was significantly higher at flowering stage compared to maturity stage and its remobilization efficiency differed significantly between the tested genotypes.

To understand the relationship between leaf photosynthetic pigments, total dry matter accumulation and grain yield simple Pearson correlation analysis was performed separately for both rabi (dry) and kharif (wet) seasons. Leaf photosynthetic pigments viz., Chl a, Chl b, total chlorophyll and carotenoid showed positive association with PN during both rabi and kharif seasons. However, the relationship is non-significant during rabi season. Leaf photosynthetic rate was found to be significantly (P<0.01) related with TDM (g hill⁻¹) recorded at maturity and grain yield (g hill⁻¹) in kharif season. However, the relationship between these parameters though positive, was found to be statistically non-significant during rabi season.
Stability analysis showed that HKR 47, IR 36, Pantdhan 4, IET 21542 and Pardeshiya produced more total dry matter across the seasons. While, Lalat, Varadhan, IET 21542, and ADT 43 genotypes not only produced relatively high grain yield but also consistent across the seasons. Two entries ADT 43 and ADT 49 showed higher harvest index (HI) which was stable across the seasons.

The entries which recorded higher values across the seasons for grain yield, TDM, HI and $P_N$ can be used as donors for developing varieties with higher $P_N$, TDM and grain yield.
CROP PHYSIOLOGY

Author : LAVANYA, B.
Title of the thesis : “PHYSIOLOGICAL AND MOLECULAR BASIS OF HETEROSIS IN RICE HYBRIDS”
Major Advisor : Dr. T. RAMESH
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9850

ABSTRACT

Pot culture experiment was conducted at Indian Institute of Rice Research (formerly Directorate of Rice Research), Hyderabad, during Kharif 2014 to study various agromorphological, physiological and molecular approaches with a view to elucidate physiological and molecular basis of heterosis in rice hybrids. The experiment was laid out in completely randomized design with three hybrid checks and two positive and two negative grain yield heterotic rice hybrids along with their parents. The data pertaining to various parameters had been recorded at different stages of rice.

The alpha amylase content and seedling vigour index were found to be maximum in the hybrid APMS6A X BCW56 along with the hybrid checks which resulted in the increased germination percentage. The heterotic hybrid APMS6A X BCW56 and hybrid check KRH2 had recorded maximum root length and volume. Tiller number plant\(^{-1}\) and productive tiller population was recorded to be maximum in the heterotic hybrid APMS6A X C20R along with the checks contributed to the production of more number of panicles and increase in yield. The photosynthetic rate and transpiration rate values were found to be maximum in the hybrid APMS6A X BCW56 along with the checks, while for stomatal conductance the check DRRH3 is alone superior. Grain number panicle\(^{-1}\) and harvest index were found to be maximum in the hybrid APMS6A X BCW56 which in turn led to the increase in grain yield.

The total biomass values were reported to be maximum in the hybrid checks DRRH3, KRH2 and DRRH2 which increased CGR, LAI and NAR. Total soluble sugars, starch and reducing sugars were recorded to be maximum in the hybrids compared to the parents which led to increased photosynthesis and increase in yield. Significant positive average heterosis and heterobeltiosis was observed for parameters like germination percentage, seedling vigor index, tiller number etc. in the crosses DRRH3, DRRH2, KRH2, APMS6A X BCW56 and APMS6A X C20R which concluded that these hybrids exhibited hybrid vigor over their parents.
The positive and negative heterotic hybrids did not show the same trend for all the parameters, but for most of the parameters *viz.* grain yield, spikelet sterility percentage, harvest index, etc. significant positive and negative heterosis was found.

Ten gene specific RT-PCR primers were designed for analysing the gene expression of key house keeping genes associated with photosynthesis and respiration among the three hybrid checks. Using the gene specific primers Semi Quantitative Reverse Transcriptase Polymerase Chain Reaction was setup. Of the 10 primers, PEPC2, NADP-MDH1, PEP CK, SBP, PRK in the hybrid KRH2 and PEPC2, PEP CK, RUBISCO in the hybrids DRRH3 and NADP-MDH1, SBP, PRK in the hybrid DRRH2 showed differential expression compared to their parents. This may be inferred that the upregulation of these genes in the hybrids may be associated with heterosis.

For the characterization of rice genotypes 14 hyper-variable polymorphic Expressed Sequence Tag derived Simple Sequence Repeats (EST-SSRs) primer pairs were used for PCR amplification. Of the 14 primers amplified in the hybrids, 6 are monomorphic and the rest are polymorphic namely RMES 7-1, RMES 7-2, RMES 8-1, RMES 9-2, RMES 10-2, RMES 12-2, ESSR 12.20.2. These hybrids were also analyzed for parental polymorphism wherein the coefficient of marker polymorphism was calculated and correlated to standard heterosis % with respect to grain yield. The parental combinations exhibiting CMP values of ≥ 0.7 exhibited positive heterosis and others are negatively heterotic for grain yield.

Both the physiological and molecular experimental results concluded that the hybrids APMS6A X C20R, APMS6A X BCW56 are positively heterotic and the hybrids APMS6A X AjayaR, PUSA5A X BR 827-35 are negatively heterotic. From the gene expression studies it can be concluded that upregulation of genes related to photosynthesis may be the possible reason for heterosis in the hybrids compared to the parents.
ENTOMOLOGY

Author : ASIYA BEGUM
Title of the thesis : “EVALUATION OF SUITABILITY OF Trichogramma chilonis ISHII IN COMBINATION WITH BIOLOGICAL, BIO RATIONAL AND CHEMICAL PESTICIDES.”
Major Advisor : S.M.A.S RAHMAN
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9860

ABSTRACT

In India, two predominant species Trichogramma chilonis Ishii and Trichogramma japonicum are distributed throughout the country. Among the Trichogrammatids, Trichogramma chilonis is widely used in IPM. In view of its increased usage in the form of Trichocards, a lot of attention is being given on its suitability with other methods of pest and disease control with special reference to chemical pesticides. The evaluation of suitability of Trichogramma chilonis Ishii in combination with bio pesticides, bio rationals, and chemical pesticides was carried out during 2014-15 at AICRP on Biocontrol of crop pests, Rajendranagar, Hyderabad.

Among the bio pesticides sprayed on host insect eggs Ha NPV resulted in highest parasitization of 90.2%. Least parasitization of 85.0% was found in Lecanicillium lecanii. Untreated control which is used as a check has resulted into 94.6% parasitization. The order of per cent parasitization of 5 bio pesticides on host insect eggs in descending order was : Ha NPV > Metarhizium anisopliae > Beauveria bassiana > Bt > Lecanicillium lecanii.

The bio pesticides which were tested on already parasitised trichocards revealed that the maximum parasitization by Ha NPV with 87.4%. Least parasitization was observed for Metarhizium anisopliae with 33.6%. Untreated control resulted in 90.0% parasitization. The order of per cent parasitization of 5 test bio pesticides on already parasitised trichocards was Ha NPV > Beauveria bassiana > Bt > Lecanicillium lecanii > Metarhizium anisopliae.

Among the bio rationals tested on host insect eggs, Azadirachthin 300ppm resulted as first with 92.6% and NSKE 5% has showed least parasitization. The untreated control showed 93.6% parasitization. The order of per cent parasitization of 5 test bio rationals on host insect eggs was: Azadirachthin 300ppm > Azadirachthin 1500ppm > Azadirachthin 10000ppm > NSKE 5% > Karanj oil extract. Whereas, the test bio rationals on already parasitised trichocards showed that the maximum parasitization was observed in Karanj oil with 73.8% Least per cent parasitization was observed by Azadirachthin 1500ppm with 50.0%. The untreated control resulted in 85.2%
parasitization. The order of per cent parasitization of 5 test bio rationals on host insect eggs:
Karanj oil extract > NSKE 5% > Azadirachtin 300ppm > Azadirachtin 10000ppm > Azadirachtin 1500ppm.

The results clearly demonstrated that among the test chemical pesticides on host insect eggs cards before parasitization, maximum parasitization of 24.2% were observed by Acephate. Acetamiprid showed least per cent parasitization of 6.2%. However, as high as 91.4% parasitization was observed in untreated control. The order of per cent parasitization of test chemical pesticides on host insect eggs cards Acephate > Thiamethoxam > Imidacloprid > Profenofos > Acetamiprid.

Among those test chemical pesticides on already parasitised trichocards, the results showed that Imidacloprid showed the highest per cent parasitization of 22.6% similar trend of maximum parasitization of 82.6% was noticed in untreated control. The order of per cent parasitization of test chemical pesticides on host insect eggs cards Imidacloprid > Acetamiprid > Acephate > Thiamethoxam > Profenofos > Acetamiprid > Acephate.

The present investigation clearly proved that bio pesticides and bio rationals were safer to *T. chilonis* while almost all chemical pesticides were detrimental to *T. chilonis* truly paving way for effective integration of *T. chilonis* with bio pesticides and bio rational Pesticides. The results also point out that caution must be exercised while using chemical pesticides under field conditions in the presence of *Trichogramma*. 
ENTOMOLOGY

Author : DEEPA, G.
Title of the thesis : STUDIES ON RESISTANCE PATTERN OF HELICOVERPA ARMIGERA (HUBNER) TO CERTAIN NEW INSECTICIDE MOLECULES
Major Advisor : Dr. T. V. K. SINGH
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9851

ABSTRACT

Experiments were carried out during 2013-2014 and 2014-2015 in the Bt Cotton Project lab, Dept. of Entomology, College of Agriculture, Rajendranagar, Hyderabad PJTSAU, to evaluate the resistance pattern of Helicoverpa armigera (Hub.) to certain new insecticide molecules.

Chlorantraniliprole 18.5 SC @ 0.20% treatment was found to be most effective against H. armigera larvae followed by flubendiamide 480 SC @ 0.0052%, spinosad 45 SC @ 0.166%, indoxacarb 14.5 SC @ 0.172% and emamectin benzoate 5 SG @ 0.003%. Emamectin benzoate 5 SG @ 0.003% was least effective recording high pupation per cent among all the treatments.

Larvae collected from Mahaboobnagar population recorded the LC50 and LC90 values for different chemicals viz., flubendiamide, (0.1 and 2.2 mg/l), indoxacarb (0.2 and 3.5 mg/l), spinosad (0.36 and 1.98 mg/l), chlorantraniliprole (0.04 and 0.2 mg/l) and emamectin benzoate (0.011 and 0.37 mg/l), respectively. On comparing with baseline data the resistance factor obtained was 0.2 (flubendiamide), 0.6 (indoxacarb), 0.007 (spinosad), 1.3 (chlorantraniliprole) and 1.1 (emamectin benzoate) at 24 hours after treatment.

For the Mahaboobnagar population at 48 HAT, LC50 and LC90 values were recorded for flubendiamide, (0.2 and 3.5 mg/l), indoxacarb (0.3 and 4.2 mg/l), spinosad (0.45 and 1.35 mg/l), chlorantraniliprole (0.06 and 0.5 mg/l) and emamectin benzoate (0.017 and 0.51 mg/l), respectively. On comparing with baseline data the resistance factor obtained was 0.4 (flubendiamide), 1.0 (indoxacarb), 0.009 (spinosad), 2.0 (chlorantraniliprole) and 1.7 (emamectin benzoate).

LC50 and LC90 values recorded for different chemicals for the Mahaboobnagar population of H.armigera were viz., flubendiamide, (0.4 and 4.2 mg/l), indoxacarb (0.9 and 6.4 mg/l), spinosad (0.57 and 1.37 mg/l), chlorantraniliprole (0.08 and 0.9 mg/l) and emamectin
benzoate (0.025 and 0.87 mg/l), respectively. The resistance factor obtained was 0.8 for flubendiamide, 3.0 indoxacarb, 0.011 for spinosad, 2.6 for chlorantraniliprole and 2.5 for emamectin benzoate, respectively at 72 hours after treatment.

Larvae of *H. armigera* collected from Mahaboobnagar, Kurnool and Guntur district resistant to flubendiamide in the F1 and F2 generations showed positive cross - resistance to chlorantraniliprole of 1.25 fold in F1, 3.6 fold in F2 and 4.8 fold in the F3 generation, respectively.

Chlorantraniliprole selected strain (F1 and F2) of Mahaboobnagar, Kurnool and Guntur district recorded positive cross - resistance to flubendiamide 6.3 fold in F1, 2.58 fold in F2 and 5.09 fold in the F3 generation, respectively.
ENTOMOLOGY

Author : GEETHA, P.

Title of the thesis : “SURVEY ON PESTICIDES USAGE, MONITORING OF PESTICIDE RESIDUES AND DECONTAMINATION METHODS IN SPINACH (Spinacia oleracea L.).”

Major Advisor : Dr. C. SRINIVAS

Degree : M.Sc.(Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9853

ABSTRACT

Spinach (Spinacia oleracea L.) is a green-leafy vegetable often recognized as one of the functional foods for its nutritional, antioxidants and anti-cancer constituents. Amongst all the vegetables, the leafy vegetables have a very high protective food value. They are rich in mineral and hence can be called as “Mines of minerals”. Vitamin A and C are present in abundant quantities.

Survey on pesticide use pattern was carried out by interviewing farmers growing spinach (Spinacia oleracea L.) by using the questionnaire prepared to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and use. Studies were undertaken to establish decontamination methods of commonly used insecticides at recommended dose to assess the differences in rate of decontamination of pesticides, which were selected based on the monitoring results of the market samples. Insecticides viz., triazophos (40% EC), chlorpyriphos (20% EC), cypermethrin (25% EC), deltamethrin + triazophos (36% EC) and profenophos (40% EC) were sprayed and spinach samples collected at zero days and analyzed for residues. Various decontamination methods were evaluated to assess the efficiency of method for removal of pesticide residues from spinach for food safety.

Education levels of farmers are very less, where in 43.33% farmers have primary school education. Majority of the farmers (46.66%) grow in 0.5 acre and <1 acre (43.33% of farmers). Majority of farmers (86.66%) grow the crop in rabi season followed by kharif season (46.66%). Fifty eight percentage of farmers knew about recommended pesticides. However, in general, half of the farmers (51.66%) contact pesticide dealer for recommendations and some farmers prefer to contact agricultural officers. Most of the farmers are unaware about pesticide classification and toxicity symbols on packing. Farmers are aware of endosulfan ban, but only 13.33% farmers know about ban of monocrotophos on vegetables. Very few farmers know about pesticide residues and related issues, but know that washing helps to reduce contamination. About 76.66% of farmers grow the crop upto 2 months and 33.33% farmers grow up to 3 months. Among the respondents 76.66% of farmers observed pesticide effects on the health of spraymen during the
spray. More common health problems observed during spray includes bad odour (70%), skin irritation (48.33%), eye irritation (46.66%), headache (21.66%) and breathlessness (10%).

The spinach samples were collected from three different local vegetable markets viz., Shamshabad, Mehadipatnam and Gudimalkapur in and around Hyderabad at regular intervals and analyzed for residues following the validated QuEChERS method. The results revealed that, samples of spinach contained 11 pesticide residues namely, chlorpyrifos, profenophos, deltamethrin + triazophos, cypermethrin, acephate, dimethoate, spinosad A, acetamiprid and indoxacarb. Frequently observed pesticides found in the 3 markets samples were chlorpyrifos, triazophos, cypermethrin, deltamethrin+ triazophos and profenophos. Based on the results, frequently detected pesticides i.e., chlorpyrifos, triazophos, cypermethrin, deltamethrin+ triazophos and profenophos were analysed for further decontamination studies. For this purpose crop has been raised in the student farm as per good agricultural practices of PJTSAU.

Among various decontamination methods tested, hot water treatment wash was found to be very effective in removing pesticide residues to an extent of 50-90% varying with type of pesticides except in case of chlorpyrifos followed by common methods i.e., 2% salt solution wash was also effective method removing residues in the range of 30-65%, tap water in the range of 13-55%.

From the results it is noticed that, farmers are having less awareness on pesticide usage, residue knowledge and decontamination methods. Based on monitoring results the frequently used pesticides were detected from the market samples, that can be analysed for residue studies and decontamination methods.
ABSTRACT

Laboratory studies were conducted in the Department of Entomology, College of Agriculture, Rajendranagar and National Bureau of Plant Genetic Resources (NBPGR), Regional Research Station, Rajendranagar, Hyderabad during 2012-14.

Studies were contemplated on screening of groundnut varieties for resistance/susceptibility to the bruchid, role of physico-chemical properties in influencing the infestation, radiography to detect hidden infestation and approaches for biorational management of the pest.

Pods and kernels of twenty groundnut varieties were assessed for their resistance/susceptibility to the bruchid, based on the biological attributes of the pest on the variety. Index of susceptibility (IS) was taken as the criteria for assessing the resistance or susceptibility and the varieties were classified into five categories viz., resistant (0 -2.5), moderately resistant (2.6-5.0), moderately susceptible (5.1-7.5), susceptible (7.6-10) and highly susceptible (> 10). The pods of three varieties viz., K1271, ICGV 05100 and K9 (3.5-4.7 IS) and kernels of five varieties viz., ICGV 00350, K9, ICGV 86015, KI271 and Narayani (4.3-4.9 IS) were classified as moderately resistant while pods of K6 (10.1) variety and kernels of K6 (10.13) and TMV 2 (10.1) were highly susceptible to the pest attack.

Assessment of the physico-chemical properties of the pods and kernels for resistance/susceptibility to the pest, shell thickness and hardness contributed to resistance, while inter granular space, kernel size and weight provided susceptibility. Nitrogen and crude protein content had a positive effect on the biology of the bruchid while crude fibre and ash contents exerted a negative effect.
Detection of hidden infestation of the bruchid through X-ray radiography in eight groundnut varieties indicated that a range of 20-30 KV of voltage, 6-8 mA of current with an exposure period of 10 seconds was optimum for effective detection.

Biorational management of the pest through evaluation of nanocides, modified atmosphere with elevated levels of carbon dioxide (CO$_2$), use of desiccant beads, plant oils and insecticides was studied. Among the nanocides, nano silica applied @ 1000 ppm and 500 ppm caused cent per cent mortality of the bruchid. Elevated levels of CO$_2$ @ 60-80% for 180 minutes resulted in cent per cent mortality of the pest within 1-2 days after treatment. Desiccant beads, zeolite/sodium aluminum silicate mixed with groundnut pods in the ratio of 1:1 proved effective in suppression of the bruchid.

Among the plant oils (neem, citronella, lemongrass and eucalyptus), eucalyptus oil @ 10 ml kg$^{-1}$ of pods was as effective as insecticides (deltamethrin and spinosad) as grain protectant in reducing the infestation up to six months and inhibited pest buildup till 9 months. All the above approaches offered protection against the bruchid infestation with no adverse effect on germination and seedling vigour index of kernels.
ENTOMOLOGY

Author : NETHAJI RATHOD
Title of the thesis : POPULATION DYNAMICS OF MAJOR INSECT PESTS OF MAIZE & THEIR NATURAL ENEMIES AND EVALUATION OF CERTAIN ECOFRIENDLY PEST MANAGEMENT APPROACHES.
Major Advisor : Mr. S. M. A. S. RAHMAN
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9858

ABSTRACT

Experiments were conducted during Kharif, 2014-15 under field and laboratory conditions at four locations namely student farm, college farm, ARI farm and farmers’ field, Rajendranagar. Evaluation of commercially available bio pesticides against pest complex of maize and Impact of crop habitat management in maize for effective colonization and utilization of Trichogramma were carried out at student farm, College of agriculture, Rajendranagar, Hyderabad. Investigations were made and found the populations of the stem borer dead heart, stem borer larvae, aphids, cob borer, natural enimies viz., spiders, coccinellids, Chrysoperla eggs, Cotesia flavipes, Chelonus blackburnii and correlations were made with weather parameters viz., Av.Max.Temp, Av.Min.Temp, Av.Max.RH at 7 AM, Av.Min.RH at 2 PM, Total Rainfall and Number of Rainy days. Pink borer population was not found during kharif season.

Stem borer dead hearts reached their peak (27.50%) during 40th standard week at college farm and ARI farm and stem borer larvae was found to be least as 0.02 no. of larvae per plant at student farm, during 35th standard week and reached its peak 0.27 during 40th standard week at student farm and ARI farm. Aphid population reached its peak (17.50%) infested twigs during 42nd standard week at college farm, ARI farm and farmers’ field and cob borer population was found to be reached its peak as (0.22) number of cob borers per plant during 44th standard week at ARI farm. Natural enemies, spider population reached its peak (0.27) during 42nd standard week at ARI farm. Coccinellid, Chrysopra, Cotesia flavipes and Chelonus blackburnii populations were found to be reached their peak viz., (0.32), (1.45), (0.55) and (0.70) during 42nd standard week at college farm. Stem borer dead hearts, per cent infested twigs by aphids, average number of spiders per plant, average number of coccinellids per plant, Chrysoperla eggs per plant and average number of Chelonus blackburnii per larvae in positive correlation with Avg. Max. Temp in all the four test locations and negative correlation with Avg. Min.Temp, Avg. Max. RH at 7 AM, Avg. Min. RH at 2 PM, Total Rainfall and No. of Rainy days.
For evaluation of the efficacy of bio pesticides, only pink borer, *S. inferens* crossed optimum damage levels. The experiment was carried out with cross hybrid 900M-GOLD under field conditions clearly indicated *B. bassiana* as the most effective with 73.58 per cent larval mortality and 68.89 per cent dead hearts reduction followed by *M. anisoplie* with 70.58 per cent larval mortality and 64.80 per cent dead hearts reduction. However, *B. thurengiensis*, and *L. lecanii*, were on par showing the mortality of 68.42 and 53.75 per cent and per cent dead hearts reduction 60.59 and 49.44 per cent respectively. Whereas the lowest per cent mortality and per cent dead hearts reduction was noticed in *HaNPV* and neem oil 1500ppm showing 40.00 and 34.04 and percent dead hearts reduction 42.86 and 40.00 per cent. The least per cent mortality and per cent dead hearts reduction were observed in control showing 10.00 and 8.84 per cent.

Module 1 (maize intercropped with red gram in 2:1 ratio along with a barrier of three rows of sorghum sown as border crop) showed less infestation of stem borer, aphids and cob borer as 0.06 cumulative mean, 9.22 per cent infested twigs by aphids, 0.04 cumulative mean and showed highest *Trichogramma* parasitization followed by Module 2 (maize intercropped with red gram in 2:1 ratio without any border crop) which showed 0.09 cumulative mean, 10.88 per cent infested twigs by aphids and 0.05 cumulative mean and 13.80 per cent *Trichogramma* parasitization. However, the Module 3 (sole crop of maize) showed highest infestation of stem borer, aphids and cob borer as 0.12 cumulative mean, 13.53 per cent infested twigs by aphids and 0.06 cumulative mean and showed least per cent parasitization of *Trichogramma* as 9.25 per cent. The damage by pink borer was not found in all the three modules.
ENTOMOLOGY

Author : PAVANI THATIKONDA
Title of the thesis : Helicoverpa armigera (Hubner) - Genotype - Environment
Major Advisor : Dr. T. RAMESH BABU
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9864

ABSTRACT

The present research was carried out under laboratory and field conditions at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Telangana, India, during 2012 - 14.

The growth of *H. armigera* was faster at 35°C than at 15 and 25°C (larval period 10 days, and pupal period 8.4 days). Larval and pupal periods were prolonged to 40.2 and 61.6 days, respectively at 15°C. The larvae did not survive at 45°C. Though the growth rate was faster at 35°C, the adult emergence was low, in addition to malformed adults and decreased egg laying. Though differences in RH did not have significant influence on the survival and development of *H. armigera* unlike temperature, 75% RH was most favourable for the growth and development of the *H. armigera*. There were no significant differences in larval weight, larval survival, larval and pupal periods, pupal weight, pupation, adult emergence and fecundity across CO2 concentrations. Elevated CO2 levels shortened the life cycle of *H. armigera*, and the fecundity increased with an increase in CO2, suggesting that elevated CO2 will lead to rapid generation turnover and increased rates of population growth of *H. armigera*. Among the three environmental factors studied, temperature exercised a major effect on growth and development of *H. armigera*.

Larval survival, larval period, pupal weight, pupation and pupal period were significantly and negatively correlated with temperature. Very low and high temperatures had an adverse effect on the survival and development of *H. armigera* larvae.

The egg laying by *H. armigera* decreased across sowing dates till December, while a slight increase was recorded in the January sown crop. In the early plantings there were significant differences among the genotypes, but such differences were less apparent in the late plantings. ICC 3137 was most preferred for egg laying, followed by KAK 2. ICCV 10 and JG 11 were relatively not preferred for egg laying. There were no significant differences in egg laying by *Spodoptera exigua* in crop sown in October, November and January and, the highest numbers
of egg masses were recorded in the December sown crop. The highest number of *S. exigua* egg masses were recorded on KAK 2, followed by ICC 3137. The *S. exigua* larval incidence was greater in the January sown crop than in the crop sown in October, November and December. Though the numbers of *H. armigera* larvae decreased with the planting dates, the extent of damage by *H. armigera* increased across the planting dates in both the seasons. The cocoons of the parasitoid *Campoletis chlorideae* decreased with the planting dates, which ultimately resulted in a decrease in the biological control of *H. armigera*. As the temperature increased across the planting dates, there was an increase in damage by *H. armigera*, and a decrease in the dry matter production and grain yield.

Maximum and minimum temperatures showed an adverse effect on population density of *H. armigera* larvae. There was a negative correlation of *H. armigera* larvae with maximum and minimum temperatures in all the genotypes, except ICCV 10. A negative correlation of yield and positive correlation of *H. armigera* damage rating was observed with temperature. The abundance of *H. armigera* decreased with an increase in temperature but the plant damage increased with a rise in temperature.

The larval weight was more in insects reared on the crop sown in November than in insects reared on the crop sown in December. Pupal weight was greater on the crop sown in October than on the crop sown in December. Pupation, adult emergence and fecundity were high, whereas larval period was shorter on the crop sown in January, suggesting that increase in temperatures during plant growth in the late sown crops favoured the growth and development of the *H. armigera*. There were no significant differences in survival and development of *H. armigera* across sowing dates. The pupal weight and fecundity were greater, and larval period was shorter on ICC 3137, contributing to its susceptibility to *H. armigera*. Different genotypes behaved differently across sowing dates, suggesting differential effect of climatic factors on expression of resistance to *H. armigera*. On ICCV 10, the pupal weight was lower in the crop sown in October, but similar to that on ICC 3137 in the January sown crop, which is susceptible.

Leaf feeding and larval weights were greater on the November sown crop, but there were no significant differences in larval survival across sowings. Among the genotypes tested, there were no significant differences in the leaf damage and larval weight, but the larval survival was highest on ICC 3137, irrespective of sowings.

Under water stress conditions, in the glass house, all the genotypes matured earlier, but there was a decrease in the number of flowers, pod yield and seed yield. There were no significant differences between the plants grown under sprinkled water and normal watering conditions in seed yield, suggesting that washing off of organic acids did not affect the seed yield. The chickpea genotypes grown under heat and water stress conditions outside the glass house matured earlier, and there was a decrease in seed yield. JG 11 produced more number of flowers under stress conditions, which resulted in an increase in seed yield.

Leaf feeding by *H. armigera* was greater on ICC 3137 in plants raised under water stress conditions. On ICCV 10, the leaf damage was high on the plants raised under heat and water stress, and under sprinkled water. KAK 2 suffered lowest damage under heat and water stress. There were no significant differences in the larval survival across the genotypes or across
treatments. Larvae fed on ICCV 10 showed highest larval survival under stressed conditions, suggesting that plant resistance might break down under stressed conditions. Larval weight was higher on plants grown under sprinkled water suggesting that washing off of organic acids from chickpea leaves resulted in an increase in feeding by *H. armigera*, which resulted in an increase in the weight of the larvae. The acid exudates on the leaves act both as feeding deterrents, and also show adverse effects on development and survival.

Carbohydrate content decreased gradually from October to December sown crops, followed by an increase in the January sown crop. Oxalic and malic acid concentrations were high in the December sown crop, and low in the October sown crop. Among the genotypes tested, ICCV 10 recorded highest malic acid concentration. ICC 3137, which is susceptible to *H. armigera*, recorded lowest amount of malic acid when sown in October.

There were no significant differences in the carbohydrate or protein content among the genotypes tested across treatments. However, the lipid content was high under water stress conditions, which might influence the amount of leaf feeding by *H. armigera*. Carbohydrate content was more in ICCV 10 under heat and water stress than in ICCL 86111 under normal watering conditions. The protein content was high in KAK 2, while the lipid content was high in ICC 3137 in all the treatments.

There were no significant differences in oxalic acid concentration under different stress conditions, but the amounts of malic acid were highest in plants raised under heat stress. Lowest amounts of malic acid were recorded in plants grown under sprinkled water, where organic acids were washed off. Lower amounts of malic acid resulted in greater feeding and weight gain by *H. armigera* larvae on plants raised under sprinkled water conditions.

The HPLC analysis of leaf samples (dry weight basis) for flavonoids indicated that the chickpeas grown at different sowing dates had 12 peaks *viz.*, chlorogenic acid (Peak 1), genstisic acid (peak 2), phloretic acid (peak 3), ferulic acid (peak 4), umbelliferone (peak 5), naringin (peak 6), 3,4 dihydroxy flavones (Peak 7), quercetin (peak 8), naringenin (peak 9), genstein (peak 10), formononetin (peak 11) and biochanin A (peak 12). No significant differences were observed in the amount of phloretic acid, naringin, naringenin, umbelliferone and genistein across sowings, as well as across the genotypes tested. There was a shift in the amount of flavonoids across sowing dates and the genotypes tested, which might affect the resistance or susceptibility of chickpea genotypes to *H. armigera*. 
ENTOMOLOGY

Author : PRAVALIKA, K.

Title of the thesis : “STUDIES ON BIOLOGY, PREDATOR- PREY INTERACTION, PREDATORY EFFICACY OF Rhynocoris marginatus Fabricius (HEMIPTERA: REDUVIIDAE).”

Major Advisor : Dr. T. UMA MAHESWARI

Degree : M.Sc.(Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9859

ABSTRACT

Studies on biology and morphometrics, predator - prey interaction through olfactometer studies, prey preference, prey stage preference and functional response of *Rhynocoris marginatus* Fab. on three different lepidopteran prey/host viz., *Spodoptera litura*, *Mythimna seperata* and *Sesamia inferens* along with *Corcyra cephalonica* as a laboratory host were carried out at Department of Entomology, College of Agriculture Rajendranagar, Hyderabad and Indian Institute of Rice Research, Rajendranagar, Hyderabad during 2014 – 2015.

During the period of study, biology and morphometrics of *R. marginatus* on different host were documented under laboratory conditions. Biology on four different prey/ hosts ranged from 62 - 74 days, minimum being on *S. litura* (62.3 ± 2.62) and maximum on *S. inferens* (73.3 ± 1.39) compared to *Corcyra cephalonica* (70.2 ± 1.58). The percent survival of *R. marginatus* on *C. cephalonica* and *S. inferens* was 66.6 per cent where as on *S. litura* and *M. seperata* it was 60.00 per cent. The average number of prey fed by the predator was more in the case of *S. litura* (25.7 ± 2.6) larvae compared to *C. cephalonica* (29.7 ± 3.5). Colour of freshly deposited eggs was yellowish brown later turned to dark brown before hatching. The average length of the egg was measured as 2.38 ± 0.02 mm and width as 0.76 ± 0.01 mm. Size of the nymph increased from I instar (5.46 ± 0.20 mm) to V instar (8.93 ± 0.11 mm). Females were larger than males in size where average length of the females was 9.77 ± 0.14 mm and that of male was 9.61 ± 0.13 mm.

The predator–prey interaction was assessed in Y-shaped and six arm olfactometer under laboratory conditions, where *R. marginatus* preferred *S. litura* (85.7%) followed by *M. seperata* (57.1%) and *S. inferens* (42.8%). The apporaching time (10.9 ± 1.99 min) and handling time (18.3 ± 2.62 min) were more with the most preferred prey *S. litura*, though *R. marginatus* took long time to feed on *S. litura*. The Excess Proportion Index (EPI) values indicated positive response of *R. marginatus* in the order *S. litura > M. seperata > S. inferens*. In six arm olfactometer, *R.
*marginatus* has highly preferred the hexane extract of *S. litura* (42.85) followed by *M. seperata* (28.1%) and least preference to *S. inferens* (21.4%) was recorded.

The studies on prey preference evaluated by multiple choice test revealed that *R. marginatus* significantly preferred *S. litura* to an extent of 50 per cent while it was 25.3 per cent for *M. seperata* and 24.7 per cent for *S. inferens*. The stage preference of *R. marginatus* to different stages of its most preferred prey, *S. litura* larvae indicated its high preference for III instar larvae of *S. litura* followed by fourth and fifth instar larvae. The type II curvilinear positive functional response exhibited by *R. marginatus* to *S. litura, M. seperata* and *S. inferens* suggests its potentiality of utility as biocontrol agent against lepidopteran pests especially the polyphagous pest, *S. litura*.

Present studies clearly indicate that *R. marginatus* could be considered as a biocontrol agent against the larvae of *S. litura, S. inferens* and *M. seperata* especially on the voracious feeding stages i.e., third and fourth instars. The results from this study revealed the searching efficiency and rate of consumption of *R. marginatus* at their maximum when the predator was searching at a prey density of 10 larvae.
ABSTRACT

A field experiment to study the seasonal incidence and management of mealybug on grapevine and laboratory experiment to understand its biology was conducted at Grape Research Station, Rajendranagar, Hyderabad from July, 2014 to March, 2015.

Studies on seasonal incidence of mealybug of grapevine in relation to abiotic factors were carried out during 2014-15 (July to March). The incidence of mealybug on grapevine started increasing from the first standard week of January 2015 and continued to increase thereafter till the end of the season upto harvesting of bunches. Higher incidence of mealybug colonies coincided with the fruiting stage and mealybugs were observed on the bark also. Correlation studies of mealybug population with weather parameters indicated that weather had a substantial influence on its incidence. Among the various weather parameters, morning relative humidity ($r = -0.6500***$) and evening relative humidity ($r = -0.5429***$) had maximum impact (significant and negative, $p < 0.001$) on mealybug incidence. Maximum temperature ($r = +0.4074*$) and sunshine hours ($r = +0.3445*$) had significant ($p < 0.05$) positive influence on the pest. The other factors did not influence pest incidence significantly. This explains the higher incidence levels in summer months when relative humidity is very low, maximum temperature and sunshine hours are higher. However mealybug incidence correlated negatively and non-significantly with minimum temperature ($r = -0.0485$), rainfall($r = -0.1130$) and wind speed($r = -0.2256$).

Studies on the biology of grapevine mealybug on pumpkin were carried out from February, 2015 to March, 2015. The incubation period on pumpkin varied from 4 to 6 days for female grapevine mealybug in the month of February with an average of $5.1 \pm 0.7$ days. The hatching percentage of eggs varied from 83.3 to 90.0 per cent with an average of 85.9 per cent during February. The female passed through three nymphal instars. The duration of first instar nymph lasted for 6 to 9 days with an average of $8.0 \pm 0.9$ days for female grapevine mealybug. The duration of second instar nymph lasted for 7 to 10 days with a mean of $8.4 \pm 0.8$ days. The duration of third instar nymph (last instar) lasted for 7 to 10 days on pumpkin with a mean of 8.9
± 0.7 days. The pre-ovipositional period ranged from 3 to 5 days with an average of 4.4 ± 0.83 days and the ovipositional period ranged from 6 to 9 days with an average of 7.5 ± 0.89 days while fecundity ranged from 427 to 479 eggs with an average of 428 ± 28.8 eggs. The longevity of adult female grapevine mealybug ranged between 10 to 13 days with a mean of 11.26 ± 0.98 days when reared on pumpkin. The total life span of female amounted to 41.7 ± 3.1 days when reared on pumpkin during the month of February and March.

Studies on the efficacy of different insecticides against mealybug on grapevine revealed that buprofezin 0.04 % was significantly superior over other treatments with 74.80 per cent reduction and also recorded highest yield of 37340 kg ha⁻¹ with a incremental benefit cost ratio of 169.3. The next promising treatments were acetamiprid 0.02 % and carbosulfan 0.05 % with 63.88 and 41.73 per cent reduction, respectively and they recorded yields of 33081 and 31193 kg ha⁻¹, respectively with incremental benefit cost ratios of 131.2 and 61.7 respectively. Imidacloprid, acephate and chlorpyriphos were not very promising with per cent reduction levels of 24.32, 22.06 and 21.94, respectively with yields of 26184, 27104 and 22578 kg ha⁻¹, respectively and incremental benefit cost ratios of 94.8, 111.2 and 90.6, respectively. Dichlorvos 0.11 % was the least effective treatment with lowest (15.16) per cent reduction of mealybug colonies and lowest yield of 21150 kg ha⁻¹ with incremental benefit cost ratio of 74.9.
ENTOMOLOGY

Author : RATNAKAR, V.
Title of the thesis : SAFETY EVALUATION OF CERTAIN INSECTICIDES TO EUROPEAN HONEYBEE, Apis mellifera LINNAEUS
Major Advisor : Dr. S. R. KOTESWARA RAO
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9855

ABSTRACT

Laboratory studies were carried out at Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad during 2014-15.

Bioassay studies on toxicity of eight conventional insecticides viz., acephate, chlorpyriphos, dichlorvos, dimethoate, profenophos, triazophos, cypermethrin and neem oil and nine newer insecticides viz., acetamiprid, clothianidin, imidacloprid, fipronil, thiamethoxam, spiromesifen, chlorantraniliprole, chlofenapyr and diafenthiuron at recommended and half of the recommended doses were tested by dry film method. The experiments were carried out by releasing honeybees into glass jars at different intervals after treatment with test insecticides i.e., immediately, 12 and 24 hours of dry film formation on glass jars.

Among conventional insecticides at their recommended doses, acephate caused cent per cent mortality after 2 and 12 hours when bees were exposed immediately and 12 hours after dry film formation. When bees were exposed immediately and at 12 hours of dry film formation, dimethoate showed cent per cent mortality after 6 and 12 hours, respectively. Neem oil recorded least per cent mortality of 14.45, 11.10 and 1.55 per cent mortality after 48 hours of treatment when bees were released immediately, 12 and 24 hours of dry film formation on glass jars.

Among newer insecticides at their recommended doses, thiamethoxam showed cent per cent mortality after 2 and 6 when bees were exposed immediately and 12 hours of dry film formation, respectively. Clothianidin and imidacloprid observed cent per cent mortality after 2 and 6 hours, respectively when bees were released immediately after dry film formation and recorded 100 per cent mortality after 12 hours when released 12 and 24 hours of dry film formation, respectively. When exposed immediately, 12 and 24 hours of dry film formation, spiromesifen caused least per cent mortality of 53.33, 83.30 and 92.25 per cent, respectively.
At half of their recommended doses also, conventional insecticides were found to be toxic to honey bees, with dimethoate reaching 100% mortality after 6, 12 and 24 hours when bees were exposed immediately, 12 and 24 hours of dry film formation, respectively. Acephate observed 100% mortality after 12, 24 and 24 hours when bees were released immediately, 12 and 24 hours of dry film formation, respectively. Neem oil was found to be the safest registering least percent mortality of 14.45, 11.10 and 1.55 after 48 hours when bees were exposed immediately, 12 and 48 hours dry film formation, respectively.

At half of the recommended doses, newer insecticides, thiamethoxam reached 100% mortality after 12 and 6 hours when bees were released immediately and 12 hours of dry film formation, respectively. Clothianidin showed 100% mortality after 6 and 48 hours when bees were exposed immediately and 12 hours after dry film formation, respectively. Spiromesifen exhibited 44.41, 22.20, and 22.21 percent mortality after 48 hours when bees were released immediately, 12 and 24 hours of dry film formation, respectively. Chlorantraniliprole was found to cause 98.46 and 11.10 percent mortality after 48 hours when bees were exposed immediately and 12 hours of dry film formation, respectively.

A field experiment was carried out to evaluate the effect of field weathered insecticide residues on *A. mellifera* in cucumber during rabi 2014. After spraying of test insecticides on cucumber, treated foliage samples were collected after 2, 8 and 24 hours and placed in cages. In each cage 25 worker honeybees were released and mortality was recorded after 24 hours of release of honeybees. Among different insecticides treated viz., acetamiprid, clothianidin, imidacloprid, thiamethoxam, acephate, chlorantraniliprole, dichlorvos and fipronil, chlorantraniliprole registered lowest mortality among all treatments i.e. 30.96, 14.06 and 1.82 percent mortality after 2, 8 and 24 hours, respectively.
ENTOMOLOGY

Author : SHAILA, O.
Title of the thesis : CHARACTERIZATION OF Cry IIa TRANSGENIC CHICKPEA LINES AND THEIR INTERACTION WITH NATURAL ENEMIES OF Helicoverpa armigera (Hubner).
Major Advisor : Dr. T. RAMESH BABU
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9863

ABSTRACT

The present research was carried out under laboratory and field conditions at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India, during 2011 – 14.

The transgenic plants suffered significantly lower leaf damage as compared to the non-transgenic plants. The larval survival and weight gained by H. armigera larvae after 5 days was significantly reduced on transgenic lines as compared to that on non-transgenic chickpeas during October and November plantings 2011-12 and 2012-13. The transgenic lines BS5A.2(T2) 19-1P2 and BS5A.2(T2) 19-2P1 exhibited significantly lower leaf damage rating, larval survival and mean larval weight under laboratory conditions.

In glasshouse conditions, BS5A.1(T2) 18-1P1 suffered significantly lower leaf damage and mean larval weight was also reduced but the larval survival of H. armigera was significantly reduced on BS5A.2(T2) 19-2P1. Significant differences in grain yield were observed between transgenic and non-transgenic plants infested with H. armigera. BS5A.2(T2) 19-2P1 had the highest dry matter weight, pod weight, seed weight and number of seeds formed as compared to the other transgenic and non-transgenic chickpea lines under infested and un-infested conditions.

The neonate larvae fed on artificial diet with BS5A.2(T2) 19-2P1 leaf powder exhibited lowest larval survival, larval weights at 5 and 10 days after initiation (DAI) and pupal weights as compared to insects reared on diets with leaf powder of non-transgenic plants and showed maximum resistance to H. armigera. The survival and development of third-instar H. armigera during 2012-13 was significantly reduced in insects reared on diets with leaf powder of transgenic chickpea BS5A.1(T2) 18-1P1 as against those reared on non-transgenic chickpeas and showed high levels of resistance to third-instar larvae of H. armigera.
Maximum amount of protein was recorded in ICC 506EB and among the transgenic lines, the protein content was highest in BS5A.1(T2) 18-2P1. The amounts of carbohydrates were significantly higher in the leaves of ICC 506EB as compared to that on transgenic lines. The highest amount of lipids were recorded in BS5A.2(T2) 19-3P1 than in BS5A.2(T2) 19-3P2. There were no significant differences in phenol and tannin contents between the transgenic and non transgenic chickpea lines.

Significantly higher amounts of oxalic acid were recorded in BS5A.2(T2) 19-1P2 and BS5A.2(T2) 19-3P1 than in BS5A.2(T2) 19-2P1. Highest malic acid content was recorded on BS5A.1(T2) 18-1P1 and lowest on BS5A.2(T2) 19-3P2. Among the non-transgenics, the maximum amount of oxalic acid was observed in ICC 506EB, followed by Semsen. Oxalic acid content was positively correlated with larval survival and larval weight. A significant and negative association was observed between the amounts of the malic acid and leaf feeding, larval survival and larval weight.

Chlorogenic acid, gentisic acid, ferulic acid, naringin, naringenin and quercetin had a positive but non-significant correlation with resistance to *H. armigera*. There was a positive and significant association between 3,4 dihydroxy flavone, genistein, formononetin and biochanin A with leaf damage, larval survival and larval weight. The amount of CryIIa protein was highest in the fresh leaf samples, followed by green pod wall, green seeds, dry pod wall, dry seeds and dry stems. In dry roots the protein concentration was quite low whereas in soil samples, it was below detectable levels. The CryIIa protein content was significantly higher in larvae fed on BS5A.2 (T2) 19-2P1 and BS5A.1 (T2) 18-1P1.

During November 2011-12 planting, among the transgenic lines tested, the survival and development of *C. chlorideae* was significantly better when reared on *H. armigera* fed on leaves of BS5A.2(T2) 19-1P2 and BS5A.2(T2) 19-3P1. Among the transgenic lines tested, the survival and development of *C. chlorideae* was significantly better when reared on *H. armigera* fed on leaves of BS5A.1(T2) 18-1P1 and BS5A.2(T2) 19-2P1 as compared to that on other transgenic lines during November 2012-13 planting.

Survival and development of *C. chlorideae* wasps obtained from *H. armigera* larvae fed on diets with transgenic BS5A.1(T2) 18-1P1, BS5A.1(T2) 18-2P1 and BS5A.2(T2) 19-3P1 leaf powder was better as compared to that on BS5A.2(T2) 19-1P2 and BS5A.2(T2) 19-3P2 lines during 2012-13. No CryIIa protein was detected in the *C. chlorideae* larvae, the negative effects of transgenic chickpeas on survival and development of *C. chlorideae* were due to the early mortality of *H. armigera* as a result the parasitoids failed to complete the development on such larvae. The survival and development of *C. chlorideae* was poorer when reared on *H. armigera* larvae fed on fresh leaf samples than the artificial diets intoxicated with transgenic chickpea leaf powders.
The survival and development of coccinellids was reduced when fed on diets with 0.1% of BS5A.2 (T2) 19-3P1 and BS5A.2 (T2) 19-3P2 leaf powder, but not on diets with BS5A.1(T2) 18-2P1 leaf powder. The direct effects of transgenic chickpeas on survival and development of lady bird beetles being 0.02% < 0.05% < 0.1%, respectively.

There were no significant effects on survival and development of coccinellid grubs when fed on aphids reared on diets with 0.02% and 0.1% leaf powder of transgenic chickpeas. The survival and development was slightly affected on diets with BS5A.2(T2) 19-3P2 leaf powder. The coccinellids fed on diets with 0.05% BS5A.2(T2) 19-3P1 leaf powder showed a marginal reduction in survival and development as compared to that on other transgenic lines during 2012-13.

The survival and development of coccinellids was slightly affected when fed on diets with BS5A.2(T2) 19-3P2 leaf powder as compared to that on other transgenic lines. In diets with 0.1%, the survival and development was affected adversely when the coccinellid grubs were fed on diets with BS5A.2(T2) 19-3P1 leaf powder during 2013-14. Though there was no detection of CryIIa protein in Bt fed aphids and coccinellids, but there were adverse effects observed on survival and development.
ABSTRACT

The present studies were conducted in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad with an objective to evaluate the relative efficacy and persistent toxicity of selected insecticides viz., imidacloprid, thiamethoxam, acetamiprid, diafenthiuron, chlorfenapyr, spiromesifen and dimethoate against apterous viviparous cowpea aphids, *Aphis craccivora* (Koch), by leaf dip and direct spray methods.

The LC50 values of insecticides viz., spiromesifen, chlorfenapyr, acetamiprid, dimethoate, diafenthiuron, thiamethoxam and imidacloprid were 0.9312, 0.9297, 0.4731, 0.3498, 0.2924, 0.1446 and 0.0436 ppm, respectively by leaf dip method indicating that imidacloprid exhibited greater toxicity among the selected insecticides. However by direct spray method, the LC50 values of insecticides were 0.2038, 0.1672, 0.2037, 0.3258, 0.4797, 0.2014 and 0.7383 ppm, respectively, which indicated that spiromesifen was the most toxic among the insecticides tested.

The period of toxicity was higher for imidacloprid (19 and 20 days) followed by acetamiprid (15 and 16 days) > dimethoate (13 and 14 days) > thiamethoxam (11 and 19 days) > diafenthiuron, spiromesifen and chlorfenapyr (9 days each and 10 days each) at 24 and 48 hours of exposure, respectively. The PT (product of toxicity) values of test insecticides were in the order: imidacloprid (985.89 and 1381.40), acetamiprid (702.39 and 910.00), dimethoate (656.50 and 858.03), thiamethoxam (356.03 and 604.32), diafenthiuron (231.58 and 308.06), spiromesifen (197.82 and 499.20) and chlorfenapyr (139.71 and 279.40) at 24 and 48 hours, respectively, which indicated that imidacloprid was more persistent followed by acetamiprid and dimethoate than the remaining insecticides.

The LT50 values ranged between 0.925 to 7.618 days (24 hours after treatment) and 3.098 to 15.560 days (48 hours after treatment). The highest LT50 value of 7.618 and 15.560 days against cowpea aphid was obtained with imidacloprid followed by dimethoate (5.765 and

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**ENTOMOLOGY**

**Author** : SOUMYA PATIL

**Title of the thesis** : RELATIVE EFFICACY AND PERSISTENT TOXICITY OF SELECTED INSECTICIDES ON COWPEA APHID, *Aphis craccivora* (Koch)

**Major Advisor** : Dr. D. SRIDEVI

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

**College** : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

**Accession Number** : D 9856
10.542 days), acetamiprid (4.893 and 8.719 days) and thiamethoxam (2.867 and 6.015 days), at 24 and 48 hours after exposure, respectively. Whereas diafenthiuron, spiromesifen and chlorfenapyr showed the LT50 values of 1.540 and 3.454 days, 1.022 and 5.159 days and 0.925 and 3.098 days, respectively.

In the field studies, the % reduction of aphid population over control clearly indicated that imidacloprid 17.5 SL @ 50 g a.i./ha (56.62%) and dimethoate 30 EC @ 300 g a.i./ha (55.60%) were superior than acetamiprid 20 SP @ 15 g a.i./ha (52.02%), thiamethoxam 25 WG @ 50 g a.i./ha (51.78%) and chlorfenapyr 10 SC @ 100 g a.i./ha (51.49%) which showed greater efficacy than diafenthiuron 50 WP @ 50 g a.i./ha (49.76%) and spiromesifen 22.9 SC @ 120 g a.i./ha (49.20%).

The % reduction of flea beetle population over control indicated that dimethoate 30 EC @ 300 g a.i./ha (47.09%), imidacloprid 17.5 SL @ 50 g a.i./ha (45.29%) and acetamiprid 20 SP @ 15 g a.i./ha (45.20%) were superior to spiromesifen 22.9 SC @ 120 g a.i./ha (44.48%), diafenthiuron 50 WP @ 50 g a.i./ha (44.43%) and chlorfenapyr 10 SC @ 100 g a.i./ha (44.32%) and thiamethoxam 25 WG @ 50 g a.i./ha (43.17%).

The incremental cost: benefit ratio (ICBR) analysis of pesticidal treatments in cowpea showed that imidacloprid treated plot recorded highest average green fodder yield (10.47 t/ha) followed by dimethoate (9.73 t/ha), thiamethoxam (9.55 t/ha) and acetamiprid (9.55 t/ha). The other treatments recorded average green fodder yield of 8.81 t/ha (diafenthiuron), 8.26 t/ha (spiromesifen), 8.17 t/ha (chlorfenapyr) and 7.52 t/ha (untreated control). The highest cost: benefit ratio was recorded by acetamiprid (1:1.59) followed by dimethoate (1:1.48) and imidacloprid (1:1.41). Thiamethoxam showed the next best ratio (1:1.33). Whereas, diafenthiuron, chlorfenapyr and spiromesifen had ICBR ratios of 1:1.17, 1:1.15 and 1:1.14, respectively.
ENTOMOLOGY

Author : VENU GOPAL, G.
Title of the thesis : SPECIES COMPOSITION, SEASONAL INCIDENCE AND EVALUATION OF CHILLI ACCESSIONS AGAINST CHILLI THRIPS (Thysanoptera:Thripidae)
Major Advisor : Dr. K. VIJAYA LAKSHMI
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D9857

ABSTRACT

Investigations were carried out on the species composition, seasonal incidence and evaluation of chilli accessions against chilli thrips under field conditions during Kharif, 2014. Species composition of chilli thrips was studied by collecting the thrips from leaves, flowers and fruits and identified by using the taxonomic keys. The thrips species inhabiting the leaves and fruits were identified as *Scirtothrips dorsalis*, while the flowers were colonized by four species of thrips, of which three species viz., *Frankliniella schultzei*, *Thrips palmi* and *Thrips hawaiiensis* belong to the family Thripidae of Terebrantia sub order and the fourth species Haplothrips verbasci belongs to the Tubulifera sub order of phlaeothripidae family. Among blossom thrips, *F. schultzei* was the predominant species constituting 84.4% of the total population followed by *H. verbasci* (10.80%) and *T. hawaiiensis* (4.20%). *T. palmi* was found in very low numbers (4) and it constituted 0.60% of the total population.

The seasonal abundance studies of *S. dorsalis* in leaves revealed the prevalence of *S. dorsalis* population from (0.68/terminal) 43rd std. week at 38 days after transplantation and continued till the harvest (9.92/terminal) with the peak population occurring during 3rd std. week at 124 days after transplantation (January 3rd week). Among the blossom thrips, the incidence of *F. schultzei* was noticed (54 thrips/50 flowers) at 82 days after transplantation on 49th std. week (December I week) and it reached to highest peak (90 thrips/50 flowers) during January I week and declined gradually by the end of crop growth period. The next dominant species in the flowers was *H. verbasci* with an initial high population of (26 thrips/50 flowers) during 51st std. week (December III week) but after two weeks the population declined suddenly to 5 numbers by 2nd std. week (January II week) and later disappeared from the flowers by 10th std. week onwards. *T. hawaiiensis* population was also noticed in the flowers on 51st std. week and from 2nd week of January onwards it was found in very low numbers till 9th std. week (March I week) and later it disappeared at the end of the flowering season. *T. palmi* was present in very low numbers (4) in flowers. *S. dorsalis* population on fruits was noticed from 3rd std. week (58/50 fruits) and
reached to peak population on 4\textsuperscript{th} std. week and they continued to infest the fruits till the end of the season (11\textsuperscript{th} std. week).

Screening of thirteen chilli accessions against *S. dorsalis* was carried out under field conditions and based on per cent leaf curl index (PLI). The accessions were classified into 6 categories. Among the accessions, 3 accessions viz., EC-390033, EC-391082 and EC-596952 which recorded (< 10) less PLI were classified as resistant accessions while, two accessions EC-599994 and EC-599976 which recorded > 50 PLI were highly susceptible to thrips. The chilli accession EC-572470 showed moderately resistant reaction, while EC-570343 was moderately susceptible to thrips. The rest of the six accessions (IC-284474, EC-599957, EC-596958, EC-599959, EC-391087 and EC-599967) were categorised as susceptible. The morphological traits and yield attributes observed in the chilli accessions revealed that the three resistant accessions EC-390033, EC-391082 and EC-596952 not only showed superior performance by recording less thrips population and low PLI, they possessed better morphological traits and gave good yield, while the highly susceptible accessions EC-599994 and EC-599976 and the susceptible accession EC-599957 in spite of recording maximum leaf curl index and high thrips population gave higher yield showing the possible tolerance mechanism of resistance.
ENTOMOLOGY

Author : VIJAY KUMAR, P.
Title of the thesis : SURVEY ON PESTICIDES USAGE, MONITORING OF PESTICIDE RESIDUES AND DECONTAMINATION METHODS IN CAULIFLOWER (Brassica oleracea L.)
Major Advisor : Dr. V. SHASHI BHUSHAN
Degree : M.Sc.(Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9854

ABSTRACT

The survey on pesticide use pattern was carried out by interviewing farmers growing cauliflower in fields based on the questionnaire prepared to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and use. Based on the monitoring results of the market samples, studies were undertaken to establish decontamination methods of commonly used insecticides at recommended dose in field situations to assess the differences in rate of decontamination of pesticide. The pesticides viz., triazophos, cypermethrin and quinalphos recommendation which were prominent in the market samples were sprayed and cauliflower samples collected at zero days and analyzed for residues. Various decontamination methods were evaluated to assess the efficiency of method for removal of pesticide residues from cauliflower for food safety.

Education levels of farmers is very less, where 36.25% farmers are illiterate. Majority of the farmers (41.25%) grow 1 acre and 2 acres (37.5%). Majority of farmers (92.5%) grow the crop in rabi season followed by kharif season (43.75%). Information on pesticide related issues indicates that 33.75% farmers know about recommended pesticides. However, in general, half of the farmers (82.5%) contact pesticide dealer for recommendations and some farmers prefer to contact agricultural officers. Most farmers are unaware about pesticide classification and toxicity symbols on packing. Farmers are aware about endosulfan ban, but only 16.25% farmers know about ban of monocrotophos on vegetables. Very few farmers know about pesticide residues and related issues, but know washing helps to reduce contamination. Among the respondents 82.25% of farmers observed pesticide effects on the health of spray workers during the spray. More common health problems observed during spray includes bad odour (85%), skin irritation (41.25%), eye irritation (22.5%), headache (23.75%) and breathlessness (11.25%).

The cauliflower samples were collected from three different local vegetable markets viz., Shamshabad, Mehadipatnam and Gudimalkapur in and around Hyderabad and analyzed for residues following the validated QuEChERS method. The results revealed that, monitoring
samples of cauliflower contained around 11 pesticide residues namely, chloropyrifos, profenophos, cypermethrin, acephate, ethion, methylparathion, carbendazim, triazophos and quinalphos. Frequently observed pesticides found in the 3 markets samples were triazophos, cypermethrin, and quinalphos. Based on the results, frequently detected pesticides i.e., triazophos, cypermethrin and quinalphos were analysed for further decontamination studies. For this purpose crop has been raised in the student farm as per good agricultural practices of PJTSAU.

Among various decontamination methods tested, hot water treatment was found to be very effective in removing pesticide residues to an extent of 50-65% chloropyrifos followed by common methods i.e., 2% salt solution wash is also effective method in removing residues in the range of 40-60%, acetic acid solution removed pesticides in the range of 35-55% and tap water in the range of 13-55%.
ENTOMOLOGY

Author : VINOD S KUKANUR
Title of the thesis : FITNESS COSTS OF RESISTANCE TO Cry1Ac IN Helicoverpa armigera (HUBNER)
Major Advisor : Dr. T.V.K. SINGH
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9861

ABSTRACT

Natural populations of Helicoverpa armigera (Hubner) were collected from various hosts in Telangana and Andhra Pradesh to estimate the frequency of resistance allele conferring resistance to Cry1Ac and fitness costs associated with resistance alleles.

During the study, F2 screen was established from field collected populations, and a total of 570 isofemales were established, from which 102 isofemales successfully produced F2 progenies and all the F2 progenies were screened using diet containing discriminating dose of Cry1Ac toxin @1μg/ml. Of 102 isofemale lines, 32 lines were confirmed after F3 tests as true positive to carry resistance alleles to Cry1Ac toxin. Remaining 70 isofemale lines did not survive the screen confirming absence of resistance alleles or confirming the presence of SS genotypes.

The frequency of Cry1Ac resistance allele in H. armigera was calculated using Bayesian inference. The estimated allele frequency for 2013-2014 was 0.085 with credibility interval ranging from 0.052-0.121 and estimated allele frequency for 2014-15 was 0.038 with credibility interval ranging from 0.016-0.069. The detection probability was 97 per cent during 2013-14 and 2014-15. The PNO for the first year was 0.028 and 0.023 during second year, indicating there was <3 per cent of chance of not detecting resistance allele(s) in the lines screened.

Resistant and susceptible strains were developed using F2 screen and thereafter F1 heterozygotes by crossing resistant and susceptible strain to study fitness cost associated with resistance allele. Fitness costs of resistance was studied by comparing life history parameters of resistant, susceptible and F1 heterozygotes. From the present study, fitness costs were evident with respect to larval weight gain, larval duration, malformed pupae, adult emergence and intrinsic rate. The study revealed that, lower weight gain was noticed in resistance strain that developed on toxin free diet (normal diet) during third instar (at 7 days), fourth instar, fifth instar and pre-pupal stage compared to susceptible strain. Similar was the case with F1 heterozygote which did not gained significant weight during third instar, fourth instar, fifth instar, pre-pupal and pupal stages compared to susceptible strain. Mean pupal duration did not differed much
between resistant, susceptible strain and F1 heterozygotes. Resistant strain took around 2-4 longer days duration to complete larval period on normal diet compared to susceptible strain. Resistant strain recorded high mortality on Cry1Ac toxin diet compared to resistant strain reared on toxin free diet and susceptible strain. Mortality of resistant and susceptible strain did not differed when developed on toxin free diet in all the experiments. Around 20 to 22 per cent of malformed pupae were noticed in resistant strain that developed on toxin free diet compared to susceptible strain.

Early adult emergence and egg laying was noticed in susceptible strain compared to resistant strain developed on toxin free diet and Cry1Ac toxin diet and F1 heterozygotes. The highest net reproduction rate (R0) was noticed in F1 heterozygotes in experiment III followed by the susceptible strain during experiment I, II and III and least net reproduction rate was recorded in resistant strain that developed on toxin free and Cry1Ac toxin diet.

The intrinsic rate of susceptible strain ranged from 135.03 to 181.45, while it reduced to > 50 per cent in resistant strain developed on toxin free diet and Cry1Ac diet. F1 heterozygote recorded intrinsic rate of 218.22. Intrinsic rate of natural increase (rm) of susceptible strain was highest and ranged from 0.11 to 0.16. The rm for resistance that developed on normal diet was lower compared to susceptible strain which ranged from 0.09 to 0.14 and the rm for F1 heterozygotes was 0.14.
ABSTRACT

A field experiment was conducted at college of Agriculture, Rajendranagar, Hyderabad, Telangana State to study the effect of organic amendments viz., vermicompost, biogas slurry and FYM and inorganic fertilizers on soil amelioration and performance of sorghum crop grown in polluted soil. The treatments consisted of T1 (control), T2 (RDF@ 100 : 60 : 40 N,P2O5 and K2O ha-1 through fertilizers), T3 (RD-N, K+ double dose of P), T4 (Vermicompost @ 5 t ha-1 +RDF), T5 (Biogas slurry @ 5 t ha-1 +RDF), T6 (FYM @ 5 t ha-1 +RDF), T7 (Vermicompost @ 5 t ha-1+ RD- N, K and double dose of P ), T8 (Biogas slurry @ 5 t ha-1+ RD- N, K and double dose of P ) and T9 (FYM @ 5 t ha-1+ RD- N, K and double dose of P). Inorganic N, P and K were supplied through urea, single super phosphate and muriate of potash. Plant samples were collected at 30 DAS and at harvest and soil samples were collected before sowing (initial) and after harvest. No. of ear heads per m2, No. of grains per ear head, test weight and yield were recorded at harvest. The plant samples were analyzed for N, P, K and micronutrients and heavy metals. Soil samples were analyzed for pH, EC, OC, available N, P and K, micronutrients and heavy metals.

At 30 DAS, the highest dry matter production was recorded in T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P) with 5.9 kg ha-1. At 90 DAS, the highest plant height and dry matter were recorded in T6 ( FYM @ 5 t ha-1 +RDF). The primary nutrients, N uptake was recorded highest by T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P) at 30 and 90 DAS and P uptake by T9 (FYM @ 5 t ha-1+ RD- N, K and double dose of P) at 30 DAS and by T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P ) at 90 DAS and K uptake by T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P) at 30 DAS and by T9 (FYM @ 5 t ha-1+ RD- N, K and double dose of P) at 90 DAS. The highest grain and stover yield were recorded by T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P) with 2185 and 5199 kg ha-1 respectively and chloropyll content was also recorded highest in T5 (Biogas slurry @ 5 t ha-1 + RDF) at 30 and 90 DAS. which was on par with T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P).
The Micronutrients, Mn and Cu uptake were recorded highest in T9 (FYM @ 5 t ha-1+ RD- N, K and double dose of P) at 30 and 90 DAS. Fe and Cu uptake was highest in T8 (Biogas slurry @ 5 t ha-1+ RD – N, K and double dose of P) at 30 and 90 DAS. At 90 DAS, Cu uptake was highest in T4 (Vermicompost @ 5 t ha-1+ RDF) and T6 (FYM @ 5 t ha-1+ RDF) treatments.

The heavy metals Pb uptake was recorded highest in T8 (Biogas slurry @ 5 t ha-1+ RD- N, K and double dose of P) at both 30 DAS and harvest. Ni uptake was highest in T7 (Vermicompost @ 5 t ha-1 + RD – N, K and double dose of P) at 30 DAS and by T9 (FYM @ 5 t ha-1+ RD – N, K and double dose of P) at 90 DAS.

Amendments effect on soil pH and EC was non-significant. The highest available soil N was found in T7 (Vermicompost @ 5 t ha-1+ RD- N, K and double dose of P) and highest available soil P was found in T3 (RD-N, K+double dose of P2O5 ha-1) and the highest K was found in T2 (RDF @ 100 : 60 : 40 N,P2O5 and K2O ha-1 through fertilizers). The highest available soil Mn, Zn, Cu, Fe and Ni was found in T1 (Control) and the highest available Pb was found in T4 (Vermicompost @ 5 t ha-1+ RDF).

The above study indicated that the application of organic amendments in combination with inorganics was highly beneficial from the view of soil nutrient availability and yield of sorghum in polluted soil. Biogas slurry with inorganic N, K + double dose of P (T8) recorded highest grain and stover yield.

The final conclusion of the research reveals that the overall the content of available micronutrients and heavy metals in post harvest soils was low when the double dose of recommended P was applied either with in organic N, K or with Organic amendments suggested the applicable of higher dosage of P then SSP in amelioration of polluted soils.
ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Author : PRASANNA LAKSHMI YAMALA
Title of the thesis : STUDIES ON UTILITY OF WASTE WATERS OF NOOR MOHAMMAD KUNTA AND ITS EFFECT ON GROWTH OF MARIGOLD (Tagetes erecta L.)
Major Advisor : Dr. T. RAMESH
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9760

ABSTRACT

Pot culture experiment was conducted to study the utilization of Noor Mohammad Kunta for cultivating marigold crop. The experiment was laid out in completely randomized block design with four replications. There were eight treatments consisting of T₁ (Normal water), T₂ (25% waste water + 75% normal water), T₃ (50% waste water + 50% normal water), T₄ (SSP @ 0.05 g kg⁻¹ soil + 50% diluted water), T₅ (Lime @ 1.25 g kg⁻¹ soil + 50% diluted water), T₆ (FYM @ 5 g kg⁻¹ soil + 50% diluted water), T₇ (Rice bran @ 2 g l⁻¹ irrigation water + 50% diluted water) and T₈ (Hydrous Iron Oxide @ 20 mg Fe ha⁻¹ soil + 50% diluted water). Fertilizers recommended to the crop were applied through urea, single super phosphate and murate of potash.

Waste water was diluted with normal water in different proportions and assessed for its quality and feasibility for using as irrigation water. Different treatments analysed were T₁ (100% normal water), T₂ (25% waste water + 75% normal water), T₃ (50% waste water + 50% normal water), T₄ (75% waste water + 25% normal water) and T₅ (100% waste water). Waste water was alkaline in nature (8.97) with EC of 2.37 dS m⁻¹ belonging to C₄ category. Total dissolved solids, total hardness, temporary hardness, chemical oxygen demand of the waste water were 1412 mg l⁻¹, 249.17 mg l⁻¹, 254.84 mg l⁻¹ and 40.92 mg l⁻¹, respectively which were found higher than the normal water. The cadmium, chromium and nickel content of the waste water were recorded as 0.37, 0.60 and 1.47 mg l⁻¹, respectively. The quality in all respects was found to be improved upon dilution with normal water.

Marigold plants were irrigated with 50% diluted waste water (as 25% diluted and waste water caused mortality) and 5 different amendments were applied to reduce the effect of salt content and heavy metals. Addition of amendments to the soil had increased the plant height throughout the crop growth period. Highest plant height (31.16 cm) was recorded by T₄ (SSP @ 0.05 g kg⁻¹ soil + 50% dilution water) and the lowest was recorded by T₃ (18.83 cm) where 50% dilution water was used without any amendment. Highest chlorophyll content (58.43 SCMR
units) was observed in treatment T₆ (FYM @ 5 g kg⁻¹ soil + 50% dilution water). Application of waste water reduced the specific leaf area of marigold crop, lowest was recorded in T₃ (42.07 cm² g⁻¹) where 50 : 50 dilution water was used. Application of SSP as soil amendment (T₄ - SSP @ 0.05 g kg⁻¹ soil + 50% dilution water) resulted in highest plant height (26.62 cm), number of flowers (6.75) and flower yield (561.8 g plant⁻¹). Over the crop growth period, the heavy metal content of the plant recorded an increase. Lowest values of cadmium, chromium and nickel were recorded by plants in T₁. Among the other treatments, cadmium content in plants was recorded lowest in T₆ where FYM was used as soil amendment and chromium and nickel were recorded lowest in T₄, where SSP was used as amendment.

The pH of the soil was moderately alkaline in its nature when irrigated with diluted waste water (T₃). Addition of different amendments had decreased the pH of the soil from 8.07 in 50:50 dilution without amendments (T₃) to 7.79, except with lime (T₅). EC of the soil was found highest in the treatment where 50 % waste water + 50 % dilution water was used (T₃) which was decreased by the addition of amendments.

Heavy metals (Cd, Cr and Ni) content in soils throughout the crop growth were recorded lowest by normal water treatment (T₁) and were highest in T₃ where 50 % dilution waste water was used. Among different amendments, application of FYM @ 5 g kg⁻¹ soil + 50% dilution water (T₆: 0.07 mg kg⁻¹) had recorded lowest soil cadmium content; and application of SSP (T₄ – SSP @ 0.05 g kg⁻¹ soil + 50% dilution water), recorded lowest chromium and nickel content in soils.

Irrigating the soils with normal water was found best. Lack of normal water availability forces farmer to use waste water particularly in peri urban areas, in which case use waste water with 50 per cent dilution along with SSP or FYM as amendments to soil is suggested for growing marigold crop.
ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Author : RAGINI, K.
Title of the thesis : SURVEY ON PESTICIDE USE, MONITORING OF PESTICIDE RESIDUES AND DECONTAMINATION METHODS IN BHENDI (Abelmoschus esculentus L.)
Major Advisor : Dr. B. ANIL KUMAR
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9759

ABSTRACT

The survey on pesticide usage pattern was carried among the bhendi growing farmers based on the questionnaire prepared to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and their use. Studies were conducted on decontamination methods of commonly used insecticides at the recommended dosage to assess the differences in rate of decontamination of insecticides, which were selected based on the monitoring results of the market samples. Insecticides viz., fipronil, flubendiamide, lambda cyhalothrin and acetamiprid were sprayed on the bhendi crop and the samples collected at zero days were analyzed for residues. Various decontamination methods were evaluated to assess the efficiency of method for removal of insecticide residues from bhendi for food safety.

Education levels of farmers are very less and only (30%) of the farmers had at least primary school education. Majority of the farmers (40%) cultivated in < 0.5 acre and (26.66%) of the farmers cultivated under 1acre. Majority of the farmers (56.66%) cultivate the crop in summer season followed by kharif season (36.66%). About 33.33% of the farmers had awareness on recommended pesticides against different pests. In general, 70% of the farmers contacted pesticide dealers for recommendations and only few farmers i.e. 16% preferred to contact Agricultural Officers. Most farmers were unaware about pesticide classification and toxicity symbols on packing. Majority of the farmers were aware of ban on endosulfan and monocrotophos on vegetables. Very few farmers know about pesticide residues and related issues, but knew that washing helps to reduce contamination. About 60% of the farmers grow the crop upto 4 months and 40% of farmers grow upto 5 months. Among the respondents, only 20% of them have observed pesticide effects on the health of spraying men during the spray and the most common health problems observed during the spray were skin irritation (40%), breathlessness (20%), head ache (20%), eye irritation (13.33%), and cough (6.66%).
The bhendi samples were collected from three local vegetable markets viz., Rythu bazar, Tower circle and Ramnagar of Karimnagar and analyzed for residues following the validated QuChERS method. The results revealed that, monitored samples of bhendi contained 10 pesticide residues namely acetamiprid, flubendiamide, chlorpyriphos, profenophos, fipronil, spinosad, lambda cyhalothrin, monocrotophos, acephate and imidacloprid and the commonly detected pesticides in the three market samples were flubendiamide, lambda cyhalothrin, fipronil, profenophos, chlorpyriphos and acetamiprid. Based on these results, the insecticides which were detected commonly i.e., flubendiamide, lambda cyhalothrin, fipronil and acetamiprid were selected and tested for further decontamination studies. For this purpose, crop has been raised in Student’s Farm as per good agricultural practices of PJTSAU.

The final conclusion of the research reveals that among various decontamination methods tested, 2% salt solution was found to be very effective in removing pesticide residues to an extent of 30-52% varying with type of pesticides and is followed by other common methods i.e., 2% tamarind solution (29-41%), baking soda (15-41%), lemon water (16-32%) and tap water treatment in the range of 14-27%.

Assessment on the permissibility of the three market samples of bhendi for safe consumption was analyzed and among the samples analyzed for different insecticide residues, two of the insecticides i.e. chlorpyriphos and acetamiprid have shown above MRL value established by Codex, while the remaining insecticide residues detected in the samples were below the MRL.
ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Author : SANATH RAJ, D.
Title of the thesis : PERFORMANCE OF VEGETABLE CROPS IN POLLUTED SOIL.
Major Advisor : Dr. P. PRABHU PRASADINI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9758

ABSTRACT

A field experiment was conducted to study the performance of vegetable crops in polluted area of PJTSAU farm where the soils contained lead and cadmium above the normal values and the water available for irrigation contained Mn, Cu, Cd, and Cr contents higher than the standards. The crops studied were: T_1-radish, T_2-carrot, T_3-potato, T_4-tomato, T_5-brinjal, T_6-bhendi, T_7-palak, T_8-fenugreek and T_9-control. Experiment was laid out in RBD. Recommended dose of organic and inorganic fertilizers were applied. The performance was studied by recording data on dry matter production, edible yield, nutrients and heavy metal content and uptake, and their impact on properties of post harvest soils. All plant and edible parts were analysed for N, P, K, Fe, Mn, Zn, Cu, Pb, Cd, Ni, and Cr for their contents and uptake was computed. Soil samples were analyzed for pH, EC, available N, P, K, Fe, Mn, Zn, Cu, Pb, Cd, Ni, and Cr using standard procedures.

Highest dry matter production at harvest was recorded by T_1 (radish - 2.023 t ha\(^{-1}\)) and lowest by T_6 (bhendi - 0.460). Edible yield on fresh weight basis indicated that leafy vegetables (palak and fenugreek) performed better in this soil followed by root crops (radish, carrot and potato, and fruit vegetable crops (bhendi, tomato and brinjal); and the yields ( t ha\(^{-1}\)), were as follows: T_1 - radish (7.95), T_2 - carrot (10.43), T_3 - potato (13.72), T_4 - tomato (14.73), T_5 - brinjal (16.06), T_6 - bhendi (4.33), T_7 - palak (5.56 ) and the lowest was recorded in T_8 - fenugreek (4.88). When compared to the average yields of Telangana state the yields were lower in all the vegetables studied. The per cent reduction in the yield was lowest in palak (36 per cent) and highest with bhendi (57 per cent).

Content of major nutrients, micronutrients and heavy metals in the plants varied significantly among the crops, however, the values were within the safe limits. Data recorded on nutrients and heavy metals content of edible parts of different crops revealed that the differences among crops with respect to all, except for P and Cr were significant. Regarding toxic heavy metals content (mg kg\(^{-1}\)) in edible parts of crops, highest content of Pb (6.04) and Cr (0.19) were recorded by T_1 – radish and Ni (3.9) and Cd (0.069) by T_7 – palak. Tomato fruits recorded lowest values of Pb (3.01), bhendi recorded lowest Cd (0.034) and brinjal fruits were low in Ni (2.20).
Chromium was lowest in fruit crops namely bhendi, brinjal and tomato. Crops varied significantly with respect to the crop uptake of N, P, K, micronutrients and heavy metals, both in case of plants and edible parts.

Effect of growing these crops on pH, EC, available N, P, K, Zn, Cu and Cd in post harvest soils was found to be non significant. The highest available N was recorded by T8 (fenugreek) highest available P was recorded by T4 (tomato) and highest available K2O was recorded by T1 (radish) in post harvested soils. Among the crops highest Mn (18.51 mg kg⁻¹) was recorded by T1 (radish), Fe (25.25) and Cu (2.19) were recorded by T6 (bhendi) and Zn (3.03) was recorded by T8 (fenugreek). Heavy metals in post harvest soils were recorded as Pb (5.80 mg kg⁻¹) in T3 (potato), Cd (0.05) in T2 (carrot), Ni (0.92) in T8 (fenugreek), Cr (0.90) in T7 (palak).

Concluding, as the lead content in edible parts was above the safe limits it is discouraged to grow vegetable crops in these soils of PJTSAU farm with the water available for irrigation in that farm, for human consumption.
ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Author : SUSAN PRIYADARSHINI, K.
Title of the thesis : MONITORING OF PESTICIDE RESIDUES AND DECONTAMINATION METHODS IN BRINJAL (Solanum melongena L.).
Major Advisor : Dr. B. ANIL KUMAR
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9758

ABSTRACT

A survey on pesticide usage pattern was carried out on the brinjal growing farmers based on the questionnaire prepared to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and its use. Studies were conducted on decontamination methods of commonly used insecticides at the recommended dosage to assess the differences in rate of decontamination of pesticides, which were selected based on the monitoring results of the market samples. Insecticides viz., profenophos, cypermethrin, lambda cyhalothrin and ethion were sprayed on the brinjal crop and the samples collected at zero days were analyzed for residues. Various decontamination methods were evaluated to assess the efficiency of method for removal of pesticide residues from brinjal for food safety.

Education levels of farmers are very less and only 30 percent of the farmers had at least primary school education. Majority of the farmers 33.33 percent cultivated in >0.5 acre and 23.33 percent of the farmers cultivated under 1 acre. Majority of the farmers 66.66 percent cultivated the crop in summer season followed by kharif season 30 percent. About 40% of the farmers had awareness on recommended pesticides against different pests. In general, 66.67 percent of the farmers contacted pesticide dealers for recommendations and few farmers preferred to contact agricultural officers. Most farmers are unaware about pesticide classification and toxicity symbols on packing. Majority of the farmers were aware of ban on endosulfan and monocrotophos on vegetables. Very few farmers know about pesticide residues and related issues, but knew that washing helps to reduce contamination. About 56.66 percent of the farmers grow the crop upto 4 months and 43.33 percent of farmers grow up to 5 months. Among the respondents, only 13.33 percent of them have observed pesticide effects on the health of spraying men during the spray and the most common health problems observed during the spray were skin irritation 36.66 percent, breathlessness 26.66 percent, head ache 20 percent, eye irritation 10 percent, and cough 6.66 percent.
The brinjal samples were collected from three local vegetable markets viz., Jangaon, Raghunathpally and Hanmakonda of Warangal district and analyzed for residues following the validated QuEChERS method. The results revealed that, monitored samples of brinjal contained 10 pesticide residues namely dimethoate, malathion, chlorpyriphos, profenophos, quinalphos, ethion, lambda cyhalothrin, cypermethrin, deltamethrin and fenvalerate and the commonly detected pesticides in the three market samples were profenophos, cypermethrin, lambda cyhalothrin and ethion. Based on these results, the pesticides which were detected commonly were tested for further decontamination studies. For this purpose, crop has been raised in students’ farm as per good agricultural practices of PJTSAU.

Assessment on the permissibility of the three market samples of brinjal for safe consumption was analyzed and among the samples analyzed for different insecticide residues, two of the insecticides i.e. chlorpyriphos and cypermethrin have shown above the Maximum Residue Level value established by Codex, while the remaining insecticide residues detected in the samples were below the Maximum Residue Level.

Among the various decontamination methods tested, 2 percent salt solution was found to be very effective in removing pesticide residues to an extent of 50-87 percent varying with type of pesticides except in case of lambda cyhalothrin and was followed by other common methods i.e., 2 percent tamarind solution which was also an effective method in removing the residues to an extent of 50-67 percent and tap water treatment in the range of 20-34 percent.
GENETICS AND PLANT BREEDING

Author : AMBATI SRIJAN

Title of the thesis: STUDIES ON COMBINING ABILITY AND BLAST RESISTANCE IN HYBRID RICE (Oryza sativa L.)

Major Advisor : Dr. S. SUDHEER KUMAR

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9829

ABSTRACT

The present investigation was undertaken to identify the effective restorers and maintainers among the elite lines. Based on the results, 12 parents were selected and mated in line × tester mating design to study the combining ability and magnitude of heterosis of experimental hybrids for grain yield per plant and yield contributing characters in Telangana.

Out of 23 lines screened for restorer and maintainer reaction 12 lines exhibited very high spikelet fertility (>75%), 8 lines exhibited partial fertility (50 to 75%), 3 lines resulted low fertility (0.1 to 50%) and none of the lines recorded complete sterility (0%). Based on the results, 12 R lines were identified as male parents and crossed with three CMS lines (IR 72081A, IR 68902A, IR 58025A) in line × tester mating design resulting in 36 hybrids. The 15 parents, 36 hybrids and a hybrid check, PA-6129 were evaluated at Rice Research Centre, Rajendranagar of Telangana during Kharif 2014 for combining ability and heterosis. Further blast screening experiment was done during Rabi 2014-15, using the checks, IR-64 and TN1.

The analysis of variance for grain yield and yield contributing characters revealed significant difference between the treatments for all the characters under study indicating that there was sufficient variability among the lines tested. Hence, combining ability analysis was carried out.

The analysis of variance for combining ability revealed significant difference between the treatments for grain yield per plant and all the component traits, thus justifying their use in the present investigation. Similarly, hybrids also varied considerably between themselves, suggesting the wide variability among the crosses.

The parents vs crosses were significant for all the characters studied except panicle length, number of unproductive tillers per plant and grain length-breadth ratio. Significance of parents vs crosses indicates that significant heterosis is observed for were found significant for
all the characters; the testers were significant for majority of characters except panicle length, flag leaf width and spikelet fertility per cent; while the interaction between lines and testers were significant for all the traits studied which suggests sufficient variability.

On the whole, based on the mean performance, GCA effects and SCA effects, IR 72081A was best among the testers while among the lines, MTU 1010, RNR 15038 and IR 64 performed better. Among the hybrids IR 58025A × MTU 1010, IR 68902A × RNR 15038 and IR 72081A × RNR 15038 performed superior to check PA 6129 in the present investigation.

Heterosis for single plant yield is mainly because of simultaneous manifestation of heterosis for yield component traits. Out of 36 hybrids studied, the significant standard heterosis is observed in 3 hybrids viz., 58025A × MTU 1010 (18.25), IR 68902A × RNR 15038 (14.59) and IR 72081A × RNR 15038 (9.57) over the hybrid check, PA 6129.

From the blast screening experiments by UBN (Uniform Blast Nursery) method, it was found that 22 hybrids and 5 parents are resistant to screening reaction; 14 hybrids and 7 parents are moderately susceptible; and 3 parents are highly susceptible to the blast disease. The parents which showed resistant reaction were IR 64, NLR 33358, KNM 118, RNR 15048 and RNR 15038 which can be used as parents for development of blast resistant varieties and hybrids. Among the top 10 hybrids with high yielding per se performance, 8 hybrids showed resistant reaction. The best hybrids identified with blast resistance are, IR 72081A × MTU 1010, IR 72081A × IR 64, IR 72081A × RNR 15038, IR 72081A × RNR(RK) 28, IR 72081A × RNR(RK) 53, IR 68902A × IR 64, IR 68902A × RNR 15038 and IR 58025A × MTU 1010.

Character association and path analysis revealed that the traits viz., productivity/day, days to 50 per cent flowering, grain length, number of productive tillers per plant, panicle weight, number of filled grains per panicle, 1000 grain weight, flag leaf width and flag leaf length have direct positive effect on grain yield per plant. 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.

From this study, three hybrids viz., IR 58025A × MTU 1010, IR 68902A × RNR 15038 and IR 72081A × RNR 15038 were identified as best hybrids with high significant standard heterosis for grain yield and yield contributing characters, high SCA effects and blast resistance. These hybrids are recommended for further testing over locations and seasons, for stable performance.
GENETICS AND PLANT BREEDING

Author : HYMAVATHI, M.

Title of the thesis : STUDIES ON GENETIC DIVERGENCE AND CHARACTER ASSOCIATION IN SOYBEAN (Glycine max L.)

Major Advisor : Dr. V. HEMALATHA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9823

ABSTRACT

Studies were carried out under field conditions during kharif, 2014 at College of Agriculture, Rajendranagar, Hyderabad with 46 genotypes obtained from different geographic regions on Randomized Block Design with two replications to study the variability, heritability, genetic advance, genetic divergence and the association between yield and its component traits.

Evaluation of 46 soybean genotypes for 11 characters indicated the existence of high variability for branches per plant, pods per plant, biological yield, pod shattering and seed yield per plant (g). High heritability coupled with high genetic advance as percent of mean was registered by the traits, plant height (cm), number of branches per plant, number of pods per plant, 100 seed weight (g), biological yield per plant (g), harvest index (%), pod shattering per plant and seed yield per plant (g) indicating predominance of additive gene action.

The character association studies revealed that biological yield, branches per plant, 100 seed weight exhibited significant positive correlation and high positive direct effect on seed yield and hence simultaneous selection of these traits will improve the seed yield.

The results of multivariate analysis and principal component analysis indicated the presence of considerable genetic divergence among 46 genotypes studied. The 46 genotypes were grouped into 8 clusters in both the methods and the clustering pattern revealed that there was no relationship between genetic diversity and geographical distribution. Biological yield per plant, harvest index, 100 seed weight and seed yield per plant contributed maximum towards diversity in $D^2$ analysis and principal component analysis identified four components, which contributed 79.77% of cumulative variance.

Based on the present investigation results, it can be concluded that the genotypes with high seed yield should be selected from different clusters and crossed so as to improve seed
yield. The cluster VIII has recorded the highest mean value for number of pods per plant, seeds per pod, seed yield per plant and low pod shattering. Whereas, cluster VI recorded highest mean value for number of branches per plant. Cluster II recorded the highest mean value for 100 seed weight. The genotypes BR 15, JS 335, MACS 1370 with high mean values may directly be used for adoption or may be used as parents in future hybridization programme.
GENETICS AND PLANT BREEDING

Author                      :  JAYA PRAKASH, T.

Title of the thesis          :  “STUDIES ON GENETIC VARIABILITY AND SELECTION GAIN IN SEGREGATING GENERATIONS FOR PROTEIN AND YIELD CONTENT IN RICE (Oryza sativa L.)”

Major Advisor               :  Dr. T. DAYAKAR REDDY

Degree                      :  M.Sc. (Ag.)

College                     :  COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number            :  D 9825

ABSTRACT

In the present investigation, two hundred progenies of four crosses of rice were evaluated to study the genetic variability and selection gain in segregating generations, to estimate the genetic parameters among the progenies for yield and protein content, 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 Indian Institute of Rice Research (IIRR), Ramachandra puram farm, International Crops Research institute for Semi Arid Tropics (ICRISAT) campus, Patancheru, Hyderabad, during Kharif 2014.

Analysis of variance indicated the existence of significant differences among the progenies for all the traits under study. High GCV and PCV values were observed for number of filled grains per panicle and total number of grains per panicle. High heritability coupled with high genetic advance as per cent of mean was observed for number of filled grains per panicle, plant height and total number of grains per panicle, which indicated that, these traits were controlled by additive type of gene action. These characters can be further improved by following simple selection procedure. The remaining traits were mostly under the influence of non-additive gene effects as they recorded low to moderate estimates of genetic advance.

Highest selection intensity observed for the crosses Suraksha x RP Bio-226 and Suraksha x Jalanidhi, while lowest selection intensity observed for the cross Suraksha x Mahamaya. Selection gain is greater than the expected mean yield in F3 generation for the cross Suraksha x Phalguna and Suraksha x Mahamaya. Selection gain has increased for both crosses in next generation, indicating that selection is effective for that particular character i.e, seed yield per plant. Selection gain was lower than expected mean yield for the cross Suraksha x Jalanidhi and
Suraksha x RP Bio-226. Selection gain is decreased for both crosses in next generation, indicating that selection is ineffective for that particular character *i.e.*, seed yield per plant.

Character association studies revealed that the characters grain yield per plant showed significant positive association with number of productive tillers per plant, number of filled grains per panicle, total number of grains per panicle, spikelet fertility and 1000-grain weight. This indicated that simultaneous selection of all these characters is important for yield improvement.

A critical analysis of the results by path analysis revealed that total number of grains per panicle exerted the highest positive direct effect on grain yield followed by spikelet fertility, 1000 grain weight, number of productive tillers per plant, L/B ratio, kernel breadth, panicle length, days to 50% flowering, days to maturity, indicating that the selection for these characters is likely to bring about an overall improvement in grain yield per plant directly.

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 progenies.
GENETICS AND PLANT BREEDING

Author : KALYAN, BODEMPUDI

Title of the thesis : CHARACTERIZATION, EVALUATION AND GENETIC DIVERGENCE STUDIES IN RICE (Oryza sativa L.) GERMPLASM

Major Advisor : Dr. K.V. RADHA KRISHNA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9827

ABSTRACT

In the present investigation, 70 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 Kharif 2014.

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 grain yield per plant, number of productive tillers per plant and number of tillers per plant. High heritability coupled with high genetic advance as per cent of mean was observed for grain yield per plant, followed by number of productive tillers per plant, number of filled grains per panicle, number of tillers per plant and plant height. This 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 one comprising of twenty two genotypes followed by cluster III with fifteen genotypes, cluster II with twelve genotypes, cluster IV with nine genotypes, clusters VII, IX and X with four, three and two genotypes respectively and clusters V, VI and VIII with one genotype each. The highest divergence occurred between cluster IV and X (194.56) followed by cluster IX and X (173.70), cluster VI and X (165.29), cluster VI and V (159.20), cluster VII...
and VIII (156.65) and cluster IV and IX (143.30), while it was low between cluster I and VIII (39.11), followed by cluster V and X (43.30), cluster VIII and IX (44.62).

Based on the inter cluster distances, a hybridization between the genotypes (IC-75789, IC-75855, IC-75913, IC-75920, IC-75864, IC-217892, IC-217760, IC-218029, IC-217978) of cluster IV and cluster X (IC-217954, IC-217992), cluster IX (IC-217781, IC-218017, IC-217867) and cluster X (IC-217954, IC-217992), cluster VIII (IC-217848) with cluster IX (IC-217781, IC-218017, IC-217867), 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 X is having highest mean value for plant height, 1000 grain weight, grain yield per plant. Cluster II for days to fifty per cent flowering, days to maturity. Cluster III for number of tillers per plant. Cluster VII for panicle length. Cluster VI for number of productive tillers per plant. Cluster V for number of filled grains per panicle.

The maximum genetic divergence was contributed by Number of filled grains per panicle was highest towards genetic divergence (35.07%), followed by 1000 grain weight (16.52%), Number of tillers per plant (14.65%), Panicle length (14.20%), Plant Height (13.00%), Days to maturity (3.14%), Days to fifty per cent flowering (2.60%), Number of productive tillers per plant (0.41%), Grain yield per plant (0.37%). The characters number of filled grains per panicle, 1000 grain weight, number of tillers per plant, panicle length together contributed 80.44% towards total divergence. Therefore, these characters should be given importance during selection indices.

Character association studies revealed that the characters grain yield per plant showed significant positive association with plant height, number of tillers per plant, number of productive tillers per plant, number of filled grains per panicle and 1000 grain weight. 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 exerted the highest positive direct effect on grain yield followed by 1000 grain weight, number of tillers per plant, number of productive tillers per plant, plant height and days to fifty per cent flowering 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 twenty nine characters studied, three were found to monomorphic and six characters were dimorphic and remaining characters are polymorphic which can be useful for varietal identification in selected rice genotypes.
ABSTRACT

The present investigation was undertaken to identify the diverse parents in maize and study the combining ability, nature of gene action, heterosis, genetic parameters, character association, G X E interaction and stability of experimental hybrids for yield and other traits.

During rabi 2011-12 eighty genotypes were evaluated for genetic diversity at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The analysis of variance revealed significant differences among the genotypes for all the characters studied except moisture content. Based on Mahalanobis D^2 analysis the 80 genotypes were grouped into eight clusters. Cluster I was the largest having 38 genotypes followed by cluster III with 26 genotypes, cluster V with 7 genotypes, cluster VI with 5 genotypes and the clusters II, IV, VII and VIII had one genotype each. From this clusters 25 parents were selected and used in hybridization programme.

Twenty five divergent parents were crossed in Line x Tester mating design by involving three testers during kharif 2012 at Maize research center, ARI, Rajendranagar, Hyderabad. The resulting 75 crosses along with parents and two standard checks viz., DMR-1142 and DMR-1144 were evaluated in Randomized Block Design replicated thrice during rabi 2012-13 at three locations viz., in Central Telangana Zone (Rajendranagar, Ranga Reddy), Northern Telangana Zone (Jagityal, Karimnagar) and Central Telangana Zone (Kampasagar, Nalgonda).

The pooled analysis of variance for combining ability revealed significant differences due to environments, parents, hybrids and various interactions indicating the existence of wider variability in the material studied. The ratios of GCA/SCA variances revealed that non additive gene action was predominant in the inheritance of all the characters.

Combining ability analysis revealed that among the parents, BML-5222, QPM-69-2, BML-5121, BML-5212 and BML-5207 were good general combiners for earliness viz., days to 50 per cent tasseling and days to 50 percent silking. Parents, BML-5212, BML-5121, BML-5118-3, QPM-57-1, BML-5161 and CM-131(Tester) recorded significant positive gca effects for cob yield per plant and these inbreds may be utilized in the development of hybrids, synthetics or composites. The
hybrids, QPM-62 X BML-6, CM-201 X BML-6 and BML-5342 X CM-131 were found to be good specific combiners for earliness. While the hybrids BML-5118-3 X BML-6, BML-5121 X BML-6, BML-5212 X BML-13, BML-5161 X BML-6 and QPM-62 X BML-13 which recorded positively significant \( sca \) effects for cob yield per plant are considered as good specific combiners. Therefore these hybrids may be recommended for heterosis breeding.

In pooled analysis high narrow sense heritability estimates were recorded in plant height, green fodder yield, cob yield, baby corn length, ear height and cob weight. Thus these traits are predominantly under the control of additive gene action and hence, these characters can be improved by selection in the development of new inbred lines.

Estimates of heterobeltiosis and standard heterosis were variable among crosses in desirable direction and some of them turned out to be best specific crosses. Heterosis for cob yield per plant is mainly because of simultaneous manifestation of heterosis for yield component traits. The highest standard heterosis for cob yield per plant was recorded for hybrids BML-5121 X CM-131, BML-5212 X BML-13, BML-5121 X BML-6, BML-5212 X CM-131 and BML-5121 X BML-13 along with \( \text{per se} \) performance, heterobeltiosis. These hybrids may be further tested in multilocation evaluation before releasing them for commercial cultivation.

Results of stability analysis revealed that ten hybrids \( \text{viz.} \), BML-5121 X BML-6, BML-5161 X BML-6, QPM-69-2 X CM-131, BML-5016 X CM-131, BML-5219 X CM-131, BML-5204-5-2-1 X CM-131, CM-119 X BML-13, BML-5347-2 X CM-131 and QPM-57-1 X CM-131 are identified as stable and best performing hybrids for cob yield per plant and other traits hence, suitable for wider environments.

Based on overall performance the best hybrid identified was BML-5121 X BML-6 with highest cob yield per plant of 27.93 g, with high \( sca \) effect (1.95), significant standard heterosis (77.32 %) and significant heterobeltiosis (78.33 %) over the check DMR-1142. This hybrid was stable over locations for cob yield per plant, days to 50 per cent tasseling, days to 50 per cent silking, plant height, ear height, baby corn length, baby corn girth, cob weight and cob yield per hectare. The next best hybrid was BML-5161 X BML-6 with a cob yield per plant of 20.39 g with significant \( sca \) effect (1.42), significant standard heterosis over DMR-1142 (29.43%) and significant heterobeltiosis (39.53%). This hybrid was stable over locations for cob yield per plant, days to 50 per cent tasseling, days to 50 per cent silking, plant height, baby corn length, baby corn girth, cob yield per hectare, green fodder yield and TSS.

The correlation and path coefficient analysis, emphasized the need for selection based on plant type with greater number of cobs per plant, cob weight, corn length, days to 50 per cent silking, plant height, corn girth. Since these were found to be the important direct contributors for cob yield per plant.

Keeping in view of the above facts, by considering all factors like \( \text{per se} \) performance, \( sca \) effect, standard heterosis, heterobeltiosis and stability, the most promising hybrids identified were BML-5121 X BML-6, and BML-5161 X BML-6. These hybrids may be further tested over locations, seasons, years before recommending for commercial release.
GENETICS AND PLANT BREEDING

Author : NAVEEN REDDY, PENDYALA

Title of the thesis : GENETIC DIVERGENCE STUDIES IN EARLY DURATION RICE GENOTYPES (Oryza sativa L.)

Major Advisor : Dr. T.DAYAKAR REDDY

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9828

ABSTRACT

In the present investigation, sixty four 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 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 2014.

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.

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, grain yield per plant, grain length, grain breadth, 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 $D^2$ values, the genotypes were grouped into fifteen clusters. Cluster II was the largest comprising of twenty nine genotypes followed by cluster III with ten genotypes, cluster I with nine genotypes, cluster VIII with five genotypes and cluster IV, V, VI, VII, IX, X, XI, XII, XIII, XIV and XV with one genotype each. The highest divergence occurred between cluster VII and XV (58.88) followed by cluster VII and XIV (50.78) cluster VI and XII (47.76) and cluster II and XV (46.59) and cluster VII and X (46.15).

Based on the inter cluster distances, hybridization between the (AAGP 9722) of cluster VII and ( NWGR-7023 ) of cluster XV, (AAGP 9772) of cluster VII and (BPT 2168) of cluster...
of XIV, (AAGP 9772) of cluster VII with cluster XII (OR 2487-9), cluster II (Pusa 2004-09-80-315-483 and NWGR 10012) and XV (NWGR-7023), cluster VII (AAGP 9772) and X (OR 2545-5) is expected to generate promising segregants for grain yield and quality traits.

The three characters days to 50 % flowering, L/B ratio, number of filled grains per panicle contributed maximum (77.63 %) towards genetic divergence. The data on cluster means for fifteen clusters indicated that, cluster VII with only one genotype (AAGP 9772) exhibited highest cluster mean for six traits viz., grain yield per plant, 1000 grain weight, no. of productive tillers per plant, panicle length, grain breadth and hulling percentage.

Cluster V with one genotype (GNV-12-10 (BP 10620F-BB4-12-B-B8-30)) recorded highest mean value for grain length. Cluster VI with one genotype (HKR 09-189) possessed highest mean value for milling percentage and head rice recovery. cluster XIII with one genotype (UPR 3831-10-1-1) recorded highest mean value for plant height.

Cluster I with genotype (CR 3727-3(IR71700-247-5-3-2-CR 3727-2-2-1)) recorded highest mean value for L/B ratio. cluster III possessed highest mean value for number of filled grains per panicle containing genotypes viz., YNP-9761 and UPR-3841-5-2-1.

Character association studies revealed that the characters grain yield per plant showed significant positive association with number of productive tillers per plant, panicle length, number of filled grains per panicle, 1000 grain weight and grain length, grain breadth and non significant positive association with plant height. 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 number of productive tillers per plant followed by 1000 grain weight, grain length, number of filled grains per panicle, panicle length, grain breadth 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 : RAJENDAR REDDY, M.

Title of the thesis : GENETIC CHARACTERIZATION AND MOLECULAR STUDIES FOR BRAN OIL USING SSR MARKERS IN RICE (Oryza sativa L.).

Major Advisor : Dr. M.SUJATHA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9762

ABSTRACT

The present investigation in rice was undertaken to estimate GCA, SCA effects (L × T mating), heterosis and to study stability of hybrids for bran oil, yield, yield components and quality traits across locations of Telangana state, to study the association and direct and indirect effects between yield and bran oil and to map the gene(s) for bran oil.

Six lines with medium to high bran oil content (Keshari, Ishwarya, Mandhya Vijaya, PR116, Kandhagiri and Phalguna) and five popular high yielding varieties (NDR359, IR64, Swarna, RPBio226 and MTU1010) with low bran oil were crossed in a line × tester design during kharif, 2012 at DRR Farm, Directorate of Rice Research, Hyderabad, Telangana state. During rabi, 2012-13 the 30 cross combinations along with their parents were evaluated at three different locations viz., Jagitial, Warangal, and Hyderabad for bran oil content, yield, yield components and quality characters.

The analysis of variance of 41 genotypes (Six lines, five testers and 30 cross combinations) revealed significant differences among the lines, testers and hybrids evaluated at different locations for all the characters under study.

The combining ability analysis of variance, in pooled analysis, showed significant differences due to locations, parents, hybrids and various interactions indicating the existence of sufficient variation in the material under study. The gca and sca variances indicated that non additive gene action was predominant in the expression of bran oil content, yield, yield component traits and quality characters except for plant height and gel consistency where additive gene action was predominant.

In pooled analysis, none of the lines and testers were found to exhibit significant gca effects for all the characters studied. Keshari and MTU1010 among lines and IR64 and Swarna among testers were good general combiners for bran oil content whereas lines
Mandhya Vijaya and Phalguna and testers NDR359 and MTU1010 were found to be promising general combiners for grain yield per plant and other traits.

Based on significant *sca* effects, in pooled analysis, for bran oil content eight crosses recorded significant positive *sca* effects. On the whole, six cross combinations *viz.* Mandhya Vijaya × NDR359, Keshari × MTU1010, Phalguna × NDR359, Mandhya Vijaya × Swarna, Kandhagiri × RP Bio226 and Phalguna × Swarna have been identified as promising based on *per se* performance, *sca* effects and heterosis for yield and its attributes in pooled analysis. Besides yield these cross combinations also possessed desirable quality characters like milling per cent, head rice recovery per cent, kernel length, kernel breadth, L/B ratio, gel consistency and amylase content. But in case of bran oil content, none of the cross combination showed significant heterosis in desirable direction though Keshari × IR64, Kandhagiri × RPBio226, Keshari × NDR359, Phalguna × MTU1010 and Kandhagiri × MTU1010 had high bran oil content among all cross combinations with optimum yield.

Genotype × environment interaction studies with 30 hybrids at different locations for bran oil content, yield and yield attributing traits by Eberhart and Russell revealed four hybrids *viz.* Mandhya Vijaya × NDR359, Phalguna × NDR359, PR116 × NDR359 and Phalguna × MTU1010 were identified as stable hybrids for grain yield per plant while in case of bran oil content the hybrid, Kandhagiri × Swarna was considered as stable cross combination.

The character association studies revealed that the attributes *viz.* kernel breadth, panicle length, 1000-grain weight, number of grains per panicle, days to 50 % flowering, plant height and kernel length were showed a significant positive association along with direct effect on grain yield per plant suggesting selection of these traits will be useful for the improvement of grain yield.

Based on the present study, it can be emphasized that Mandhya Vijaya × NDR359 and Phalguna × NDR359 are stable with the desirable *sca* effects, heterosis and *per se* performance for grain yield and other important attributes. Keshari × IR64 and Kandhagiri × RPBio226 had high bran oil content among all cross combinations with optimum yield. These hybrids may be further tested over locations, seasons and years and recommended for commercial release.

During *Kharif, 2013*, F2 generation of Keshari × Swarna was grown at DRR Farm, Directorate of Rice Research, Hyderabad, for the estimation of genetic parameters. The estimated value of PCV is higher than GCV, it means that the apparent variation is not only due to genotypes but also due to the influence of environment and selection for this trait sometimes may be misleading. Medium heritability coupled with high genetic advance as per cent of mean was observed for this trait indicating the presence of additive gene action. Hence this trait can be improved through simple selection procedures.

Till now there are no reports about the markers related to bran oil. Attempt has been made with 30 SSR markers representing 12 chromosomes of rice in cross Keshari × Swarna to find out the bran oil related markers and concluded that RM5140 marker –can be used as bran oil related marker in future studies as it showed the highest F value (Probability less than 0.005).
GENETICS AND PLANT BREEDING

Author : RAJKUMAR, A.

Title of the thesis : GENETIC DIVERGENCE STUDIES FOR YIELD AND ITS COMPONENTS IN RICE (Oryza sativa L.)

Major Advisor : Dr. N.A. ANSARI

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9821

ABSTRACT

One hundred and eighteen genotypes of rice comprising of landraces from north east, tropical japonica accessions, introgression lines and elite cultivars were evaluated to assess the genetic diversity present in the experimental material, to estimate the genetic parameters for yield and yield components and the extent of association between the yield and its component characters including the direct and indirect effects. The experiment was laid out in augmented block design with 5 checks at ICAR-Indian Institute of Rice Research farm, ICRISAT Campus, Patancheru, Hyderabad, during Kharif 2014.

Analysis of variance indicated the existence of significant genotypic differences among the genotypes for the yield, its components for all the characters. High Genotypic coefficient of variation and Phenotypic coefficient of variation were observed for characters like number of tillers per plant, number of productive tillers per plant, number of filled grains per plant, harvest index, 1000 grain weight and yield per plot. High heritability coupled with high genetic advance as per cent of mean was observed for characters like plant height, number of tillers per plant, number of productive tillers per plant, number of filled grains per panicle, harvest index, plot yield, 1000-grain weight, grain yield per plant, which indicated that these traits were controlled by additive type of gene action in the inheritance of these characters. The remaining traits were mostly under the influence of non-additive gene effects as they recorded low to moderate estimates of genetic advance.

Morphological divergence by Tocher’s method indicated the existence of significant diversity among the genotypes which were grouped into twelve clusters. Out of 12 clusters, cluster III was the largest comprising of 42 genotypes followed by clusters I with 24 genotypes, cluster II with 21 genotypes, cluster V with 16 genotypes, cluster III with 13 genotypes and clusters VI, VII, VIII, IX, X, XI and XII each with one genotype. The higher amount of divergence was observed between clusters IV and XII (3298579) followed by clusters I and XII.
(2735295.), clusters III and XII (2178405.500) and clusters VIII and XII (1754711), while it was low between clusters VIII and IX (5235.734).

Inter cluster distances, revealed that hybridization between the genotypes of clusters IV and XII (LRJB 1), clusters I and XII (LRJB 1), clusters III and XII (LRJB 1), clusters VIII (TJJB 25) and XII (LRJB 1) would generate promising segregants for grain yield and would produce encouraging results. The clusters X, XI & XII were having highest mean values for characters like days to fifty per cent flowering, days to maturity, panicle length, number of filled grains per panicle, 1000 grain weight, harvest index and grain yield per plant. The genotypes TJJB 23, LRJB 37, LRJB 1 from these clusters having high mean values could be used as parents in future hybridization programme.

The results showed that the contribution of yield per plot was highest towards genetic divergence (89.47%), followed by number of filled grains per panicle (7.24%), plant height (3.15%), harvest index (0.07 %) by 5 times, days to 50% flowering 0.04%, days to maturity(0.03%), and 1000 grain weight (0.01%), respectively to the genetic divergence in decreasing order. In the present investigation yield per plot contributed the maximum towards genetic divergence, hence the character is important in selection indices. Number of filled grains per panicle and days to 50% flowering are also important in selection indices.

Correlation studies revealed that grain yield per plant showed significant positive association with plant height, number of filled grains per panicle, 1000 grain weight, panicle length, harvest index and yield per plot. This indicated that simultaneous selection of all these characters is important for yield improvement. A critical analysis of the results by path analysis revealed that the traits viz., number of filled grains per panicle, 1000 grain weight, days to 50% flowering, number of tillers per plant, plant height, harvest index and yield per plot have positive direct effect on 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 and harvest index. As the yield component, filled grains per panicle are 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 and high harvest index would be more desirable for selection to realize higher yield.
GENETICS AND PLANT BREEDING

Author : RAMYA RATHOD
Title of the thesis : GENETIC DIVERGENCE STUDIES IN HIGH IRON AND ZINC GENOTYPES OF RICE (Oryza sativa L.)
Major Advisor : Dr. M. BHARATHI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9824

ABSTRACT

In the present investigation, fifty six high iron and zinc genotypes of rice were evaluated to study the genetic diversity available for selection of 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 Indian Institute of Rice Research Farm, Ramachandrapuram, Hyderabad, during kharif, 2014.

Analysis of variance indicated the existence of significant differences among the genotypes for yield, its components and nutritional traits for all the characters. High GCV and PCV values were observed for number of filled grains per panicle, number of productive tillers per plant and grain yield per plant.

High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of productive tillers per plant, number of filled grains per panicle, 1000-grain weight, grain yield per plant, grain iron and zinc concentration 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 $D^2$ values, the genotypes were grouped into six clusters by using Tocher’s method. Out of six clusters, cluster I was the largest comprising of forty five genotypes followed by clusters II with six genotypes, cluster III with two genotypes, clusters IV,V and VI were monogenotypic clusters. Days to 50 per cent flowering, plant height, number of filled grains per panicle, grain iron concentration and grain zinc concentration together contributed 88.45 % towards total divergence.
Maximum inter-cluster distance was noticed between cluster III and V, cluster V and VI, cluster II and V and cluster II and III. The greater the distance between two clusters, the wider the genetic diversity among the genotypes of these clusters. Hence hybridization between genotypes from these clusters would produce high heterotic recombinants.

The cluster III was having highest mean values for number of productive tillers per plant, panicle length and number of filled grains per panicle, cluster IV recorded maximum mean value for 1000-grain weight, cluster V had highest mean value for grain iron concentration and cluster VI recorded highest mean values for days to 50 per cent flowering, plant height, grain yield per plant and grain zinc concentration. The promising genotypes 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 grain yield per plant showed significant positive association with number of productive tillers per plant, panicle length and number of filled grains per panicle indicating that these characters are important for yield improvement. Grain iron concentration also exhibited positive significant association with grain yield per plant indicating that this character could also be considered for improving grain yield as well as grain quality.

A critical analysis of the results by path analysis revealed that the traits 1000-grain weight, numbers of filled grains per panicle, number of productive tillers per plant, grain iron concentration, grain zinc concentration, days to 50 per cent flowering 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 : GADE PRIYANKA

Title of the thesis : STUDIES ON COMBINING ABILITY OF HYBRIDS UNDER DIRECT SEEDED AEROBIC CONDITIONS AND INTROGRESSION OF DROUGHT QTL INTO HYBRIDS OF RICE (*Oryza sativa* L.)

Major Advisor : Dr. M. SUJATHA

Degree : M.Sc. (Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9826

ABSTRACT

The present investigation was conducted to estimate the heterosis, combining ability, correlations and path coefficients for yield components by crossing eleven parents in line × tester design at Indian Institute of Rice Research, Hyderabad and introgression of 12.1 QTL under drought was also investigated.

Analysis of variance revealed the presence of sufficient variation in the experimental variation.

Significant heterosis over mid and better parents was observed in several cross combinations. The crosses IR58025A × HHZ12-SAL2-Y3-Y2 for days to 50 per cent flowering, IR58025A × HHZ12-Y4-DT1-Y3 for plant height, IR79156A × ABR-158-81R for number of productive tillers per plant and panicle length, IR79156A × HHZ12-SAL2-Y3-Y2-1 for number of grains per panicle, APMS6A × HHZ12-SAL2- Y3-Y2-1 for grain yield per plant, IR79156A × RPBIO4918-205 for biomass, APMS6A × HHZ12-SAL8-Y1-SAL1 for harvest index exhibited highly significant heterosis and heterobeltiosis for yield and yield components. In comparison with aerobic standard check CRdhan 201, these hybrids showed relatively better yield heterosis.

Through combining ability analysis, the parents APMS6A, RPBIO4918-205, HHZ12-SAL2-Y3-Y2-1, and HHZ17-Y16-Y3-Y were identified as the potential combiners for grain yield and prime component traits, plant height, number of productive tillers per plant, panicle length, number of grains per panicle, spikelet fertility, biomass and harvest index. As such, these parents could be better utilized in breeding programmes.

Among the crosses APMS6A × HHZ12-Y4-DT1-Y3, APMS6A × HHZ12- SAL2-Y3-Y2-1, IR79156A × RPBIO4918-205 were identified as best specific crosses in view of their high *per se* performance, *sca* effects and *gca* of their respective parents.
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 grains per panicle, plant height, longer panicle length and high harvest index. As the yield component grains per panicle is in turn dependent on panicle length and plant height, attention should be paid towards increasing the panicle length, maintaining optimum plant height and harvest index would be more desirable for selection to realize higher yield with good quality traits.

Vandana NIL was crossed with KMR-3R and the positive F1s obtained were backcrossed to KMR-3R. The BC1F1 plants were screened for the presence of resistant allele of qDTY12.1 by using the gene linked markers RM28099 and RM28130. For use in background selection of the foreground selected plants, a total of 197 SSR markers were used for screening of parental polymorphic survey and a total of 52 markers were observed to be polymorphic between the donor and recipient parent. The polymorphic markers were then used for background selection at each backcross generation to identify the best backcross plant (which were foreground selected for qDTY12.1) and possessing maximum recurrent parent genome introgression.

Taking into consideration the genetic analysis of present investigation, pedigree selection in the cross combinations, APMS6A × HHZ12-Y4-DT1-Y3, APMS6A × HHZ12-SAL2-Y3-Y2-1 and IR79156A × RPBIO4918-205 for grain yield was considered as most feasible and rewarding. Elite hybrid rice parental line KMR-3R has been improved for drought tolerance through introgression of qDTY12.1 from Vandana NIL.
The present investigation was carried out to identify the molecular markers associated with the kernel iron and zinc concentrations and to study the gene action involved in the inheritance of the traits under concern using generation mean analysis by conducting two separate experiments at ICRISAT, Patancheru. Besides that, studies were also made to estimate the nature and magnitude of genetic effects and to understand the association of kernel iron and zinc concentrations with grain yield and other agronomic traits.

In the first experiment, an attempt was made to identify the molecular markers associated with the kernel iron and zinc concentrations using F_{2:3} mapping population of a cross between a high kernel iron and zinc containing parent, ICGV 06099 and a low kernel iron and zinc containing parent, ICGV 93468. Parental polymorphism survey was conducted with 200 SSR markers, out of which thirty three markers were found polymorphic between the parents. Out of 33 polymorphic SSR markers, three markers viz., SEQ1B09, IPAHM245 and SEQ9G05 showed significant association with the kernel iron concentration with a phenotypic variation of 0.23, 2.19 and 6.34 %, respectively, towards the trait and three markers viz., GM2638, IPAHM245 and SEQ9G05 showed significant association with phenotypic variation of 1.75, 2.25 and 6.01 %, respectively towards kernel zinc concentration. Validation of these markers in another F_{2:3} population derived from the cross ICGV 06040 × ICGV 87141 also showed the strong association of these markers with the trait of interest.

Studies on genetic parameters in F_{2:3} population of the cross ICGV 06099 × ICGV 93468 revealed that PCV was moderately higher than GCV for all the traits including kernel iron and zinc concentrations. Heritability (broad sense) was also found to be higher for kernel iron (64.24 %) and zinc (62.21 %) concentrations. However, low genetic advance as per cent of mean was recorded for the traits understudy. Correlation studies revealed significant positive association between kernel iron and zinc concentrations. However, these micronutrient concentrations did not show any significant association with pod yield.
In the second experiment, six generations ($P_1$, $P_2$, $F_1$, $F_2$, $B_1$ and $B_2$) each of two crosses (ICGV 06040 × ICGV 87141 and ICGV 06099 × ICGV 93468) were evaluated in compact family block design during post-rainy season, 2013-14 at ICRISAT, Patancheru. Observations were recorded on important agronomic traits along with kernel iron and zinc concentrations which were estimated using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES).

Analysis of variance showed significant differences among the generations of both the crosses for days to emergence, days to maturity, hundred kernel weight, shelling percentage (in the cross ICGV 06040 × ICGV 87141 only), pod yield per plant, kernel iron and zinc concentrations. The phenotypic coefficient of variation was moderately higher than genotypic coefficient of variation for all the traits under study including kernel iron and zinc concentrations which suggested moderate influence of environment on these traits. High heritability (broad sense) coupled with moderate genetic advance as per cent of mean was observed for kernel iron and zinc concentrations in the cross ICGV 06040 × ICGV 87141 indicating that these traits were governed by additive gene action and that selection will be effective, whereas moderate heritability (broad sense) was observed for the same traits in the cross ICGV 06099 × ICGV 93468. Significant negative heterobeltiosis and residual heterosis over better parent for kernel iron and zinc concentration was observed in the cross ICGV 06040 × ICGV 87141 suggesting outperformance of better parent over $F_1$ and $F_2$ whereas significant negative heterosis for kernel zinc concentration was observed in the cross ICGV 06099 × ICGV 93468. Correlation studies showed highly significant positive correlation between kernel iron and zinc concentrations in both the crosses, indicating the possibility of simultaneous improvement of both the traits. Kernel iron and zinc concentrations did not show any significant association with pod yield per plant suggesting that no penalty will be there on yield while selecting for kernel iron and zinc concentrations. Positive significant association between 100-kernel weight and kernel zinc concentration was observed indicating the chance of improvement of zinc concentration in bold seeded genotypes.

Generation mean analysis revealed that at least one of the scaling tests to a maximum of three scaling tests viz., A, B and C were significant for the above mentioned traits which indicated the presence of non-allelic interactions. For kernel iron and zinc concentrations additive gene action and additive × additive interaction were positively significant in the cross ICGV 06040 × ICGV 87141 whereas only additive gene action was significant in positive direction in the cross ICGV 06099 × ICGV 93468. However, the magnitude of additive gene effect was higher than the interaction component for the traits under concern. The signs of dominance ($h$) and dominance × dominance ($l$) were opposite for kernel iron and zinc concentrations along with the other traits indicating the presence of duplicate type of epistasis. Selection among parental lines and pedigree method of breeding may be profitable to exploit additive component of gene action for bringing about improvement for kernel iron and zinc concentrations in groundnut.
GENETICS AND PLANT BREEDING

Author: SANTHOSH KUMAR, B.
Title of the thesis: COMBINING ABILITY STUDIES IN NEW PROMISING HYBRIDS IN RICE (Oryza sativa L.)
Major Advisor: Dr. KULDEEP SINGH DANGI
Degree: M.Sc. (Ag.)
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9822

ABSTRACT

The present investigation was carried out at R.A.R.S, Polasa, Jagtial. With the aim to identify promising hybrids. The main objectives of the investigation were to study the combining ability of parents and the crosses to identify superior parents and hybrids. Besides magnitude of heterosis, heterobeltiosis and standard heterosis, were also estimated. The study also aimed to assess the physical grain quality traits of the hybrids and identification of hybrids with gall midge resistance.

Four CMS lines were crossed with nine testers and the resultant 36 crosses along with the parents and two checks viz., Samrat and 27P31 were evaluated for combining ability (Line x Tester design), heterosis and grain quality traits at R.A.R.S, Polasa, Jagtial during kharif, 2014.

Combining ability effects were studied and heterosis was estimated for the various characters like days to 50% flowering, plant height, panicle length, number of productive tillers per plant, number of tillers per plant, spikelet fertility, 1000 grain weight, incidence of gall midge, kernel length, kernel breadth, L/B ratio, hulling percentage, milling percentage and head rice recovery.

The analysis of variance for yield contributing and physical grain quality characters revealed significant difference among the treatments for all the characters under study. In case of replications, for most of the characters, there were no significant differences except for, panicle length, incidence of gall midge, hulling and milling percentage, which signifies that the differences were mainly due to the genotypes. So, further study of these genotypes for combining ability can be continued.

The gca effects of the parents revealed that the lines viz., CMS 46A and CMS 11A and the testers viz., JGL-20779, JGL-18047, JGL-20171 were promising general combiners for single plant yield. Based on significant sca effects, six cross combinations viz., CMS 46A x JGL-20779,
CMS 11A x JGL-20779, CMS 11A x JGL-21820, CMS 46A x JGL-18222, CMS 46A x JGL-21820 and JMS-1 x JGL-20779 appeared promising for grain yield.

The physical grain quality traits like kernel length, kernel breadth, L/B ratio, hulling and milling percentage, head rice recovery, was studied and it was found that among the lines, CMS 46A line had maximum hulling, milling and head rice recovery. Among the testers, JGL-20779 recorded maximum hulling, milling, head rice recovery percentage. Among the crosses CMS 23A x JGL-20171 was the best hybrid for hulling, milling, and head rice recovery percentage.

Heterosis for single plant yield was mainly because of simultaneous manifestation of heterosis for yield component traits. Of the 36 hybrids studied, the significant positive standard heterosis over the best check Samrat, was observed in three hybrids, These hybrids are, CMS 46A x JGL-20779(15.30), CMS 11A x JGL-20779 (13.88), CMS 11A x JGL-21820(11.03).

The best hybrid identified was CMS 46A x JGL-20779, which had highest single plant yield of (32.4 g/plant), short duration (123 days) and L/B ratio (3.19) which indicates the fitness of the grain, highly preferred by consumers of Telangana. Further, it showed lower susceptible reaction to gall midge at Jagtial.

Another hybrid CMS 11A x JGL- 21820 with short duration (125 days) gall midge resistance and higher single plant yield (31.2 g/plant) and L/B ratio is (2.36) also appeared to be promising.

Another hybrid CMS 23A x JGL-21820 with short duration (121 days) gall midge resistance and higher single plant yield (27.7 g/plant) and L/B ratio is (2.67) also appeared to be promising.
GENETICS AND PLANT BREEDING

Author : GAURI SHANKAR JATWAR
Title of the thesis : MOLECULAR MAPPING OF STIGMA EXSERTION TRAIT IN RICE (Oryza sativa L.)
Major Advisor : Dr. J. SURESH
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9830

ABSTRACT

Rice (Oryza sativa L.) is the principal source of carbohydrate in food grain crops to most of the people in the world. Food security is one of the major problems to be concerned in the world. Hence an attempt was made in present investigation to increase the rice production in hybrid rice by studying the phenotypic performance of stigma exsertion trait in F3 population which has a prime importance in increasing the out crossing rate in rice. And also to map the genomic region associated with stigma exsertion in F2 population using popularly used maintainer line IR68897B with low stigma exsertion (36.78%) and BF-16B, other maintainer line with high stigma exsertion (80.25%) in rice.

The F3 population were grown to analyse phenotypic performance of stigma exsertion trait. The observed data on phenotyping was subjected to chi square analysis to test their goodness of fit to appropriate mendelian ratios. On phenotyping of 674 plants of F3 population, the plant segregated into 91 low, 456 moderate and 127 high stigma exserted plants. The phenotypic data were analysed and Chi square value was significant, thus stigma exsertion were appeared to be a quantitative trait.

Transgressive segregation was observed in F3 population, indicated that complementary action of the gene with additive effects had been dispersed in the parents. The frequency distribution of total stigma exsertion in the F3 population showed a continuous variation and also signifying that the stigma exsertion trait is controlled by polygenes.

The mapping of Quantitative Trait Loci (QTLs) related to total stigma exsertion was carried out by Inclusive composite interval Mapping (IciM) using 56 polymorphic
SSR markers distributed over 12 chromosomes. The percentage of total phenotypic variance explained by the identified QTLs for total stigma exsertion (TSE) was estimated as PVE value. The Logarithm of Odds score threshold value of 2.5 was used to identify region containing putative loci associated with total stigma exsertion. QTLs positions were assigned to the point of above threshold value of LOD score which indicated the target region.

A total of 9 QTLs were identified on chromosomes 2, 3, 4, 5, 6, 7, 10 and 11 for total stigma exsertion in rice. The phenotypic variance and LOD value explained by each QTL ranges between 8.2% to 40.57% and 2.65 to 7.12 respectively. The QTL qTSE-2 on chromosome 2 was flanked by RM12398-RM151 and account for 40.57% of phenotypic variance. Two QTLs qTSE-3a and qTSE-3b on chromosome 3 were flanked by RM1350-RM15466 and RM15466-RM7000 respectively and collectively explained 68.61% of phenotypic variance. The QTL qTSE-4 on chromosome 4 was flanked by RM16649- HRM17405 and account for 8.68% of phenotypic variance. The QTL qTSE-5 on chromosome 5 was flanked by RM5592-HRM18222 and account for 33.54% of phenotypic variance. The QTL qTSE-6 on chromosome 6 was flanked by RM20615-RM19569 and account for 32.10% of phenotypic variance. The QTL qTSE-7 on chromosome 7 was flanked by RM500-RM21393 and account for 8.76% of phenotypic variance. The QTL qTSE-10 on chromosome 10 was flanked by RM5095-RM311 and account for 34.06% of phenotypic variance. The QTL qTSE-11 on chromosome 11 was flanked by RM5926-RM26213 and account for 23.18% of phenotypic variance.

Out of 9 QTLs, the 6 QTLs were contributed from the donor parent (BF-16B) and the 3 QTLs from recipient parent (IR68897B) for stigma exsertion to the progeny. Both the parents were contributed toward the stigma exsertion but the more QTLs were contributed from the donor parent to the progeny.
GENETICS AND PLANT BREEDING

Author : SHIVA KUMAR, M.
Title of the thesis : STABILITY ANALYSIS FOR YIELD AND GRAIN IRON AND ZINC CONCENTRATIONS IN RICE (Oryza sativa L.)
Major Advisor : Dr. K. RADHIKA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9820

ABSTRACT

The present investigation was carried out to study the stability, variability, heritability, genetic advance, correlations and path analyses of yield, its contributing characters and grain quality parameters sixty rice genotypes at three locations of Telangana region viz., Rajendranagar, Jagtial and Warangal. The experimental material was sown in Randomized Block Design (RBD) with three replications during kharif, 2014. Observations were recorded on fifteen characters. The results revealed that genotype x environment interaction was significant for all the characters except panicle length and kernel length. The mean square due to genotype x environment (linear) interaction was found to be significant for all the characters except panicle length and kernel length indicating that a considerable proportion of genotype x environment interaction was contributed by the linear component. Therefore, prediction for most of the genotypes appears to be feasible for these characters.

Among the genotypes, Sheetal, Shiva, Erramallelu, RNR-17846, RNR-17828, Suganda Samba, RNR-17856-1 and RNR-18809-1 for days to 50% flowering, WGL- 505 and RNR-17856-2 for total number of tillers / plant; Godavari Isukalu and Chittimutyalu for number of productive tillers / plant; Polasa Prabha for total number of grains / panicle; JGL-19621 for number of filled grains / panicle; Pothana and Sona for 100- seed weight and Polasa Prabha and KNM-118 for seed yield / plant were identified as stable genotypes for yield and its component characters under study.

For grain quality parameters, the stable genotypes identified were RNR-17861 and JGL-18047 for kernel length; Shiva, Badrakali and RNR-17861 for kernel breadth; WGL-915, Badrakali and Keshava for kernel L/B ratio; Sheetal, WGL-558, Pranahita and RNR-17856-2 for grain iron concentration and Sheetal, Anjana and RNR-17861 for grain zinc concentration.

The estimates of PCV were higher than those of GCV for all the traits studied. High heritability along with high genetic advance was recorded in rice for plant height, total number of
grains / panicle, number of filled grains / panicle, seed yield / plant, 100-seed weight, kernel length, kernel L/B ratio and grain zinc concentration indicating that these traits were mainly controlled by additive gene action. Therefore, simple selection can be practiced for further improvement of these characters. Kernel breadth, grain iron concentration, number of productive tillers / plant, total number of tillers / plant, panicle length, spikelet fertility and days to 50% flowering exhibited high heritability along with moderate genetic advance as percent of mean indicating the involvement of both additive and non-additive gene actions in controlling these traits and both selection and heterosis breeding may be useful in their improvement.

The correlation analysis revealed that the seed yield / plant showed significant positive correlation with number of filled grains / panicle over all the locations. Thus, selecting genotypes with more number of filled grains / panicle may prove effective in increasing the yield potential.

Path coefficient analysis revealed that selection of traits with significant positive association as well as positive direct effect on seed yield /plant viz., total number of grains / panicle, number of filled grains / panicle, 100-seed weight and spikelet fertility can be considered as the most reliable indicators of yield improvement in rice. Negative direct effect and negative significant association of plant height with seed yield / plant suggests that enhancement of plant height is not improving the yield.
GENETICS AND PLANT BREEDING

Author : SHIVA PRASAD, G.

Title of the thesis : STUDIES ON GENETIC DIVERSITY IN RICE (ORYZA SATIVA. L.) AND QTL MAPPING FOR COLD TOLERANCE AT SEEDLING STAGE AND HEAT TOLERANCE AT GRAIN FILLING STAGE

Major Advisor : Dr. K.V.RADHA KRISHNA

Degree : Ph. D.

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9832

ABSTRACT

The present investigation was carried out in this experiment the rice germplasm collected from different sources including wild races to identify genotypes that are optimum for both cold and heat stress and study the combining ability, heterosis, nature of gene action, genetic parameters, character association, inbreeding depression and qtl mapping for cold tolerance at seedling stage and heat tolerance at grain filling stag. The data was collected on 19 characters namely, tillers per plant, effective tillers per plant, plant height, leaf length, leaf width, panicle length, sterility per cent, yield per plant, 100-seed weight, seed density, grains per panicle, fertile grains per panicle, pollen viability, days to 50 per cent flowering, germination per cent, coleoptile length, radical length, seedling growth and seed vigor.

The diverse germplasm lines obtained from DRR, Hyderabad with a view to study the nature and magnitude of variability, degree of association between yield and its components and direct and indirect effects of the different qualitative characters on seed yield, characterization of the genotypes into different clusters to identify the promising genotypes possessing desirable traits besides their yielding ability, identify a high yielding best combining hybrids as compared to standard checks, to estimate the heterosis and inbreeding depression for cold tolerance at seedling stage, and mapping of QTLs for cold tolerance at seedling stage and heat tolerance at post flowering stage.

The experimental material was sown in augmented block design with five checks Vikas, RP-Bio226, Prasanna, N-22 and AK Dhan during rabi, 2011-12 at DRR farm, ICRISAT campus, patancheru, Hyderabad. A perusal of genetic parameters viz., PCV and GCV for all the characters studied indicated less influence of the environment on the characters. High values of phenotypic coefficient of variation and genotypic coefficient of variation were obtained for effective tillers per plant, yield per plant, number of grains per panicle, number of fertile grains.
per panicle, coleoptile length, seedling growth and seed vigor. Among the characters, highest heritability was recorded for number of fertile grains per panicle, followed by germination per cent, panicle length and leaf length, tillers per plant, 100-seed weight, coleoptile length and days to 50 per cent flowering.

High heritability was observed for most of the characters, indicating that they were least influenced by the environmental effects. In the present investigation, high heritability coupled with high genetic advance as percent of mean was observed for number of tillers per plant, number of effective tillers per plant, plant height, leaf length, leaf width, 100-seed weight, seed density, number of grains per panicle, sterility per cent, yield per plant and number of fertile grains per panicle indicating that variation for these traits contributed markedly to the total variability exhibited high heritability estimates coupled with high genetic advance as per cent of mean which suggested that these characters were amenable for further improvement by following simple selection methods.

Genetic diversity studies using D^2 statistics revealed the presence of considerable diversity among the genotypes through the formation of large number of clusters with wide range of inter cluster distances. Two techniques i.e Tocher’s method and Euclidean D^2 were used to measure genetic divergence quantitatively. A wide range of variations was observed in cluster means for all the traits under study. Cluster analysis through Euclidean method distributed 470 genotypes into 22 groups, Out of the 22 groups obtained, group III was the largest. The genotypes of clusters 1, 2, 3, 14, 15, 16, 17, and 21 showed lowest sterility per cent. Genotypes of clusters 1, 2, 3, 4, 5, 6, 7, 8, 12 and 22 showed highest seedling growth, hence, the genotypes of the clusters 1, 2, 3, 4, 5, 6, 7, 8, 12 and 22 can be used in breeding programmes for development of cold tolerant varieties.

Tocher’s method distributed 470 genotypes into 13 groups. Genotypes of clusters 1, 3, 6, 7, 8, 9, 11, 12 and 13 showed highest seedling growth, genotypes of cluster 1, 10 showed lowest sterility per cent, hence genotypes that are present in cluster 1 and 10 were performing better in cold and heat environments. The mode of distribution of genotypes into various clusters was at random indicating that geographical distributions and genetic diversity were not related to each other. Among the characters studied the most important character contributing to the divergence was seed vigor followed by fertile grains per panicle, grains per panicle, germination per cent, seed density, sterility per cent, plant height, leaf length and number of tillers per plant.

Character association studies revealed that the genotypic correlation coefficient were higher than the corresponding phenotypic correlation coefficients indicating the strong inherent association were somewhat masked at the phenotypic level due to environmental effect. Study of correlations revealed that grain yield per plant was positively correlated with grains per panicle, fertile grains per panicle registered positive significant association with yield per plant. Hence, selection for improvement of these traits would simultaneously improve the yield.

In combining ability studies, the lines, Erramallelu, N-22, Vijetha and Tella hamsha can be considered as good general combiners and among testers, IC-346231, IC-372023, IC-449906 and IC-449880 can be considered as good general combiners. These parents had resulted in the production of superior crosses for grain yield per plant. Hence, these could be utilized in the crop improvement programmes for the development of hybrids.
High specific combining ability effects for grain yield per plant were noticed in the crosses. The crosses, Vijetha X IC-372023 Erramallelu X IC-449880 and Tella hamsa X IC-372023 can be considered as good specific combiners. Which can be considered as good specific combiners and genetically potential crosses as these were superior for yield and important yield contributing characters. These crosses may be advanced for further breeding programmes. The hybrids Tella hamsa X IC-449906 and Tella hamsa X IC-334178 showed desirable significant heterosis for grain yield per plant and grain yield per plot over standard checks Tella hamsa, and N-22.

In inbreeding depression investigation, yield per plant may be governed by both additive and non-additive gene effects. Three hybrids BPT-5204 X IC-449880 (76.30 %), Tella hamsa X IC-449906 (13.33%) and Tella hamsa X IC-334178 (13.33%) had significant inbreeding depression and the 38 hybrids showed negative inbreeding depression.

In the QTL mapping study, 16 parental lines screened with a total of 81 reported SSR markers which were dispersed throughout the 12 chromosomes to study genetic diversity across 16 parental lines. Among which 45 markers were found to be polymorphic. Two qtls were identified (one for cold tolerance at seedling stage and heat tolerance at grain filling stage), both are on the 4th chromosome.
GENETICS AND PLANT BREEDING

Author : SRAVANI, D.
Title of the thesis : GENETIC CHARACTERIZATION AND MOLECULAR STUDIES ON PROTEIN CONTENT USING MICROSATELLITES IN RICE (*Oryza sativa* L.)
Major Advisor : Dr. T.DAYAKAR REDDY
Degree : Ph. D.
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9761

ABSTRACT

The present investigation was undertaken in rice to elicit information on combining ability, heterosis, character association, direct and indirect effects, stability of hybrids for protein content, yield, yield components and quality characters of hybrids at different locations of Telangana state and also to map the gene(s) for protein content using microsatellite markers

Eight divergent parents were selected and crossed in diallel fashion excluding reciprocals during *kharif*, 2012 at DRR Farm, Directorate of Rice Research, Hyderabad, Telangana state. During *rabi*, 2012-13 the 28 cross combinations along with their parents were evaluated at three different locations viz., Jagitial, Warangal, and Hyderabad for protein content, yield, yield components and quality characters.

The analysis of variance of 36 genotypes (eight parents and twenty-eight cross combinations) revealed significant differences among the parents and hybrids evaluated at different locations for all the characters under study.

The combining ability analysis of variance in pooled analysis, showed significant differences due to locations, parents, hybrids and various interactions indicating the existence of sufficient variation in the material under study. The $gca$ and $sca$ variances indicated that non additive gene action was predominant in the expression of protein content, yield, yield component traits and quality characters

In pooled analysis, none of the parents was found to exhibit significant $gca$ effects for all the characters studied. Jalanidhi, Phalguna were found to be promising general combiners for protein, grain yield per plant and other traits.
Based on significant \(sca\) effects, in pooled analysis, for protein content, seven crosses recorded significant positive \(sca\) effects. On the whole, twelve cross combinations \(\text{viz.},\) Suraksha \(\times\) Jalanidhi, Suraksha \(\times\) MTU1010, Suraksha \(\times\) Swarna, Jalanidhi \(\times\) Phalguna, Jalanidhi \(\times\) Mahamaya, Jalanidhi \(\times\) MTU1010, Phalguna \(\times\) RPPIO226, Phalguna \(\times\) Swarna, Mahamaya \(\times\) RPPIO226, MTU1010 \(\times\) BPT5204, RPPIO 226 \(\times\) BPT5204, RPPIO 226 \(\times\) Swarna have been identified as promising based on \(per\ se\) performance, \(sca\) effects and heterosis for yield and its attributes in pooled analysis. Besides yield these cross combinations also possessed desirable quality characters like milling per cent, head rice recovery per cent, water uptake, Alkali Spreading Value. But in case of protein content, none of the cross combination showed significant heterosis in desirable direction though Mahamaya \(\times\) Swarna, Phalguna \(\times\) Swarna, Suraksha\(\times\) Mahamaya, Jalanidhi \(\times\) MTU1010, Suraksha \(\times\) Jalanidhi, Phalguna \(\times\) RPPIO226 had high Protein content among all cross combinations with optimum yield.

Genotype \(\times\) environment interaction studies with twenty eight hybrids at different locations for protein content, yield and yield attributing traits by Eberhart and Russell revealed four hybrids \(\text{viz.},\) Suraksha \(\times\) Jalanidhi, Jalanidhi \(\times\) MTU1010, Phalguna \(\times\) Swarna, BPT 5204 \(\times\) Swarna were identified as stable hybrids for protein content, while in case of grain yield per plant the hybrids Jalanidhi \(\times\) Mahamaya, MTU1010\(\times\) BPT5204 was considered as stable cross combination.

The character association studies revealed that the attributes \(\text{viz.}\) number of productive tillers per plant, plant height, kernel breadth and kernel length had a significant positive association along with direct effect on grain yield per plant suggesting selection of these traits will be useful for the improvement of grain yield and grain yield per plant had a negative significant association with protein content in pooled analysis.

Based on the present study, it can be emphasized that Jalanidhi \(\times\) Mahamaya, MTU1010 \(\times\) BPT 5204 are stable with the desirable \(sca\) effects, heterosis and \(per\ se\) performance for grain yield and other important attributes. Suraksha \(\times\) Jalanidhi and Phalguna \(\times\) Swarna had high protein content among all cross combinations with optimum yield. These hybrids may be further tested over locations, seasons and years and recommended for commercial release.

For mapping of gene(s) for protein content, RM1369, RM263 and RM337 were identified to be associated with protein content. RM337 showed highest significant variation with protein at the tune of recombination frequency 0.23. So further investigation is warranted to identify closely linked markers by increasing the population size and number of microsatellite markers.
GENETICS AND PLANT BREEDING

Author : SRIRAM AJMERA
Title of the thesis : STUDIES ON STABILITY ANALYSIS FOR GRAIN IRON AND ZINC CONCENTRATIONS IN RICE (Oryza sativa L.) GENOTYPES.
Major Advisor : Dr. S. SUDHEER KUMAR
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9763

ABSTRACT

The present investigation was undertaken with thirty seven rice genotypes including two checks at three different locations situated at different agro-climatic regions of TELANGANA viz., Directorate of Rice Research farm at ICRISAT, Medak (Central Telangana Zone), Regional Agricultural Research Station, Jagtial (Northern Telangana Zone) and Agricultural Research Station, Kampasagar (Southern Telangana Zone) for studying stability for ten characters viz., days to 50 per cent flowering, plant height, panicle length, number of productive tillers per plant, total number of grains per panicle, number of filled grains per panicle, grain Iron content, grain Zinc content, 1000-grain weight and grain yield per plant.

At three locations, the analysis of variance indicated significant variation among the genotypes for all the characters studied. The pooled analysis of variance indicated significant variation among the environments, genotypes and Genotype x Environment interaction for all the characters studied. The significance of genotype and environment interaction suggests that genotypes behaved differently in different environment.

The thirty seven Genotypes showed significant differences for all the characters, when tested against pooled error and pooled deviation. It reveals that the selected genotypes are having significant variation for all characters and may not showing uniform performance in different environments. Environments showed highly significant differences for all the characters under study except thousand grain weight, when tested against pooled error and panicle length, grain Iron content and 1000 grain weight showed no significant differences, when tested against pooled deviation. It reveals that wide difference between environments. Whereas, Genotype x Environment interaction components showed highly significant differences for all the characters, when tested against pooled error and days to 50% flowering, plant height, total number of grains per panicle, grain zinc content and 1000 grain weight showed significantly differences, when tested against pooled deviation. It indicates wide differential behavior of genotypes in changing environments. The environment + (Genotype x Environment) was significant for all the
characters, when tested against pooled error and all the characters shown significant differences except panicle length, number of filled grains and grain iron content, when tested against pooled deviation. It is indicating distinct nature of environments and genotype x environment interactions in phenotypic expression. Significance of Environment (linear) component for all the characters except Grain iron content, when tested against pooled error and panicle length, grain iron content and 1000 grain weight showed no significant differences, when tested against pooled deviation. It’s indicating that difference between environments and their influence on genotypes for expression of these characters.

The Genotype x Environment (linear) interaction was significant for all characters except panicle length, when tested against pooled error, while it was significant for days to 50% flowering, plant height and 1000 grain weight when tested against pooled deviation showed the significant differences. This indicated significant differences among the genotypes for linear response to environments (bi) behavior of the genotypes could be predicted over environments more precisely and G X E interaction was outcome of the linear function of environmental components. Hence, prediction of performance of genotypes based on stability parameters would be feasible and reliable. The significant pooled deviations for all characters, when tested against pooled error, indicates that the performance of genotypes is entirely unpredictable in nature.

Based on environmental indices, the location ICRISAT is best among three locations for grain yield, grain Zinc content and most of the yield traits. The same location may be used for further studies to expect yield stability in rice in future. Kampasagar is best location for grain Iron content.

Among the genotypes studied, the genotypes RPHP104 and RPHP 107 were identified as the best genotypes at three locations, as they recorded highest mean for grain yield per plant with highest 1000 grain weight, number of productive tillers per plant and highest number of filled grains per panicle with moderate Iron and Zinc content. The genotypes RPHP 91 and RPHP 92 recorded the highest grain Zinc content along with moderate grain yield and 1000 grain weight. The mean performance of genotype RPHP 106 is high for grain Iron content along with grain yield per plant and 1000 grain weight.

Among the genotypes studied for the stability analysis at three locations, the genotype RPHP 103 and RPHP 104 showed stable performance for grain yield along with moderate to high grain Zinc content. The genotype RPHP 106 showed stable performance for grain yield, grain Iron content, total number of grains per panicle and panicle length based on Eberhart and Russell (1966) stability criteria.
GENETICS AND PLANT BREEDING

Author : SUSMITA DEY
Title of the thesis : AGRO-MORPHOLOGICAL CHARACTERIZATION OF PROMISING GENOTYPES FOR SHEATH BLIGHT RESISTANCE IN RICE (Oryza sativa L.)
Major Advisor : Dr. K. B. ESWARI
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9765

ABSTRACT

Rice is one of the three major food crops of the world. Sheath blight disease, caused by the pathogenic fungus Rhizoctonia solani Kuhn, is one of the most devastating rice diseases, resulting 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. It has been reported that resistance to R. solani is a typical quantitative trait controlled by polygenes in rice.

The present investigation is an attempt to identify resistance to sheath blight in rice germplasm and is fared on 2 years screening of ~2000 germplasm at ICAR-Indian Institute of Rice Research (IIRR), Rajendranagar, Hyderabad. Thirty six genotypes promising to sheath blight resistance from 2012 & 2013 screening were evaluated and a moderate level of resistance to this disease was identified in nine (9) genotypes viz., SM-801 (N-22 mutant); 10-3 (Introgression line from wild species); Ngonolasha, Wazuho phek, Gumdhan, Phougak and Thangmoi (land races from north east); BG-380-2 and RP-2068-18-3-5 (gall midge biotypes).

Relationship between morphological traits and sheath blight resistance was identified by correlating the morphological traits with moderately resistant check Tetep and susceptible check IR50. Among the 60 morphological characters as per DUS testing guidelines of rice, only four characters viz., days to heading, tiller number/plant, stem thickness and days to maturity have shown distinct differences between moderately resistant genotypes and susceptible checks. Results indicated that genotypes with early heading date and early maturity are more susceptible than late heading and late maturing types. Moreover, genotypes with few tillers were found to show more resistance reaction than with more tiller numbers. It has been observed in the present experiment that almost all the MR promising genotypes identified in the study were found to possess thick stem.
A set of 15 genotypes including 3 moderately resistant checks (Tetep, Teqing and Jasmine 85), 9 tolerant to sheath blight as identified in this study (SM-801, 10-3, Ngonolasha, Wazuho phek, Gumdhan, BG-380-2, RP-2068-18-3-5, Phougak and Thangmoi) and three susceptible checks (IR 50, Swarna and BPT 5204) were screened with reported QTL markers for resistance to sheath blight QTL. Six markers were found monomorphic and nine markers were polymorphic with PIC values ranging from 0.3696 to 0.6044. Preliminary screening with molecular markers revealed that one or both the flanking markers of the reported QTLs from Tetep or Teqing with same type of allele in Tetep/Teqing and one or two susceptible checks. This indicates that QTLs for sheath blight tolerance in the promising genotypes identified in the present study may or may not be the same as known QTLs. Further, known QTLs need to be validated with more number of polymorphic markers within the QTL region.

Hence the present study has been successful in identification of ninemoderately resistant sources for sheath blight resistance in rice, in identifying the relation between morphological traits & sheath blight resistance and molecular screening with reported QTLs. Future line of work is required to identify reason behind the association of sheath blight resistance with a set of morphological characters and further attempts to be taken for designing polymorphic marker among identified moderately resistant genotypes and susceptible parents, which will helpful to introgress the sheath blight resistance in high yielding varieties.
GENETICS AND PLANT BREEDING

Author : VARA PRASAD, B.V.

Title of the thesis : GENETIC DIVERGENCE, HETEROSIS, COMBINING ABILITY AND STABILITY ANALYSIS FOR GRAIN YIELD AND YIELD CONTRIBUING CHARACTERS IN NEW INBRED LINES OF MAIZE (Zea mays L.)

Major Advisor : Dr. M.BHARATHI

Degree : Ph. D.

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9761

ABSTRACT

The present investigation was undertaken to identify the diverse parents in maize and study the combining ability, heterosis, nature of gene action, genetic parameters, character association, G × E interaction and stability of experimental hybrids for yield and yield components. The data was collected on days to 50 per cent tasseling, days to 50 per cent silking, days to maturity, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernels per row, 100-grain weight (g) and grain yield per plant (g).

During Kharif 2012, 109 genotypes were evaluated for genetic diversity at Agricultural Research Station, Madhira, Khammam district. The analysis of variance revealed significant differences among the genotypes for all the 11 characters studied. Based on Mahalanobis D² analysis 109 genotypes of maize were grouped into eleven clusters. The pattern of distribution of genotypes into various clusters revealed that there was no relationship between geographical distribution and genetic diversity. Greater genetic divergence was found in clusters VI and cluster IX, suggested exploitation of these two clusters by intermating the genotypes in a definite breeding design to explore the fullest range of heterosis and to realize good recombinant lines. Based on genetic divergence studies, the genotypes MRC- 1028 (BML-13), MRC- 1023 (BML-7), MRC- 1029 (BML-14), MRC- 1021 (BML-5) from cluster VI, MRC- 1112, MRC- 1156, MRC- 1176, MRC- 1661, MRC- 1179, MRC- 1564, MRC- 1544, MRC- 1582, MRC- 1604, MRC- 1358, MRC- 1601 from cluster IX and MRC- 1561, MRC- 1123, MRC- 1209, MRC- 1271 from cluster X were selected for hybridization programme as they were expected to produce high heterotic crosses.

The selected nineteen parents (15 lines and 4 testers) were crossed in a L × T fashion and resulting 60 crosses along with 19 parents and 3 checks, viz., DHM-117, 30 V 92 and 900 M...
Gold were evaluated in randomized block design with three replications at three locations viz., Tandur, Warangal and Madhira.

The pooled analysis for combining ability over three locations revealed significant difference for locations for all the characters. Significant differences for replication × locations were not recorded. The differences among the parents, parents vs hybrids and hybrids were observed to be significant for all the characters studied. Partitioning of hybrids into females, males and females × males revealed that variance differences were significant for all the traits studied. Interaction effects of (parents vs hybrids) × location were also significant for all the traits. Significant variances for location × parents were recorded for days to maturity. Location × crosses were significant for all the traits studied. The ratios of GCA/SCA variances revealed that non-additive gene action was predominant in the inheritance of all the characters viz., days to 50 per cent tasseling, days to 50 per cent silking, days to maturity, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernels per row, 100-grain weight (g) and grain yield per plant (g).

Combining ability analysis revealed that among the parents, MRC- 1271, MRC- 1544 and BML- 14 were found to be good general combiners for earliness viz., days to 50 per cent tasseling, days to 50 per cent silking and days to maturity. The parents, MRC- 1123, MRC- 1176 and BML- 13 recorded significant positive gca effects for grain yield, these inbreds may be utilized in population improvement or in the development of synthetics and composites. The hybrid, MRC- 1661 × BML- 13 was found to be good specific combiners for earliness. While the hybrids, MRC- 1176 × BML- 7, MRC- 1358 × BML- 13, MRC- 1556 × BML- 14, MRC- 1561 × BML- 5, MRC- 1564 × BML- 7, MRC- 1179 × BML- 13, MRC- 1604 × BML- 5, MRC- 1604 × BML- 14, MRC- 1123 × BML- 13 and MRC- 1176 × BML- 13 which recorded positively significant sca effects for grain yield and yield contributing characters. Hence, considered as good specific combiners, therefore, these hybrids could be recommended for heterosis breeding.

Estimates of relative heterosis, heterobeltiosis and standard heterosis were variable among crosses in desirable direction and some of them turned out to be best specific crosses. Heterosis for grain yield per plant is mainly because of simultaneous manifestation of heterosis for yield component traits. The highest standard heterosis for grain yield per plant was recorded for hybrids, MRC- 1123 × BML- 13, MRC- 1358 × BML- 13, MRC- 1123 × BML- 14, MRC- 1123 × BML- 7, MRC- 1176 × BML- 7, MRC- 1271 × BML- 13, MRC- 1544 × BML- 7, MRC- 1544 × BML- 13, MRC- 1179 × BML- 13, MRC- 1209 × BML- 13, MRC- 1561 × BML- 13 and MRC- 1209 × BML- 7 which recorded positively significant sca effects for grain yield and yield contributing characters. These hybrids may be further exploited in multilocation evaluation before releasing them for commercial cultivation.

In pooled analysis high narrow sense heritability estimates were recorded for days to 50 per cent silking followed by days to 50 per cent tasseling, 100-grain weight, days to maturity, ear height, number of kernels per row, ear length, ear girth, number of kernel rows per ear, plant height and grain yield per plant (28.18%).

Results of stability analysis revealed that Twelve hybrids viz., MRC- 1123 × BML- 13, MRC- 1358 × BML- 13, MRC- 1123 × BML- 14, MRC- 1123 × BML- 7, MRC- 1176 × BML- 7, MRC- 1271 × BML- 13, MRC- 1544 × BML- 7, MRC- 1544 × BML- 13, MRC- 1179 × BML- 13, MRC- 1209 × BML- 13, MRC- 1561 × BML- 13 and MRC- 1209 × BML- 7 exhibited average stability and were adaptable for wider environments. None of the hybrids recorded less or more than unit regression with higher grain yield than the general mean.
Study of correlations revealed that the character grain yield per plant showed significant and negative correlation with days to 50 per cent tasseling, days to 50 per cent silking, days to maturity and positive correlation with plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and 100-grain weight in three locations and pooled analysis.

The path coefficient analysis at genotypic level revealed that character number of kernels per row exhibited the largest direct effect on grain yield per plant followed by plant height, ear height, 100-grain weight, ear length, number of kernel rows per ear, ear girth, days to 50 per cent tasseling, days to maturity and days to 50 per cent silking.

Keeping in view of the above facts, by considering all factors like per se performance, sca effect, standard heterosis, relative heterosis, heterobeltiosis and stability, the most promising hybrids identified were MRC- 1123 × BML- 13, MRC- 1358 × BML- 13, MRC- 1123 × BML- 14, MRC- 1123 × BML- 7 and MRC- 1176 × BML- 7. These hybrids may be further tested over locations, seasons, years before recommending for commercial release.
MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author: HADASSAH (P. HARITHA DEVI), G.

Title of the thesis: MARKER ASSISTED INTROGRESSION OF BLAST RESISTANCE GENES INTO POPULAR RICE VARIETY, COTTONDORA SANNALU (MTU 1010)

Major Advisor: Dr. Ch. V. DURGA RANI

Degree: M.Sc.(Ag.)

College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number: D 9813

ABSTRACT

The present investigation was undertaken with an aim to introgress the blast resistance genes into popular rice variety, Cottondora Sannalu (MTU 1010). The experiment was carried out at Institute of Biotechnology (IBT), Professor Jayashankar Telangana State Agriculture University (PJTSAU), Rajendranagar, Hyderabad during 2012-13. Marker assisted back cross (MABC) breeding method was followed for introgression of blast resistance genes (Pi54, Pi1 and Pi2) into MTU1010. Foreground as well as background analysis was carried out in BC$_2$F$_1$ and BC$_2$F$_2$ generations. In the foreground selection of 134 BC$_2$F$_1$ Plants, 10 plants were confirmed with three genes. Among these ten selected lines of BC$_2$F$_1$ -13$^{th}$ plant scored the highest genome recovery (80%), while the 26$^{th}$ plant scored lowest genome recovery (51%). The low genome recovery was possibly due to inheritance of additional non-target loci from the donor genome in BC$_2$F$_1$ plants. From the three plants of BC$_2$F$_1$ generation with maximum percentage of recurrent parent genome recovery, were selected and selfed to generate BC$_2$F$_2$ generation. Total five hundred and forty seven BC$_2$F$_2$ plants were raised from selfed seed during rabi 2012-13. Among the 547 plants, five plants (44, 159, 403, 438 and 497) were confirmed for all the three genes. Background selection was conducted for the two gene and three gene positive plants (32) to check the recurrent parent genome recovery. Ninty three out of 311 SSR markers showed polymorphism between MTU 1010 and NLR 145. A total of 32 plants were subjected for background analysis. Among three gene combination plants, 80% recurrent parent genome was observed in BC$_2$F$_2$- 44$^{th}$ plant while a minimum of 40% was observed in BC$_2$F$_2$-159$^{th}$ plant. In two gene combinations 82% of highest parent genome recovery observed in 367$^{th}$ and 443$^{rd}$ plants and 51% of lowest parent genome recovery observed in 350$^{th}$ plant. Those plants with 80% and above recurrent parent genome were advanced to BC$_2$F$_2$ generation. BC$_2$F$_2$ progenies with highest recurrent parent genome recovery will be advanced as BC$_2$F$_3$ progenies for testing in uniform blast nursery to identify the blast resistant progenies which are similar to MTU 1010 characteristics.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : GOVARDHAN, E.
Title of the thesis : Delineation of areas deficient in micronutrients and sulphur in soils of Chittoor district of Andhra Pradesh
Major Advisor : Dr. (MRS) M. Chandini Patnaik
Degree : M.Sc. (Ag.)
College : College of Agriculture, Rajendranagar
Accession Number : D 9747

ABSTRACT

Soil fertility mapping with specific reference to micronutrients and sulphur was carried out by analyzing 576 geo-referenced soils collected from 64 mandals of Chittoor district of Andhra Pradesh. The pH of the soils was found to be in the range of 4.5 to 8.9 and majority of them (53%) were alkaline in nature. The EC of the district soils was normal and was in the range of 0.10 and 1.66 dSm$^{-1}$. Fifty five percent of soils analysed from Chittoor district was found to be medium in organic carbon content (0.5 to 0.75%) and 43% registered low organic carbon content. The nutrient index rating for OC, therefore, was found to be medium (1.78). The available phosphorus content was found to be in the range of 11 to 239 kg ha$^{-1}$ and indicated that their fertility class was medium and high in 21 and 79 per cent soils, respectively. The Nutrient Index (NI) value for available phosphorus (2.66) indicated that it was high. Potassium availability was found to be low in 4, medium in 42 and high in 54 per cent of soils of Chittoor with a NI value of 2.49 (high).

The soils of Chittoor district was found to be suffering from one or other or combination of two or more micronutrients in 324 out of analysed 576 samples and constituted 56 per cent (Zn alone in 103, Fe in 40, B in 60, Mn in 5, Cu in 5 and multi micronutrient deficiencies in 107 samples). Among individual nutrients, the soils of Chittoor were found to be deficient in available zinc to an extent of 33 per cent and boron in 21% samples. The iron deficiency in the district was found to be 19 per cent followed by copper in 4 and manganese in 2.6 per cent of samples. The sulphur deficiency in the district’s soils was found to be 18 per cent. The NI values for different micronutrients and sulphur in soils of Chittoor district was found to be 1.77 (medium) for Zn, 2.24 (medium) for B, 2.26 (medium) for Fe, 2.74 (high) for Cu, 2.82 (high) for Mn and 2.54 (high) for S. The correlation coefficients were worked out for various parameters studied in the investigation. All the thematic maps related to studied micronutrients and sulphur were prepared in GIS environment and presented.

The soils having two or more micronutrient deficiencies in the same sample were found to be 107 out of total 576 and constituted 18.6 per cent of the total soils and 33% of 324 samples suffering from micronutrient deficiencies in the district. These multi micronutrient deficiencies occurred with nine combinations of two micronutrients, six combinations of three micronutrients.
and one with four micronutrient combination. Zn+Fe (35 numbers) and Zn+B (31 no) combinations in the same soil sample of the district were recorded as predominant multi micronutrient deficient categories.

Based up on the crop that was supporting prior to soil sampling, the district soils were grouped into twelve categories. It was observed that the zinc deficiency was found to be to an extent of 42, 33, 28 and 27 percent, respectively, in soils on which paddy, sugarcane, tomato and groundnut were grown. The iron deficiency in the same crop supporting soils was found to be 21, 22, 18 and 13 per cent, respectively. Boron deficiency in the soils supporting paddy, sugarcane, tomato and groundnut crops was recorded as 22, 24, 23 and 18 per cent, respectively. Multi micronutrient deficiencies in the same soil samples were also noticed to a tune of 56, 53, 44 and 38 per cent, respectively on the soils that were supporting paddy, sugarcane, tomato and groundnut.

In this study, mandals of the district were also categorized based on the extent of nutrient deficiencies within their soils. It was observed that 15 mandals found to have their soils with >50% Zn deficiency, 8 mandals with >50% B deficiency and 4 mandals with >50% Fe deficiency. Similarly, the soils of five mandals registered sulphur deficiency of more than fifty per cent.

Based up on the magnitude of micronutrients and sulphur deficiencies that were observed in the district, twenty six mandals were identified wherein mandal specific micronutrient and sulphur related interventions are most important for alleviating their problems and to enhance the crop production. Similarly, it was also suggested to work for the development and use of micronutrient formulation of Zn+B+Fe to employ in this predominantly rain fed district due to large occurrence of multiple or multi-micronutrient deficiencies.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : LAXMAN RAO, P.
Title of the thesis : EFFECT OF SOIL AMENDMENTS ON SOIL PHYSICAL ENVIRONMENT, YIELD AND GREEN HOUSE GAS EMISSIONS IN MAIZE (Zea mays L.).
Major Advisor : Dr. G. JAYA SREE.
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9752

ABSTRACT

Effect of soil amendments on soil physical environment, yield and green house gas emissions in maize (Zea mays L.) was studied with taking maize variety 900-M-GOLD during rabi 2014-15 in Randomised Block Design (RBD) with 6 treatments replicated four times at the college farm, college of agriculture, Rajendranagar.

The soil was sandy loam in texture, slightly alkaline, non saline and medium in organic carbon content. The soil was low in available nitrogen and medium in available phosphorus and high in available potassium. Treatments consist of combinations of RDF and amendments (tanksilt @ 50 t ha$^{-1}$, vermicompost @ 5 t ha$^{-1}$, FYM @ 10 t ha$^{-1}$ and biochar @ 10 t ha$^{-1}$), Recommended Dose of Fertilizers (RDF) alone and control. Undisturbed core samples were collected for determination of bulk density, hydraulic conductivity and soil moisture at field capacity and permanent wilting point using pressure plate apparatus. Undisturbed aggregates were taken for determining aggregate stability by wet sieving method. Data on GHG emission samples were collected at regular intervals from various treatments using anchors and chambers and analysed by GC (Varian 3800) on the same day.

The gravimetric soil moisture content was increased in order of tanksilt > vermicompost > biochar > FYM > RDF > control. Application of tanksilt increased moisture holding capacity of soil 2.1 to 5.6 % over control throughout growth period. The application tanksilt and vermicompost significantly increased the (AWC) available water content (2.5 and 1.48 %) respectively compared to control (9.02%). However the application of biochar, FYM and RDF resulted in AWC of (9.14, 9.43 and 9.29%) which was on par with the control.

The application of different amendments tanksilt, vermicompost and FYM along with RDF significantly decreased the bulk density compared to RDF applied plots.

Almost 50% increase in aggregate stability was observed with the application of tanksilt (28.92 %). Significant increase in stability of aggregates was noticed in tanksilt, vermicompost, biochar and FYM application over control (19.95 %). Application of all the amendments viz.,
tanksilt, vermicompost, biochar and FYM reduced hydraulic conductivity to 0.020, 0.029, 0.031 and 0.028 cm min\(^{-1}\) respectively over the control (0.034 cm min\(^{-1}\)).

Clay percentage was increased from 16.3 to 18.2% by application of tanksilt @ 50 t ha\(^{-1}\). Almost 2% increase in clay content was observed.

Application of tanksilt, vermicompost and biochar in combination with RDF resulted in significant increase of soil available NPK status.

Application of all the amendments improved dry biomass and was significantly more than that of control and RDF plots. Application of amendments increased the drymatter production in the order of tanksilt > vermicompost > biochar > FYM > RDF > control. The application of tanksilt, vermicompost, biochar, FYM and RDF significantly increased the SPAD meter reading (20.69, 19.50, 15.79, 15 and 11.53) respectively compared to the control (9.73).

The increase in grain yield was 33.14, 30.38, 15.94 and 10% in tanksilt, vermicompost, biochar and FYM applied plots respectively over RDF applied plots (3547 kg ha\(^{-1}\)).

The cumulative CO\(_2\) emissions were recorded in the order of control > vermicompost > tanksilt > FYM > RDF > biochar. The application of vermicompost, tanksilt, FYM, RDF and biochar decreased the cumulative CO\(_2\) emission (126.3, 124.4, 121.6, 111.13 and 109.18 kg CO\(_2\)-C ha\(^{-1}\)) respectively compared to the control (134.12 kg CO\(_2\)-C ha\(^{-1}\)). The application of biochar, RDF, tanksilt and FYM decreased the cumulative CH\(_4\) emission (0.051, -0.041, -0.097 and -0.151 kg ha\(^{-1}\)) respectively compared to the control (0.059 kg ha\(^{-1}\)) but the application of vermicompost increased the cumulative CH\(_4\) emission (0.093 kg ha\(^{-1}\)). The application of RDF, tanksilt, FYM vermicompost and biochar increased the cumulative N\(_2\)O emission (1.58, 0.97, 0.78, 0.67 and 0.38 kg ha\(^{-1}\)) respectively compared to the control (0.037 kg ha\(^{-1}\)). The application of RDF, tanksilt, FYM, vermicompost and biochar increased the N\(_2\)O emission factor (0.775, 0.41, 0.28, 0.243 and 0.127) respectively. Highest global warming potential was observed in the RDF and this was followed by tanksilt and lowest being the control i.e., without any fertilizer application. Among the amendments lowest global warming potential was observed in biochar application plots.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : NAGENDRA, V.
Title of the thesis : INFLUENCE OF RICE PRODUCTION SYSTEMS AND NUTREINT MANAGEMENT PRACTICES ON RICE YIELD AND SOIL PROPERTIES
Major Advisor : Dr. S. HARISH KUMAR SHARMA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9751

ABSTRACT

Rice is grown under aerobic condition and under waterlogged conditions and by different planting systems. Nutrient management for the crop also is done in different practices like use of only fertilizers, use of only organics and integration of both. The crop growth and yield and soil properties may be affected differently under different production systems and nutrient management practices.

Present study has been taken up to evaluate the effect of production systems and nutrient management practices on crop performance and soil properties at the Indian Institute of Rice Research, Rajendranagar, Hyderabad during kharif 2014.

The study was taken up on a black clay loam soil. At the initiation of the experiment, the soil was alkaline in pH, non-saline. It was high in organic carbon, available phosphorus and available potassium and low in available nitrogen.

The experiment was conducted in a split plot design with production systems as main plots and nutrient management practices as sub plots. Three production systems viz., transplanted rice (TPR), direct sown rice (DSR) and aerobic rice (AR) were taken as the main plots. Five nutrient management practices viz., application of recommended dose of nutrients through fertilizers (100% RDF), application of only vermicompost equal to 100% of recommended N (100% VC), integrated application of vermicompost (equal to 25% of recommended nitrogen) along with 75% of recommended NPK through fertilizers (75% RDF+25% VC), integrated application of vermicompost (equal to 50% of recommended nitrogen) along with recommended dose of nutrients through fertilizers (100% RDF+50% VC) and control (no manure or fertilizer application) were studied in subplots.

Transplanted rice recorded higher grain yield (4414 kg ha\(^{-1}\)) and straw yield than others. Direct sown rice recorded significantly higher grain yield (3681 kg ha\(^{-1}\)) than aerobic rice (2686 kg ha\(^{-1}\)). Among nutrient management practices, highest grain yield was obtained with integrated nutrient management by applying 100% NPK + 50% VC (4317 kg ha\(^{-1}\)). 100% RDF (3761 kg...
ha\(^{-1}\)) and 75% RDF + 25% VC (3542 kg ha\(^{-1}\)) were on par. Insufficient nutrient availability with control (3098 kg ha\(^{-1}\)) and 100% VC (3252 kg ha\(^{-1}\)) resulted in lowest grain yield.

Transplanted rice recorded highest uptake of nitrogen (87.8 kg N ha\(^{-1}\)), phosphorous (14.3 kg P ha\(^{-1}\)) and potassium (78.8 kg K ha\(^{-1}\)) while aerobic rice recorded lowest uptake of nitrogen (42.0 kg ha\(^{-1}\)), phosphorous (8.0 kg ha\(^{-1}\)) and potassium (43.8 kg ha\(^{-1}\)) following trend of the dry matter production.

However, high internal nitrogen and phosphorus use efficiency was recorded under aerobic rice indicating that more grain was produced per unit N or P uptake.

Among the nutrient management practices, 100% RDF + 50% VC recorded highest uptake of nitrogen (84.2 kg ha\(^{-1}\)), while the phosphorus and potassium uptake with 100% RDF + 50% VC, 75% RDF + 25% VC and 100% RDF were on par.

Organic carbon content of soil increased with application of 100% RDF + 50% VC. Only vermicompost application did not increase available NPK in soil probably because it was applied for only one season.

Activities of enzymes viz., urease, dehydrogenase and phosphatase increased with age of crop from MT to PI stage, recorded highest activity at PI stage and decreased with maturity. Highest urease, dehydrogenase and alkaline phosphatase activities were observed in 100% RDF + 50% VC under aerobic condition. Application of vermicompost along with 100% RDF i.e., treatment 100% RDF + 50% VC increased the activity of all enzymes and microbial respiration over application of only fertilizers or only vermicompost in all the production systems.

Highest dehydrogenase activity was recorded under aerobic rice at all the stages indicating higher microbial activity over anaerobic conditions of DSR and TPR. Highest bacterial population, fungal population and microbial respiration were also recorded under aerobic rice.

In aerobic rice, application of vermicompost alone along with fertilizers decreased the bulk density and increased the porosity over its non-application.

Superior crop performance in terms of yield and nutrient uptake was recorded under transplanted conditions. Aerobic rice recorded higher enzyme activity and microbial activity. Integrated application of vermicompost (equal to 50% of recommended nitrogen) and fertilizers at 100% RDF (i.e., without reducing NPK application from recommended levels) proved beneficial in improved crop performance, enzyme activity and microbial activity in soil.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : PAVANI, G.
Title of the thesis : L-GLUTAMINASE ACTIVITY IN SOILS– ASSAY, DISTRIBUTION, KINETICS AND THE EFFECT OF CROP COVER ON ITS ACTIVITY
Major Advisor : Dr. P. CHANDRASEKHAR RAO
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9748

ABSTRACT

Present research work has been carried out with several objectives viz: to have a basic understanding of the activity and characteristics of L-glutaminase in the heterogeneous soil matrix, then to determine the influence of pH, moisture, temperature and kinetics with a view to determine its involvement in soil nitrogen transformation.

Thirty soil samples collected from different parts of Rangareddy district of Telangana state were assayed using standard procedure. L-Glutaminase activity of surface soils were expressed as µg of NH$_4^+$ released g$^{-1}$ soil 2h$^{-1}$ and ranged from 2.1 to 13.6 with an average value of 6.42 with the pH 8 buffer solution and with the pH 10 buffer solution the values ranged from 2.3 to 11.5 with an average value of 5.6. A simple correlation was carried out between the levels of L-glutaminase activity with physico-chemical and chemical characteristics of soil. The correlation analysis showed that L-glutaminase activity was positively and significantly correlated with organic carbon content (0.86**) and has shown no correlation with pH, EC and silt.

Soil L-glutaminase activity increased with an increase in substrate concentration i.e from 2 to 30 mM and with further increase in substrate concentration, minimal change in the enzyme activity was observed. Characteristics of enzyme activities like maximum enzyme reaction velocity and Michaelis constant were determined using Michaelis Menten equation, V$_{max}$ values varied with the type of soil from 12.65 to 58.82 and the K$_m$ values varied from 8.21 to 82.41 µg of L-glutamine hydrolyzed g$^{-1}$ soil 2h$^{-1}$ for soil L-glutaminase.

Effect of temperature on L-glutaminase activity was studied by incubating the soil samples from 20 to 80°C. Increase in temperature increased L-glutaminase activity from 20°C to 50°C, but decreased sharply with further increase in temperature. Temperature coefficient (Q$_{10}$) values were also calculated and found to be less than 1 when the temperature exceeds 50°C indicating the deactivation of enzymes.
L-glutaminase activity increased with increase in pH from 2 to 8 and thereafter a decrease in enzyme activity was observed with further increase in pH. The activity of L-glutaminase increased with increase in moisture levels from 30% to 100% but a sharp increase was observed up to 50% moisture and thereafter it levels down.

A pot culture experiment was conducted with one Alfisol in the Vegetable Production Unit of Department of Horticulture, to study the influence of crop cover on soil enzyme activity. The experiment was undertaken with three cereals - rice, sorghum and maize, two oilseeds - groundnut and sesamum, two legumes - blackgram and greengram, two vegetables - spinach and bhendi. The experiment was conducted using crops as treatments in Completely Randomized Block design with three replications along with uncropped control. The effect of plant cover on L-glutaminase activity showed that there was increase in L-glutaminase activity with age of crop and it varied with the plant species grown. The increase in L-glutaminase activity (μg of NH₄⁺ released g⁻¹ soil 2h⁻¹) ranged in groundnut from 5.7 to 13.4, blackgram from 5.7 to 12.9, greengram 5.6 to 12.7, sesamum from 4.8 to 11.8, rice from 4.7 to 11.3, maize from 4.3 to 10.2, sorghum from 3.1 to 10.7, spinach 3.8 to 9.5, bhendi from 2.4 to 8.4. The activity of L-glutaminase, acid and alkaline phosphatases under different crop coverages followed the order groundnut> black gram> greengram> sesamum> rice> maize> sorghum> spinach> Bhendi. The presence of plants and the type of plants grown on soil have shown a marked effect on enzyme activities.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : SAMEENA KHATHOON
Title of the thesis : ZINC NUTRITION ON PERFORMANCE OF SUNFLOWER (Helianthus annuus L.) HYBRID IN ALFISOLS
Major Advisor : Dr. T. ANJAIAH
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9745

ABSTRACT

The study was conducted during Kharif, 2014 at Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad. The soil of the experimental field was a sandy loam with pH 8.3, electrical conductivity 0.082 dS m

 Among all micronutrients zinc plays a vital role in plant nutrition. In order to know the effect of various levels and sources of Zn on the performance of sunflower hybrid, this study was conducted with sunflower hybrid DRSH-1 as a test crop. The experiment was laid out in randomized block design with three levels (10, 15 and 20 kg ha

 Zinc levels and sources were applied as per the treatments.

The plant samples were collected at 60 DAS and 90 DAS. Similarly soil samples were also collected at 60 DAS and 90 DAS. Seed yield was recorded at harvest stage. The shoot and seed samples were analyzed for N, P, K, S and Zn. Seed samples were analysed for oil content, fatty acid composition and protein content. Nutrient uptake was computed in both plant and seed samples. Soil samples were analyzed for pH, EC, OC, available N, P, K, S and Zn at 60 DAS and 90 DAS.

The mean sunflower yields viz., seed and stover at maturity were recorded as 1680, 3541 kg ha

 The combined application of Zinc + RDF at 20 kg ha

 The combined application of Zinc + RDF at 20 kg ha


characters showed an increase over control which are non significant i.e., plant height from 143.8 to 170.3 cm and 151.9 cm to 185.5 cm in treatments received ZnSO₄.H₂O @ 0 kg ha⁻¹ and 20 kg ZnSO₄.H₂O kg ha⁻¹, respectively at 60 DAS and 90 DAS.

The application of 20 kg ZnSO₄.H₂O ha⁻¹ produced significantly maximum protein content oil yield and protein yield were recorded 20.2%, 737 kg ha⁻¹ and 315 kg ha⁻¹ but oil content (43.9 %) increased over control which was non significant.

The highest uptake of N, K, S and Zn was recorded (65.4, 142, 12.5 kg ha⁻¹ and 105 g ha⁻¹ and 51.2, 70.4, 9.9 kg ha⁻¹ and 120.7 g ha⁻¹) in treatment T₇ (RDF + ZnSO₄. H₂O @ 20 kg ha⁻¹ at 90 DAS and 60 DAS, respectively.

The response of sunflower due to applied treatments was attributed to poor fertility i.e., low nutrient (OC, N, Zn) status of soil. At 60 DAS and 90 DAS, the treatments that received zinc sources showed maximum available N, P₂O₅, K₂O, S and Zn contents in soil.

There was no significant variation in pH, EC, OC and available P, K content at after harvest of sunflower among different sources and levels of zinc but the variation was found significant in available N, S and Zn.

The study indicated that the application of zinc sulphate monohydrate @ 20 kg ha⁻¹ along with RDF gave maximum net income from sunflower crop and B:C ratio also highest in treatment T₇. Based on the results of investigation it can be concluded that among zinc sources and levels, application of 20 kg ZnSO₄.H₂O is sufficient for obtaining optimum yields and good quality of sunflower when grown on light textured Alfisols. Zinc fertilizers should be at least 40-50% water soluble to supply adequate plant available Zn. ZnSO₄.H₂O is relatively more free flowing powder form and less solubility than ZnSO₄.7H₂O, Zn-EDTA.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : SANKUPAR SING KHARSYNTIEW
Title of the thesis : ANTIOXIDANT CONTENT AND YIELD OF CABBAGE AS INFLUENCED BY ORGANICS AND INORGANICS ON AN ALFISOL
Major Advisor : Dr. V. SAILAJA
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9750

ABSTRACT

A field investigation was conducted at College Farm and laboratory analysis of the samples obtained from the field at the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad during the year 2014-15. The objectives of the experiment are to study the effect of inorganics and organics on the antioxidant content, drymatter and head yields, nutrients content and uptake of cabbage, microbial populations of the rhizosphere and soil fertility status.

The experiment was carried out with seven treatments in a Randomized Block Design comprising of three factors replicated thrice having cabbage as the test crop. The treatments are two levels of fertilizers (100% and 75% RDF), two levels of humic acid (0 and 30 kg ha⁻¹) and three organic sprays viz., salicylic acid, ascorbic acid and humic acid of them the first two are antioxidants.

Humic acid when applied at 30 kg ha⁻¹, showed a significant increase in the drymatter to 2.4 t ha⁻¹ against 1.93 t ha⁻¹ without humic acid. Reduced level of fertilizers when applied in conjunction with humic acid resulted in comparable nutrient contents of the plant. Soil application of humic acid coupled with foliar applied humic acid fared well in increasing nutrient contents in plant. Application of humic acid and foliar spray of organics also significantly improved the nutrient content and uptake by plant.

The available N, P₂O₅ and K₂O of soil were 292, 69.5 and 297 kg ha⁻¹ with 100% RDF and 285, 54.8 and 291 kg ha⁻¹ with humic acid. Available P present in the soil at 45 DAP when humic acid was applied in integration was significantly higher with reduced level of 75% RDF i.e., 81.0 kg ha⁻¹ against 64.4 kg ha⁻¹ with 100% RDF alone.
Humic acid when applied at 30 kg ha$^{-1}$ showed significant effect on bacterial and fungal population of $59 \times 10^5$ CFU g$^{-1}$ soil and $22 \times 10^4$ CFU g$^{-1}$ soil respectively. Salicylic acid encouraged the formation of fungal colonies while ascorbic acid bacterial colonies.

Drymatter yield was not influenced by levels of fertilizers. Humic acid when applied at 30 kg ha$^{-1}$, showed a significant mean drymatter of 2.4 t ha$^{-1}$. Application of 100% RDF resulted in a significantly higher yield of 32.8 t ha$^{-1}$, which was 16 per cent higher than the yield of 28.4 t ha$^{-1}$ obtained due to 75% RDF. The yield, nutrient contents and uptakes realized by 100% RDF can be almost achieved at a reduced level (75%) of fertilizers by integrating with soil application of humic acid @ 30 kg ha$^{-1}$ and foliar application of organics.

Individual application of inorganic fertilizers at 75% RDF across humic acid and organic sprays contained a higher mean TFC of 12.30 µg rutin g$^{-1}$ fw. Humic acid also showed significantly higher mean TFC of 12.82 µg rutin g$^{-1}$ fw., mean TPC of 30.33 µg of pyrocatechol g$^{-1}$ fw. Foliar application of humic acid was found to increase mean TPC to 30.72 µg of pyrocatechol g$^{-1}$ fw. Salicylic showed higher mean TAC of 9.86 µg AAE mg$^{-1}$. The DPPH (%), the radical scavenging capacity, was significantly higher for 75% RDF i.e., 66.2. Among the three organic sprays, salicylic was significant and showed a DPPH of 67 per cent and reducing power of 0.71 while it was on par with humic acid.

From the above investigations, it was understood that at higher dose of fertilisers (100% RDF), the antioxidant contents (TPC, TFC) and antioxidant capacity, radical scavenging power and reducing power were much lower as compared to the reduced level of fertilisers. While, in respect of drymatter yield there was no significant difference amongst the levels of fertilisers. The nutrient contents and uptakes realized by 100% RDF can be almost achieved at a reduced level (75%) of fertilizers by integrating with soil application of humic acid @ 30 kg ha$^{-1}$ and foliar application of organics.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author : SARITHA, J.D.
Title of the thesis : SORPTION BEHAVIOUR OF METRIBUZIN IN VEGETABLE GROWING SOILS OF RANGAREDDY DISTRICT AND ITS PERSISTENCE IN SOILS AND TOMATO
Major Advisor : Dr. T. RAM PRAKASH
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9746

ABSTRACT

Metrribuzin [4-amino-6-tert-butyl-4,5-dihydro-3-methylthio-1,2,4-triazinone], a triazine, is widely used as a selective herbicides for pre and post-emergence control of annual grasses and numerous broad leaf weeds in the field and vegetable crops and it is the most popular broad spectrum herbicide used by tomato growing farmers in Ranga Reddy district of Telangana state.

Thirty soils samples collected from different tomato growing regions of the Ranga Reddy district in Telangana state were evaluated for their metribuzin adsorption capacity, desorption characteristics and persistence through laboratory experiments and field sample analysis.

Adsorption-desorption behaviour of metribuzin in soil samples was studied through batch equilibrium protocol and the herbicide was quantification was done spectro-photometrically by using UV-Vis spectrophotometer at 455 nm. Persistence was estimated through incubation studies at constant temperature of 27±0.2°C. Metribuzin persistence under field conditions was assessed by collecting the depth wise soil samples from different farmers fields analyzing them on GC-ECD. Tomato fruit samples were also collected at the time first picking and analysed for metribuzin residues on GC-ECD.

Soil reaction of the tomato growing soils was slightly acidic to moderately alkaline and all the soils were non-saline. Organic content (g kg⁻¹) content varied from 0.28 to 0.94 g kg⁻¹. Most of the soils were sandy clay loam in texture. Majority of the soils were low in available nitrogen. Available P content of 14 soils was medium in range and remaining 16 soils was high.

The adsorption isotherms were mainly parabolic in nature with ‘S’ shaped character in most of the soil samples except samples 7 and 24. In these soils the isotherms were ‘L’ shaped. The adsorption data fitted well with Freundlich equation. The Kf values for the soils varied from 0.051 (S-24) to 1.369 (S-13) and the n values varied between 0.74 (S-25) to 1.11 (S-
The co-efficient of determination ($R^2$ values) were higher than 0.97, indicating an excellent fit of the adsorption data by Freundlich equation. The values of $1/n$ suggested the existence of non-linear adsorption. Fitting the adsorption data in mathematical equation as postulated by Saroja Raman indicated that these isotherms fitted well for the S shaped isotherms with adsorption constants varying from 0.064 to 0.960.

Freundlich constant was positively and significantly correlated with organic carbon ($r = 0.802^{**} P<0.01$), clay content ($r = 0.737^{**} P<0.01$) and clay + OC ($r = 0.741^{**} P<0.01$). The soil water distribution quotient $K_d$ values of the thirty soils varied between 0.11 and 0.96. The $K_{d_{oc}}$ values for metribuzin in soils varied from 33.36 to 140.31.

Percent desorption varied between 23.93 to 50.18 in S-8; 78.34 to 51.81 in S-12 and 66.34 to 37.42 in S-21 samples. Hysteresis was highest in soil-8 and lowest in soil-12 and intermediate in soil-21 which specified that the desorption in the soil is strongly influenced by the clay and organic matter content. The desorption Freundlich constants varied between 0.988 (10 $\mu$g mL$^{-1}$) to 7.930 (50 $\mu$g mL$^{-1}$) in S-8; 0.019 (10 $\mu$g mL$^{-1}$) to 0.385 (50 $\mu$g mL$^{-1}$) in S-12 and 0.237 (10 $\mu$g mL$^{-1}$) to 7.930 (50 $\mu$g mL$^{-1}$) in S-21. $K_f$ values for desorption increased with increase in initial concentration of herbicide for all the soils.

This kind of adsorption and desorption behaviour, as indicated by isotherms, showed that metribuzin is weakly retained by the soil. This adsorption is not completely reversible, the desorption isotherms showing hysteresis.

Persistence studies indicated that, disappearance curves of metribuzin consisted of two distinct pathways, an initial faster rate followed by a slower phase of dissipation. The faster mode of disappearance continued till about 30 days followed by a slower rate of disappearance phase which continued till the end of the study. The rate constants for entry of the metribuzin into labile pool ($k$ values) for the soils varied from 0.00321 to 0.00419 at saturation; 0.00279 to 0.00323 at field capacity and 0.00156 to 0.00175 at 50 % of the field capacity. The rate constant for entry in to the bound pool ($k_1$ values) were in the range of 0.00179 to 0.00236, 0.00178 to 0.00225 and 0.00225 to 0.00279 at saturation, field capacity and 50 % field capacity respectively.

Metribuzin persisted in the soils upto 60 DAA (Days after application) in the soils where the clay and organic carbon content were relatively higher. Whereas, persistence could be detected upto 45 DAA in light textured soils. Beyond 60 days the metribuzin concentration in the soil reached the detection limit of 0.05 mg/kg. Metribuzin residues in tomato samples collected at the time of harvest was below the detection limit and MRL of 0.05 mg kg$^{-1}$.
SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author: SRINIVAS, A.
Title of the thesis: PHOSPHORUS FERTILIZER REQUIREMENT AND USE EFFICIENCY IN RICE BASED CROPPING SYSTEMS ON P-ACCUMULATED SOIL
Major Advisor: Dr. P. SURENDRABABU
Degree: Ph. D.
College: COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number: D 9753

ABSTRACT

The present investigation was carried out to determine the (i) Extent of occurrence of high P soils in selected locations of the erstwhile Andhra Pradesh state (ii) Status of P fractions and fixation characteristics of selected high P soils (iii) P-availability pattern in high P soils and (iv) Phosphorus fertilizer requirement and use efficiency in rice-rice and rice-sunflower cropping systems in a high P soil.

In order to fulfill the objectives of the investigation, survey for recording occurrence of high-P soils in selected mandals of 3 districts of erstwhile Andhra Pradesh was carried out. For the selected soils of these three locations (three each from 3 locations), P-fixation, P-fractions and availability of P with different rates of its application was studied under laboratory conditions. Field experiment was conducted at college farm of ANGRAU, Hyderabad on a high-P soil (P$_2$O$_5$ of 126 kg ha$^{-1}$) during 2009-10 and 2010-11. P$^{32}$ isotope was employed in incubation and field experiments.

Survey carried out in Varni mandal of Nizamabad district, Mangalagiri mandal of Guntur district and Velugodu mandal of Kurnool district revealed that the occurrence of high-P soils in these mandals are 98, 71 and 77 percentages, respectively. The P-fixation characteristics of the selected soils in Varni mandal of Nizamabad district revealed that the P-fixation capacity of these soils decreased slightly with the increasing soil P-fertility. The P-fractions, namely, saloid-P, Al-P, Fe-P, red-P and Ca-P of the selected nine soils of these locations ranged from 12.58 to 14.27, 31.63 to 32.63, 28.97 to 30.78, 19.97 to 21.40 and 107.02 to 110.74 mg kg$^{-1}$, respectively.

There was an increased availability of Olsen’s extractable P$_2$O$_5$ by 27, 36 and 32 per cent, when 100 % RDP was supplied to these selected location soils and upon comparing with control. The extent of increase in available P$_2$O$_5$ was from 45 to 65 kg with 44 per cent enhancement in C-1 category, further 31 per cent enhancement in C-2 category from 89 to 117 kg and 27 % from 126 to 160 kg P$_2$O$_5$ ha$^{-1}$ in C-3 category.
The per cent Pdff increased in all location soils with the increase in DAI. Within each location soils, the per cent Pdff decreased with increasing initial P fertility level. The per cent recovery of applied P was higher in Velugodu soils (52 %) followed by Mangalagiri soils (50 %) and Varni soils (39 %) when comparison was made on one to one basis among soils of each location in between 25 to 100 % RDP application.

Application of P during kharif to rice crop either in the rice-rice system or rice-sunflower system indicated that the grain yield of paddy during kharif remained similar due to application of either 100 or 75 % RDP. In case of rice-rice system, the grain yield was in the range of 5668 to 5775 kg ha\(^{-1}\) due to application of P @ 75 to 100 % RDP. The paddy grain yield also remained at par due to these treatments in pooled kharif rice data of rice-sunflower system. The straw yield, like grain, registered similar value when P was applied to kharif rice @ either 75 or 100 per cent RDP and it was in the range of 5908 to 6090 in rice-rice system and 5655 to 5849 kg in rice-sunflower system.

The rabi paddy grain yield, after kharif rice, was significantly affected by fresh rabiP application. However, P applied @ 75 and 100 % RDP of rabi dose registered similar yields of 5654 and 5760 kg ha\(^{-1}\). Similarly, the straw yield was also recorded at par (5915 and 6140 kg h\(^{-1}\)) due to 75 and 100 % rabi RDP application. Decreasing of rabi RDP to 50 per cent significantly reduced the yield of both grain and straw of rabi rice.

The kharif residual effect of applied P in the rabi was also found to affect the grain and straw yield of rabi rice. The grain and straw yields decreased from 5876 to 5130 and 6319 to 5361 kg ha\(^{-1}\), respectively, as the rate of P application in the earlier kharif got decreased from 100 to 25 per cent. The quantities of P applied @ 100 or 75 % RDP of kharif dose in conjunction with 100 or 75 % RDP applied in rabi resulted in similar yield of paddy grain in the range of 5916 - 5973 kg ha\(^{-1}\) and straw yield of 6230 - 6673 kg ha\(^{-1}\). These observations indicated that the best option could be to apply 75 % of RDP each, for both kharif and rabi rice crops in rice-rice system raised on a high P soil without sacrificing the yields.

The per cent Pdff of the rice dry matter in kharif decreased from 25.29 to 16.62 in rice-rice system and from 26.22 to 16.20 per cent in rice-sunflower system as the rate of P application to the crop was reduced from 100 to 25 % RDP. The fertilizer P uptake on the other hand, increased with the incremental rates of P application up to 100 % RDP. The per cent P utilization by kharif paddy dry matter was almost 70 per cent higher due to 25 % RDP application, when compared to 100 % RDP in this High -P experimental soil. The soil P uptake remained in the range of 13.8 to 16.91 kg ha\(^{-1}\) across different treatments of kharif rice dry matter in both the systems.

The per cent Pdff of rabi paddy dry matter (after kharif rice) was found to be decreasing from 27.52 to 19.84 and from 23.12 to 22.25 as the rate of P application made in rabi and earlier kharif reduced, respectively. The fertilizer P uptake of rabi rice dry matter was found to be higher when the crop received the combined dose of 75 or 100 % RDP of both the seasons (5.27 to 5.60 kg ha\(^{-1}\)). The per cent P utilized by the rabi rice crop remained higher with the lower rates of P application of either rabi or previous kharif rates. It decreased from 36.01 to 20.13 per cent due to rabi treatments and 29.24 to 25.31 % due to residual kharif treatments, upon reduced rates of P application. The post harvest soil analysis after kharif and after rabi in rice-rice system indicated that there is not much build up in available P\(_2\)O\(_5\) due to P application to this already high P soil.

Application of fresh phosphorus levels during rabi to sunflower crop after preceding kharif rice revealed that the sunflower seed yield was similar (1616 or 1566 kg ha\(^{-1}\)) irrespective of 100 or
75 % RDP application. The stalk yields of sunflower also resulted in similar trend in this high P soil. The cumulative studies indicated that the seed / stalk yield of sunflower was at par due to P application @ 100 % RDP of rabi + 100 % RDP of kharif or 75 % each of kharif and rabi doses. Thus, it is concluded that an amount of 25 % RDP each in kharif + rabi can be reduced to obtain similar yields like that of 100% RDP in each season in rice - sunflower system on a P-accumulated soil.

The freshly applied rabi P to sunflower crop decreased the per cent Pdff of its dry matter at bud initiation stage in High - P soil from 25.8 to 22.1. The residual effect of kharif treatments indicated that the per cent Pdff decreased drastically from 27.3 to 20.3 per cent as the rates of P applied in preceding kharif rice decreased from 100 to 25 % RDP. The per cent Pdff was highest due to cumulative effect of 100 % RDP of both the seasons (29.3 %). This was found to be on par due to the cumulative effect of 100 % RDP of rabi + 75 % RDP of kharif (27.1 %) or 75 % RDP of rabi + 100 % RDP of kharif (27.3 %).

The per cent P utilization of applied P by rabi sunflower decreased from 9.5 to 6.7% with the increment of rabi P application and got reduced from 10.5 to 5.8 per cent as the plots that received P in the earlier kharif got reduced from 100 to 25 per cent. The soil P uptake by sunflower during rabi registered lower values with reduced P application of rabi dose as well as earlier kharif doses employed in rice (5.38 to 4.09 kg ha\(^{-1}\)). Post harvest soil analysis after kharif rice as well as after entire cropping system of rice – sunflower system did not result in any build up in available P\(_2\)O\(_5\) as the duration of sequence is one year and the P applied to crops are either RDP or lower levels.

In the entire rice-rice cropping system raised on a high P soil, the total paddy grain yield obtained due to 100 % RDP application during both the seasons (a total of 120 kg P\(_2\)O\(_5\) ha\(^{-1}\)) was found to be 11.42 tons ha\(^{-1}\) yr\(^{-1}\) of grain and 12.05 tha\(^{-1}\) yr\(^{-1}\) of straw. Similarly, reduced P application (i.e. 75 % RDP in each season totaling to 90 kg P\(_2\)O\(_5\) ha\(^{-1}\) yr\(^{-1}\)) also helped in realizing similar grain yield of 11.45 t ha\(^{-1}\) yr\(^{-1}\). The P removal by both the crops in rice-rice system was to an extent of 40.15 kg ha\(^{-1}\) (grains) and 16.80 kg ha\(^{-1}\) (straw) when 100 % RDP was applied to both the crops of the sequence. Removal of P to an extent of 39.09kg ha\(^{-1}\) by grain and 16.80kg ha\(^{-1}\) by straw was also observed in this high P soil when P was applied at the reduced rate of 75 % RDP to each crop of system. The per cent P utilization by the entire cropping system revealed that application of 75 % RDP to each crop in the sequence resulted in better utilization of applied P to a tune of 26 per cent when compared to 22 % that was realized due to 100 % RDP application to each crop.

It was observed that the rice equivalent of 10280 kg paddy grain ha\(^{-1}\) yr\(^{-1}\) was obtained when P was applied at the full rate of 100 % RDP in both the seasons in the entire rice-sunflower cropping system. Almost, similar rice equivalent yield of 10227 kg ha\(^{-1}\) yr\(^{-1}\) of paddy grain was obtained even when 75% RDP was applied to each crop of rice - sunflower system. The total P removal by paddy grain and sunflower seed was 26.12 and 25.88 kg ha\(^{-1}\), respectively, due to 100% or 75% RDP application to both the crops. The per cent P utilization by both the crops in the entire system was 14.5 when 100% RDP was applied to both the crops and slightly higher at 17.2 per cent even when RDP is reduced by 25% in rice and sunflower crops of rice – sunflower cropping sequence on a high P soil.
A field experiment was conducted during kharif 2014 to study the effect of Integrated Nutrient Management on forms of potassium, dry matter, pod yield, nutrient uptake, quality parameters and soil properties at college farm, College of Agriculture, Rajendranagar in Bhendi crop. The experiment was conducted in RBD with eleven treatment combinations replicated three times. The treatments consisted of T₁ (control), T₂ (RDF), T₃ (50% K₂O through MOP and 50% K₂O through FYM), T₄ (50% K₂O through MOP and 50% K₂O through VC), T₅ (50% K₂O through MOP and 50% K₂O through PM), T₆ (75% K₂O through MOP and 25% K₂O through FYM), T₇ (75% K₂O through MOP and 25% K₂O through VC), T₈ (75% K₂O through MOP and 25% K₂O through PM), T₉ (100% K₂O through FYM), T₁₀ (100% K₂O through VC) and T₁₁ (100% K₂O through PM). Inorganic N, P and K were supplied through urea, single super phosphate and muriate of potash.

Organic nutrient sources namely vermicompost, poultry manure and farm yard manure were analyzed in the laboratory using standard procedures. The results revealed that vermicompost was neutral to very slightly alkaline in reaction with a pH of 7.3, EC was 0.9 dSm⁻¹, and total organic carbon content was 17.8%. Total N, P and K contents were 1.13%, 0.34% and 0.42% respectively. Poultry manure was slightly alkaline in reaction with a pH of 7.7, E.C 0.02 dSm⁻¹ and organic carbon content of 23.34%. Total N,P and K contents of poultry manure were 1.13%,0.93% and 0.54% respectively. The analysis of farm yard manure indicated that the pH was 7.1, E.C was 0.56 dSm⁻¹, and organic carbon was 23.86%. Total N,P and K contents of farm yard manure were 0.46%,0.42% and 0.89% respectively.

Organic nutrient sources were applied as per the treatments. The first set of plant samples were collected at 30 DAS, second set at 60 DAS and third set at harvest stage. Similarly soil samples were also collected at 30 DAS, 60 DAS and at harvest stages. Pod yield was recorded over 12 pickings. The plant samples were analysed for N, P and K. Fruit samples were analysed
for crude protein and crude fibre content. Soil samples were analysed for pH, EC, OC, available N, P, K and different forms of K (water soluble, exchangeable, non-exchangeable or fixed and step K) at 30 DAS, 60 DAS and at harvest.

At 30 DAS, 60 DAS and at harvest stages, water soluble K, exchangeable K and step K recorded highest values under the treatment T₄ (50% K₂O through MOP and 50% K₂O through VC) but the non-exchangeable or fixed K was higher under T₁ (Control).

At 30 DAS, 60 DAS and at harvest stages the highest dry matter production was recorded in T₄. The highest pod yield was recorded in T₄ with fruit yield of 7590 kg ha⁻¹. The primary nutrients uptake was recorded highest in T₂ (RDF) at 30 DAS, 60 DAS and at harvest. However K uptake was highest in T₄ at harvest. The highest crude protein content was recorded in T₁₀ (100% K₂O through VC) and the lowest fibre content at harvest was recorded under T₁₀ (100% K₂O through VC).

There was no significant variation in pH, EC, OC and available P content at harvest stage among different treatments but the variation was significant in available N and K.

The study indicated that the application of organic manures alone or in combination with inorganic fertilizers resulted in higher nutrient availability, fruit yield and quality parameters in behind.
STATISTICS AND MATHEMATICS

Author : SREENIVAS, AKULA
Title of the thesis : A STUDY ON SHIFTS IN AREA, PRODUCTION AND PRODUCTIVITY OF MAJOR CROPS IN NORTHERN TELANGANA ZONE
Major Advisor : Dr. D.SRINIVASA CHARY
Degree : M.Sc. (Ag.)
College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR
Accession Number : D 9744

ABSTRACT

The Area, Production and Productivity of major crops in Northern Telangana Zone have registered sudden increases or decreases over a period of time due to the introduction of new technologies, incidence of pests and diseases, fluctuation in the weather parameters etc. It has led to several shifts in cropping pattern. Whenever a shift occurs in the area of a crop, it leads to either an increase or decrease in area under the other crops i.e. area allocation under the crops is not independent. Identifying the shifts in cropping pattern alone is not sufficient. It is essential to observe whether an impact of these shifts has occurred in production and productivity levels of the crops. Hence an attempt was made to identify the shifts in crop characteristics of major crops grown in Adilabad, Karimnagar, Nizamabad districts and Northern Telangana Zone as a whole. The study was based on 34 years of data (1979-80 to 2012-13) in the three districts and Northern Telangana Zone as a whole.

In an attempt of identifying the shifts in cropping pattern, the hierarchical approach in particular, the Ward’s minimum variance method was found to be suitable. In cluster analysis each cluster represent a period of years with similar year-to-year fluctuations i.e. each cluster represents a certain level of “shift” in cropping pattern.

It was found that rice crop recorded an increase in area in the recent years in all the districts of the zone. The production levels of all the major crops rice, cotton and maize were increased and shown a considerable positive shift in the Northern Telangana Zone. The recent scenario, maize is at the top position in production levels (19,915 thousand tonnes) followed by cotton and rice in all the districts of the Zone. Cotton and maize crops have shown considerable increase in productivity levels. The major factor for the increase in production level of the commercial crop cotton was the maximum coverage but not due to the productivity levels. This indicates that there is no impact of technological innovations during the recent years in increasing the production levels of cotton. Hence there is a need to put more efforts on improving the productivity levels of the major crops of Northern Telangana Zone.
WATER MANAGEMENT

Author : RAMANJANEYA, B.

Title of the thesis : “GREENHOUSE GROWN TOMATO (Lycopersicon esculentum L.) TO DRIP IRRIGATION AND N-FERTIGATION IN SEMIARID TROPICS”

Major Advisor : Dr. K. SREENIVASA KUMAR

Degree : M.Sc.(Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9778

ABSTRACT

Greenhouse tomato production in semiarid tropics suffers from sustainable yields due to lack of optimized irrigation and fertigation levels. The present study is aimed to investigate the effects of greenhouse microclimate, irrigation and fertigation levels on the tomato production in agro-climatic conditions of Southern Telangana. The experiment was laid out in randomized block design with three levels of irrigation and fertigation replicated thrice to keep the error degree of freedom in limits. The treatments were GHC + Drip irrigation(0.75 Epan) + 100 % N (T₁), GHC + Drip irrigation (0.75 Epan) + 125 % N (T₂), GHC + Drip irrigation (0.75 Epan) + 150% N (T₃), GHC + Drip irrigation(1.0 Epan) + 100 % N (T₄), GHC + Drip irrigation (1.0 Epan) + 125 % N (T₅), GHC + Drip irrigation (1.0 Epan) + 150% N (T₆), GHC + Drip irrigation(1.25 Epan) + 100% N (T₇), GHC + Drip irrigation (1.25 Epan) + 125% N (T₈), GHC + Drip irrigation(1.25 Epan) + 150% N (T₉), NGHC + Control (100% N + surface irrigation = IW/CPE@5cm) (T¹₀). The experimental soil was sandy clay loam in texture with low available nitrogen and high available phosphorous and potassium.

Time course evaluation of greenhouse microclimate indicated that, on an average, air temperature, relative humidity and light intensity varied from 22.9 to 28.9 °C, 52 to 69% and 8.1 to 13.1 klux, respectively against ambient condition (23 to 27 °C), (51-67 % ) and ( 31.8 to 42.3 k lux), which is favorable for greenhouse vegetable cultivation. Effect of different irrigation and fertigation levels on the biometric performance of tomato inferred that, plant height and dry matter production were maximum at GHC + Drip irrigation (1.0 x Epan) + 125% N at all growth stages. Significantly higher fruit yield ( 44.89 t ha⁻¹ ) was observed in GHC + Drip irrigation (1.0 x Epan) + 125% N , while less number of fruit yield ( 15.28 t ha⁻¹ ) was observed with NGHC + Control (100% N + surface irrigation) = IW/CPE @ 5cm.
The highest lycopene content of tomato at initial and final pickings (3.47 mg 100 g⁻¹), (6.57 mg 100 g⁻¹) was recorded in GHC + Drip irrigation (1.0 Epan) + 125% N as compared to the rest of the treatments followed by lowest (1.40 mg 100 g⁻¹), (3.53 mg 100 g⁻¹) in NGHC + Control (100% N + surface irrigation) = IW/CPE @ 5cm. The treatment of GHC + Drip irrigation (1.0 x Epan) + 125% N recorded higher WUE (99.32 kg ha mm⁻¹) over rest of the treatments with least WUE (33.16 kg ha mm⁻¹) observed in NGHC + Control (100% N + surface irrigation = IW/CPE@5cm). Total NPK uptake in tomato fruits and haulms at 30, 60 and 90DAT and at harvest was significantly superior in GHC + Drip irrigation (1.0 x Epan) + 125% N, over the rest of treatments. The lowest NPK uptake was found in the control (NGHC + Control (100% N + surface irrigation = IW/CPE @ 5cm).

Economic analysis of greenhouse production among the treatments indicated that maximum net returns (₹ 1,82,237 ha⁻¹) and B: C ratio (5.32) were associated with GHC + Drip irrigation (1.0 Epan) + 125% N, while the least net returns (₹ 36,436 ha⁻¹) and B:C ratio (1.91) were observed with control (NGHC + Control (100% N + surface irrigation = IW/CPE @ 5cm). The greenhouse grown tomato production in 384 m² area is economically viable with B:C ratio of 1.8 and payback period of 4 years and 1 month with present level of irrigation and fertigation. The findings of the study can provide guidelines for the selection of suitable irrigation and fertigation levels in maintaining sustainable greenhouse tomato production for semiarid tropics.
WATER MANAGEMENT

Author : SATHISH, A.

Title of the thesis : “WATER MANAGEMENT FOR DIFFERENT SYSTEMS OF RICE (Oryza sativa L.) CULTIVATION IN PUDDLED SOILS”

Major Advisor : Dr. K. AVIL KUMAR

Degree : M.Sc.(Ag.)

College : COLLEGE OF AGRICULTURE, RAJENDRANAGAR

Accession Number : D 9777

ABSTRACT

Hyderabad during kharif 2014 to study the “Water management for different systems of rice (Oryza sativa L.) cultivation in puddled soils” in a strip plot design with three replications. The treatments comprises of three systems of cultivations (direct seeding with drum seeder, transplanting with machine and conventional transplanting) as main treatments and four irrigation regimes (irrigation of 5 cm, when water level falls below 5 cm from soil surface in field water tube, irrigation of 5 cm, when water level falls below 10 cm from soil surface in field water tube, irrigation of 5 cm at 3 days after disappearance of ponded water and recommended submergence of 2-5 cm water level as per crop stage) as sub plots treatments with medium duration variety RNR 15048. Seedlings of 17 days and 21 days age were transplanted in machine transplanting and conventional transplanting respectively. The experimental soil was sandy loam in texture and low in available nitrogen, high in available phosphorus and potassium.

Significantly higher number of tillers m-2 and dry matter accumulation were observed in machine transplanting (MTP) over drum seeding (DS) at all growth stages except 50 DAS. Number of tillers in machine transplanting at 110 DAS and at harvest was on par with conventional transplanting. Significantly lower root volume was observed in drum seeding (CTP and at harvest, respectively) than rest of methods of crop establishment at 110 DAS and harvest and was on par with CTP at 80 DAS. However, CTP was on par with machine transplanting at 80 DAS and at harvest, but significantly differed at 110 DAS. Significantly higher (20%) number of panicles were recorded by MTP as compared to DS and was on par with CTP. Different rice cultivation systems did not show significant influence on panicle length, filled and unfilled grains panicle-1, and test weight. MTP recorded significantly higher grain (14.7 %) and straw (10.5 %) yield over drum seeding method. However conventional transplanting method was found on par to machine transplanting method with 2.7 and 1.0 per cent variation.
Drum seeding system required higher total applied water (1359.4 mm) by 2.6 per cent as compared to CTP (1325.5 mm) and MTP (1313.5 mm). Significantly higher water use efficiency (4.7 kg mm⁻¹) was recorded with MTP compared to DS (4.0 kg mm⁻¹) and was on par with CTP (4.5 kg mm⁻¹). Machine transplanting recorded significantly higher gross returns (82,880 ha⁻¹), net returns (50,035 ha⁻¹), and B: C (2.54) ratio over CTP and DS. However, CTP (44,088 ha⁻¹) was found on par with MTP in terms of recording net returns.

Among different irrigation regimes significantly higher number of tillers m⁻² and dry matter was recorded with recommended submergence of 2-5 cm water level as per crop stage over irrigation of 5 cm submergence when water level falls below 10 cm in field water tube and was on par with irrigation of 5 cm at 3 DADPW and 5 cm submergence with 5 cm drop of water level in field water tube. The root volume was significantly higher in irrigation of 5 cm, when water level falls below 5 cm from soil surface in field water tube at 80, 110 DAS and at harvest. Significantly higher filled grains (306) panicle-land panicle weight were recorded with recommended submergence of 2-5 cm water level as per crop stage than irrigation of 5 cm submergence with 10 cm drop of water level in the field tube and was on par with irrigation of at 5 cm, when water level falls below 5 cm from soil surface in field water tube and irrigation of 5 cm at 3 DADPW. Interaction between irrigation regimes and systems of rice cultivation did not influence significantly on number of tillers, dry matter, yield and yield attributes, nutrient uptake, post harvest nutrient status of soil and economics.

Recommended submergence of 2-5 cm water level recorded significantly higher grain and straw yield (6148 and 7039 kg ha⁻¹, respectively) and N, P, K uptake and was on par with irrigation of 5 cm when water falls below 5 cm from soil surface in field water tube. There was saving of water by 36.5 (1154.7 mm), 28.5 (1271.7 mm) and 40.4 per cent (1085.0 mm), respectively compared to recommended practice of irrigation (1819.7 mm), though there was reduction of grain and straw yield by 5.4 and 4.4, 6.5 and 2.4, 12.5 and 11.9 per cent, respectively due to irrigation of 5 cm at 3 DADPW (5817 and 6732 kg ha⁻¹, respectively), irrigation of 5 cm when water falls below 5 cm from soil surface in field water tube (5751 and 6872 kg ha⁻¹, respectively), and irrigation of 5 cm when water falls below 10 cm from soil surface in field water tube (5379 and 6204 kg ha⁻¹, respectively). Higher gross returns (83706 ha⁻¹) were obtained with recommended submergence of 2-5 cm water level and net returns (47245 ha⁻¹) and B: C (2.48) ratio was significantly higher with irrigation of 5 cm at 3 DADPW than recommended submergence and was on par with irrigation of 5 cm when water falls below 5 cm from soil surface in field water tube (44986 ha⁻¹).

Based on the research results, it can be concluded that machine transplanting produced higher growth, yield and yield attributes, gross and net returns and B: C ratio compared to direct seeding with drum seeder and conventional transplanting systems of cultivations. There was saving of water by 36.5, 28.5 and 40.4 per cent respectively compared to recommended practice of irrigation, though there was reduction of grain yield by 5.4, 6.5 and 12.3 per cent respectively due to irrigation of 5 cm at 3 DADPW, irrigation of 5 cm when water falls below 5 cm from soil surface in field water tube and irrigation of 5 cm when water falls below 10 cm from soil surface in field water tube respectively. Gross and net returns and B: C ratio was significantly higher with irrigation of 5 cm at 3 DADPW and was on par with irrigation of 5 cm when water falls below 5 cm from soil surface in field water tube.
FOODS & NUTRITION

Author : ANITHA, R.

Title of the thesis : SCREENING FOR QUALITY AND GLYCEMIC INDEX OF SELECTED NEWLY RELEASED RICE VARIETIES OF NORTHERN TELANGANA ZONE, TELANGANA

Major Advisor : Dr. K. MANORAMA

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR

Accession Number : D 9837

ABSTRACT

Over 2 billion people in Asia alone derive 80 per cent of their energy needs from rice, which contains 80 percent carbohydrates, 7–8 percent protein, 3 percent fat and 3 percent fibre. Rice protein, though small in amount, is of high nutritional value. Despite numerous studies on different varieties of rice, there is lack of published data on glycemic index of newly released rice varieties of Telangana. Low glycemic index rice varieties with good nutritional composition may encourage farmers as well as consumers to increase their demand. Therefore a study has been planned to assess the Physico-chemical, Organoleptic quality and glycemic index profiling of the selected newly released rice varieties of Northern Telangana region.

The selected newly released rice varieties Anjana (JGL-11118) and Pradhyumna (JGL-17004) are grown in Northern Telangana region. For the study, the paddy sample of selected Anjana (JGL-11118) and Pradhyumna (JGL-17004) rice varieties were procured from Regional Agricultural Research Station, Jagityal, Karimnagar District. The selected Rice varieties were assessed for Milling Properties (Brown rice percentage, husk percentage, Milled recovery, Head rice percentage, Broken Rice percentage) Physical properties (Grain hardness, 1000 Kernel weight, Elongation ratio, Volume Expansion, water up take by the grains, L/B ratio) chemical properties and glycemic Index.

Lower head rice percentage was observed in Anjana (JGL-11118) compared to Pradhyumna (JGL-17004). The length and breadth of the rice kernels were measured using digital vernier caliper (Yamayo, Digimatic caliper). The Length/ Breadth ratio of rice varieties Anjana (JGL-11118) and Pradhyumna (JGL-17004) were 3.62 ± 0.16 mm and 3.37 ± 0.12 mm. These varieties are classified as short slender grains. Starch content of Anjana and Pradhyumna varieties was 70.21 percent and 69.83 percent. Amylose content of evaluated varieties was 26.1 percent in Pradhyumna and 25.53 percent in Anjana. Evaluated varieties fall into intermediate category and high Amylose content (AC) category. The amylopectin content of Anjana and Pradhyumna was 74.2 percent and 74.3 percent respectively, where as Pradhyumna had the
higher percentage of amylopectin compared to Anjana. Organoleptic test revealed that the rice variety Anjana (JGL-11118) had scored high in all sensory attributes compared to Pradhyumna (JGL-17004) rice variety.

Moisture content of rice varieties Anjana and Pradhyumna was 7.85 ± 0.2 and 7.21 ± 0.12 percent. Ash content of Anjana and Pradhyumna was 0.53 ± 0.13 and 0.89 ± 0.02 percent. Ash content of rice variety Pradhyumna was higher than the ash content of rice variety Anjana. The protein content was 7.9 ± 0.0 and 7.53 ± 0.2 g/100 g respectively in Anjana and Pradhyumna. The fat content was 0.55 ± 0.08 and 0.59 ± 0.06 g/100 g respectively in Anjana (JGL-11118) and Pradhyumna (JGL-17004). Crude fibre content was 0.39±0.10 and 0.24 ± 0.05 g/100 g respectively in Anjana (JGL-11118) and Pradhyumna (JGL-17004). Carbohydrate content of Anjana (JGL-11118) and Pradhyumna (JGL-17004) was 83.11±0.62 and 83.7 ± 0.07. Energy values of the Anjana (JGL-11118) and Pradhyumna (JGL-17004) rice were 369.45 ± 0.64 and 370.38 ± 0.62 kcal/100 g. Iron content of rice varieties Anjana (JGL-11118) and Pradhyumna (JGL-17004) was 0.93 ± 0.04 and 0.86 ± 0.04 mg/100 g. Calcium content of rice varieties Anjana (JGL-11118) and Pradhyumna (JGL-17004) was 9.3±1.15 and 10.3 ± 0.5 mg/100 g. In vitro starch digestibility content was 36.9 ± 1.75 and 28.9 ± 1.5 respectively in Anjana (JGL-11118) and Pradhyumna (JGL-17004).

Clinically healthy adult subjects (n=20) of age 19 - 25 years were selected for the study on glycemic index of the rice Anjana (JGL-11118) and Pradhyumna (JGL-17004). The blood samples were taken at fasting state (0 min) and at 15, 30, 45, 60, 90, and 120 min interval after ingestion of the reference food and test food.

Results of the study revealed that Glycemic Index value of Pradhyumna (JGL-17004) and Anjana (JGL-11118) rice were 51.3 and 52.7. From these results we can conclude that Pradhyumna (JGL-17004) and Anjana (JGL-11118) rice varieties belong to lower GI category. Statistical analysis on correlation between Anjana (JGL-11118) and Pradhyumna (JGL-17004) revealed a value of $r=0.73363$, and it was observed that there was a significant correlation between In vitro starch digestibility and Glycemic Index at 5% (p<0.05) level of significance.
FOODS & NUTRITION

Author : ASHA, T.
Title of the thesis : SCREENING FOR QUALITY AND GLYCEMIC INDEX OF POPULAR RICE VARIETIES OF HAT ZONE OF ANDHRA PRADESH
Major Advisor : Dr. K. UMA MAHESWARI
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9839

ABSTRACT

The present study was conducted to assess the milling quality characteristics (percentage of brown rice, husk, broken rice, head rice and total milled rice) physico-chemical quality characteristics (grain hardness, 1000 Kernel weight, Kernel length, breadth, Length/Breadth ratio, volume expansion, elongation ratio, water uptake cooking time), nutrient (moisture, protein, fat, fibre, carbohydrate, energy, total ash, calcium and Iron) content, in-vitro protein and starch digestibility, organoleptic quality and glycemic index profiling of the selected popular rice varieties of HAT zone i.e. MTU-1001 and MTU-1010.

The varieties MTU-1001 and MTU-1010 were released in the year 2000 and 2001, respectively. The duration of MTU-1001 in kharif season was 130-135 days and the crop yield was 45-50 quintal per hectare. The duration of MTU-1010 in kharif season was 120-125 days and the crop yield was 40-45 quintal per hectare. The brown rice percentage was 79.97% and 76.97% for MTU-1001 and MTU-1010, respectively. The husk percentage was 26.62% and 25.37% for MTU-1010 and MTU-1001 respectively. The head rice recovery percentage of MTU-1001 and MTU-1010 was 39.96% and 41.93% respectively. The broken rice percentage of MTU-1001 and MTU -1010 was 28.32% and 21.73% respectively. Kernel length was 6.19±1.72 mm and 6.36±0.61 mm for MTU-1001 and MTU-1010, respectively. Kernel breadth was 1.75±0.09 mm and 1.71±0.11 mm MTU-1001 and MTU-1010, respectively. Length/Breadth ratio was 3.80±1.6 mm for MTU-1001 and 3.72±0.19 mm for MTU-1010. Statistically significant difference at 5% level (P<0.05) between two samples in the mean percentage of grain hardness, 1000 kernel weight, length/breadth elongation ratio and water uptake ratio was observed. Statistically significant difference was not observed between the two samples with regard to kernel length, breadth, volume expansion and cooking time. The moisture, protein, fat, crude fibre, ash, carbohydrate, energy value, iron and calcium content was 8.56 g, 8.18 g, 0.52 g
0.57 g, 0.47 g, 84.27 g, 358.9 g, 0.13 mg and 11.2 mg respectively for MTU-1001 and 8.05 g, 7.05 g, 0.54 g, 0.39 g, 0.41 g, 83.58 g, 364.08 g, 0.26 mg and 11.8 mg, respectively for MTU-1010. The in-vitro protein and in-vitro starch digestibility of MTU-1001 was 68.25, 29.5, respectively and for MTU-1010 was 65.72 and 32.8, respectively. Statistically significant difference at 5% level (P<0.05) between two samples in the mean percentage of moisture, protein, fat, crude fibre, carbohydrate, iron and calcium was observed. Statistically significant difference was not observed between the two samples with regard to ash. Organoleptic properties of selected rice varieties were done by 15 trained panels of judges. MTU-1010 had significantly higher scores for all sensory attributes compared to MTU 1001. Statistically significant difference at 5% level (P<0.05) between two samples in the mean percentage of overall acceptability was observed.

When reference food and test foods were administered at 0 min, 15 min, 30 min, 45 min, 60 min, 90 min, there was no significant difference (p>0.05) between the test foods, but there was significant difference between the reference food and test foods in both the varieties of rice tested. But at 120 min there was significant difference (p<0.05) in blood glucose levels between the two rice varieties. It was observed that reference food had a maximum peak level of blood glucose i.e 160mg/dl compared to test foods. MTU-1001 had a peak level of 122 mg/dl and another MTU-1010 had a peak level of 126 mg/dl. It was observed that there was significant difference (p<0.05) between the reference food and test foods is the peak level of glucose. MTU-1001 and MTU had glycemic index levels of 48.96 and 50.48, respectively. According to Jenkins et al., classification of glycemic index of MTU-1001 and MTU-1010 can be categorized as low GI foods.

It can be concluded that both the rice varieties i.e. MTU-1001 and MTU-1010 have low glycemic index value; therefore they are very much beneficial to the people suffering with diabetes.
FOODS & NUTRITION

Author : FARIYA KHALEEL

Title of the thesis : SCREENING FOR QUALITY AND GLYCEMIC INDEX OF SELECTED NEWLY RELEASED RICE VARIETIES OF SOUTHERN TELANGANA REGION OF ANDHRA PRADESH

Major Advisor : Dr. V. VIJAYA LAKSHMI

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR

Accession Number : D 9840

ABSTRACT

The study was conducted to analyze the milling, physico-chemical characteristics and glycemic index of two newly released rice varieties. Rice is grown in almost all parts of the state in all the seasons and in all kinds of soils, and is rightly called as “Annapurna State Rice bowl of India and granary of South India”. Rice is a staple diet for Indians. This study confirms that rice can be a part of healthy diet for the average consumer. In India rice is an important source of food as well as a source of income to the farming community. “Rice is vitality, rice is vigor too, and rice indeed is the means of fulfillment of all ends in life.

Two newly released rice varieties viz. RNR-15048 and Krishna (RNR-2458) of Southern Telangana zone was selected for the study. The rice varieties information pertaining to the production and culture of rice varieties was collected from ARI. The rice variety RNR-15048 was released in the year 2015 and is suitable both for kharif and rabi season. It is a 125 days high yield culture having blast resistance with short slender grains. It means yield potential is 6.5 t/ha and the maximum being 7.0 t/ha. Whereas Krishna (RNR-2458) was also a new released variety in the year 2012. It is suitable for kharif season with semi-tall, 135 days duration with the mean yield of 6.5 t/ha and the maximum being 7.0 t/ha. It has fine grains and good cooking quality. Consumer always prefered rice by good appearance, size and shape of the grain, its cooking characteristics, taste, tenderness and flavor of cooked rice whereas less attractive grain characteristics and relatively poor cooking quality hamper the acceptance and spread of varieties.

The selected rice varieties were assessed for milling quality (HRR, brokens, milling recovery and hulling percentage) physico-chemical characteristics (1000 grain weight, kernel length, breadth and L/B ratio and hardness), cooking properties (water uptake, volume expansion, elongation ratio, cooking time) nutrient composition (moisture, ash, protein, fat, fibre, starch, amylose, IVPD, IVSD) Glycemic index of two newly released rice varieties was
determined. The blood samples were drawn at fasting state (0 min) and at 15, 30, 45, 60, 90, 120 min after ingestion of the reference and test food and sensory evaluation of grains for their cooking quality was conducted by semi trained taste panel members.

Rice milling is a most gigantic industry in India. The milling quality characteristics of selected rice varieties were assessed. No rice variety can commercially be successful unless it possesses high quantity of head rice with minimum brokens. The head rice and broken rice percentage of RNR-15048 and Krishna (RNR-2458) were 84.67% and 69.29%, 15.34% and 30.60% respectively. It was observed that RNR-15048 had high head rice percentage and less brokens.

The kernel length was highest in Krishna (RNR-2458) which was 5.48 mm (RNR-15048) to 1.49 mm (Krishna RNR-2458). Depending on L/B ratio, two rice varieties viz., RNR-15048, Krishna (RNR-2458) were of short slender type. Hence it was observed that RNR-15048 is a fine variety with low breadth of the kernels. The water uptake, elongation ratio, volume expansion, hardness, was similar in both varieties. Whereas Krishna (RNR-2458) took more time to cook than RNR-15048.

The nutrients were as per the nutritive values for both the rice varieties. In-vitro protein and in-vitro starch and protein digestibility of RNR-15048 and Krishna (RNR-2458) were 56.02%, 63.02% and 22.03%, 21.73% respectively. The overall acceptability character was recorded in RNR-15048 rice variety which had good colour, appearance and texture than other variety.

The glycemic index of RNR- 15048 was 51.6 whereas Krishna (RNR-2458) was 51.7. The study revealed that the both rice varieties could be categorized low glycemic index range. As per glycemic index, foods were categorized as low (GI value <55), medium (GI value 56-69) or high GI foods (>70).
FOODS & NUTRITION

Author : HEMA MALINI, CH.

Title of the thesis : SCREENING FOR QUALITY AND GLYCEMIC INDEX OF POPULAR AND PRE-RELEASED RICE VARIETIES OF NORTH COASTAL ZONE OF ANDHRA PRADESH

Major Advisor : Dr. V. VIJAYALAKSHMI

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR

Accession Number : D 9834

ABSTRACT

India is one of the world’s largest producers of rice accounting for 20% of all world’s rice production. Rice is India’s pre-eminent crop and is the staple food of the people of the eastern and southern parts of the country. Despite numerous studies on different varieties of rice, there is lack of published data on glycemic index of newly released rice varieties of Andhra Pradesh. Low glycemic index rice varieties with good nutritional composition may encourage farmers as well as consumers for their demand. Hence this study was undertaken to assess the quality and glycemic index profiling of the selected popular Srikakulam sannalu (RGL-2537) and pre-released (RGL-11226) rice varieties.

Information regarding production and cultivation of rice varieties was collected. Popular variety Srikakulam sannalu (RGL-2537) was released in year 1996 with duration of 165 days in Kharif season and yields 3.0 tonnes per hectare. The information regarding second variety (RGL-11226) could not found since it is a pre-released rice variety. The milling quality characteristics of selected rice varieties were assessed. The head rice and broken rice percentages of Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) were 58.05%, 37.86% and 69.98%, 28.82% respectively. The low head rice of Srikakulam sannalu (RGL-2537) was due to more chalkiness in the rice.

Physico-chemical characteristics were estimated for selected rice varieties. Srikakulam sannalu (RGL-2537) had kernel length of 5.91mm, kernel breadth of 1.62mm and L/B ratio of 3.64mm. Pre-released variety (RGL-11226) had kernel length of 6.06mm, kernel breadth of 1.63mm and L/B ratio of 3.69mm.

Nutrient analysis of selected rice varieties was done. Nutrients like ash, moisture, protein, fat, carbohydrate and energy were estimated and minerals like calcium and iron were analysed. The nutrients were as per the nutritive values for both the rice varieties. In-vitro protein and in-
vitro starch digestibility were estimated. The in-vitro protein and in-vitro starch digestibility of Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) were 58.28%, 28.8% and 63.12%, 36.8% respectively.

Organoletic properties of selected rice varieties was done by 15 trained panel of judges. Pre-released variety (RGL-11226) had higher scores for all sensory attributes compared to popular variety (RGL-2537). Glycemic index of popular variety Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) was determined. The blood samples were drawn at fasting state (0 min) and at 15, 30, 45, 60, 90, and 120 min interval after ingestion of the reference food and test food. The mean glycemic response of Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) showed peak levels at 30 minutes and ranged between 124.73±19.98 and 129.8±22.07 respectively. It was observed that the glycemic index of Srikakulam sannalu (RGL-2537) was 55.18 and glycemic index of pre-released variety (RGL-11226) was 57.42. Results of the study revealed that glycemic index of Srikakulam sannalu (RGL-2537) was lower than that of Pre-released variety (RGL-11226). As per glycemic index, foods were categorized as low (GI value <55), medium (GI value 56-69) or high GI foods (>70). Therefore Srikakulam sannalu (RGL-2537) would be categorized as low GI category and pre-released variety (RGL-11226) would be categorized as medium GI category.
FOODS & NUTRITION

Author : JUVERIA SULTANA
Title of the thesis : ANTIOXIDANT ACTIVITY OF SAFFLOWER (CARTHAMUS TINCTORIUS LINNE)
Major Advisor : Dr. APARNA KUNA
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9835

ABSTRACT

India is the largest producer of safflower (Carthamus Tinctorius L.) (0.09 million tonnes) in the world with highest acreage (0.16 million hectares), but with an average productivity of only 641kg/ha (Directorate of Economics and Statistics, Ministry of Agriculture, 2014), a multipurpose crop, has been grown for centuries in India for the orange-red dye (carthamin) extracted from its brilliantly colored flowers and for its quality oil rich in polyunsaturated fatty acids (linoleic acid, 78%). The tender leaves, shoots and thinnings of safflower are used as pot herb, green leafy vegetable and salad. Studies have found that intake of antioxidants as food supplements has an effective role in maintaining and promoting health in coronary artery diseases and some types of cancers have shown a reversed relationship with the consumption of food rich in Polyphenols. These studies have led to a special attention to natural resources for the purpose of finding an antioxidant molecule. (kaviarasan et al., 2007). The following study was done to study the “Antioxidant activity of safflower petal (Carthamus tinctorius linne)”.

The results of antioxidant activity of six varieties of safflower petals revealed that the variety NARI-6 had the highest DPPH scavenging activity (341.54±5.68%) and reducing power assay (3.51±0.00 absorbance) which were statistically significant (p>0.01).

Hence NARI-6 and Annigeri-1 variety petals were selected for the development of products. The sensory evaluation results indicated that NARI-6 Safflower petal incorporated biscuit (SFPB) T1 at 4g incorporation had the highest overall acceptability (4.01±0.79). The SFPB T1 was further used for physico-chemical and nutrient analysis, the scores obtained are TA (0.36±0.16%), TSS (2.5±0.1°B), pH (6.60±0.00) and color L* (54.43±0.04), a* (19.82±0.05), b*(46.25±0.03). The titrable acidity of NARI-6 dried petals was 0.8 % citric acid. This could be due to the loss of ascorbic acid during product development. Titrable acidity was studied to ensure physico-chemical changes during preparation of the product (Sandhu et al., 1985) and during storage (Karla and Tandon, 1985). The proximate results of SFPB are as follows, carbohydrate (86.33±0.12%), protein (5.62±0.09%), fat (2.16±0.16%), crude fiber
(0.6±0.3%), total carotenoids (2396.33±20.18 μg/100g) and ascorbic acid (1188±198 mg/100g) shows that the SFPB is good source of major nutrients.

The antioxidant stability on storage revealed the scavenging DPPH radical activity on 0\textsuperscript{th} day was the highest (95.58±3.70%). The antioxidant activity was decreased significantly (p>0.01) from 15\textsuperscript{th} day to 30\textsuperscript{th} and 45\textsuperscript{th} day (57.35±23.66%), (56.99±11.87%), (44.73±11.99%) respectively. Wang et al., 2010, determined a poor ferrous ion-chelating effect from the carotenoid extract (1.8%) while showing high DPPH activity (70.6%) concluding that, having metal chelating activity of the studied extracts may be due to the strikingly higher phenolic contents. The reducing power activity on 0\textsuperscript{th} day was the highest (3.17±0.05absorbance). The reducing power activity was found to be decreased significantly from 15\textsuperscript{th} day to 30\textsuperscript{th} and 45\textsuperscript{th} day (2.14±0.05absorbance), (1.01±0.00absorbance), (0.23±0.00absorbance) respectively. The super oxide anion radical activity on 0\textsuperscript{th} and 15\textsuperscript{th} day were (474.26±2.37%, 233.06±0.46%) respectively and on 45\textsuperscript{th} day it was found to be similar to 0\textsuperscript{th} day values (465.10±58.13%) which is statistically significant (p>0.01) when compared with 15\textsuperscript{th} day. The total flavonoids content decreased from 0\textsuperscript{th} to 15\textsuperscript{th} to 30\textsuperscript{th} day (129.93±0.94μg RE to 108.66±0.73 μg RE to 28.01±0.06 μg RE) respectively while on 45\textsuperscript{th} day of storage the total flavonoid content of SFPB significantly (p>0.01) increased to 102.57±3.44μg of RE. Flavonoids quench the free radicals and chelates the metallic ions. Flavonoids are ideal scavengers of peroxyl radicals due to their favorable reduction potentials relative to alkyl peroxy radicals and thus, in principle, they are effective inhibitors of lipid peroxidation. (Polovka et al., 2003). The variation of total phenolic content from 0\textsuperscript{th} to 15\textsuperscript{th} day were statistically significant (p>0.01) (23.26±0.99 μg PE), (35.17±0.27μg PE) respectively, whereas it was lowest on 30\textsuperscript{th} day (5.96±0.72μg PE) and was highest on 45\textsuperscript{th} day (93.6±0.41μg PE).

The results of Pearson’s correlation for antioxidant activity of SFPB on storage was scavenging DPPH radical activity positively correlated with reducing power assay (r = 0.75**) which was statistically significant (p>0.01) while DPPH activity negatively correlated with super oxide anion radical activity (r = -0.52 ) which was not statistically significant (p>0.01). There is a very good distribution of carbohydrates, proteins, fat, fiber, carotenoids, antioxidants in the safflower petal varieties and the incorporation in the products should be commercialized to enhance the health of the individuals against diseases.
FOODS & NUTRITION

Author : NIDA FATIMA HAZARI
Title of the thesis : DEVELOPMENT OF E – NUTRITION EDUCATION MATERIAL AND ASSESSING ITS EFFECTIVENESS ON NUTRITIONAL KNOWLEDGE, ATTITUDE AND PRACTICES OF RURAL WOMEN.
Major Advisor : Dr. V. VIJAYA LAKSHMI
Degree : Ph. D.
College : COLLEGE OF HOME SCIENCE, HYDERABAD
Accession Number : D 9842

ABSTRACT

The use of Information and Communication Technology (ICT) is considered to be a necessity in order to overcome the challenges that are hindering the country from developing in all sectors and also from reducing the digital divide. Hence, the present research is about the use of ICT tools in empowering rural women through the development of e - learning content and delivery for self-learning environment for the rural population.

Rural women are the key agents for achieving the economic, environmental and social changes required for sustainable development. Thus, empowering women is the key not only to the well-being of individual, families and rural communities but also to the overall economic productivity given women’s large presence in the agricultural workforce worldwide.

A quasi experimental pretest and post test research design was used to assess the effectiveness of the developed e – learning education material on the nutritional knowledge, attitude and practices of rural women.

A sample of 100 rural women of reproductive age group (15 – 49 years) from three different villages were selected which formed the experimental group. Likewise a sample of 30 rural women of similar age group from the same villages constituted the control group.

Data on socio - economic and demographic characteristics of rural women was collected through structured interview schedule and observation. A standardized questionnaire was developed to measure the participant’s nutritional knowledge, attitude and practices.

Since rural women lack computer literacy, the e – learning education material was developed using the multimedia component ‘animation’. Empowering women through e – learning (EWE), a 2 D animated film was made in English and local language (Telugu) which
included educational content on nutritional needs of children (0 - 6 years), pregnant, lactating women, the common nutritional deficiencies seen in these groups and strategies to control and prevent them.

The 2 D animated film developed was pretested for acceptability by field functionaries and rural women. The results showed that the 2 D animated movie was potentially effective and thus was shown to the experimental group for a period of six months whereas the control group was not given any such intervention. Six months after the intervention, post test was conducted administering the same standardized questionnaire to both the groups. The findings revealed that the experimental group showed higher scores on nutritional KAP than the pre intervention scores and individual differences in the scores were also reduced considerably which indicated that there was a positive effect of e – learning education material digital (EWE) in the experimental group not only in terms of improvement in gain in scores but also in adoption of desirable practices.

Correlation matrices were worked out with all the nine independent and three dependent variables. Age was seen to be highly and positively correlated with type of family, education, occupation, income and urban contact showed a highly negative but significant relationship with age.

Marital status was highly and positively significant with occupation and income of the respondent and negatively but highly significant with the level of education and audio – visual material possession.

Occupation, income and audio – visual material possession were highly and positively correlated with education and only type of family was negatively significant with education.

Income was highly and positively correlated with audio- visual material possession, mass media exposure and urban contact. Audio – visual material possession were highly and positively correlated with urban contact.

To determine the relative degree to which the socio – economic and demographic characteristics contribute to variation in nutrition and health knowledge, attitude and practice of rural women a step down regression analysis was carried out. Age and marital status were the positive predictors of nutrition and health knowledge of rural women explaining 5 per cent of variation. Type of family was the only variable which showed 3 per cent variation on the attitude of rural women. Occupation, type of family, income and urban contact emerged to have a strong influence on the practices of rural women explaining 21 per cent of variation.

Hence, the present study showed that the nutrition education intervention conducted over a period of six months had a positive impact on nutrition knowledge, attitude and practice.
FOODS & NUTRITION

Author : SUJATHA, M.
Title of the thesis : EFFECT OF HEAT TREATMENT AND GAMMA IRRADIATION ON IN VITRO STARCH DIGESTIBILITY, IN VITRO PROTEIN DIGESTIBILITY AND TOTAL PHENOLICS OF SELECTED MILLET GRAINS
Major Advisor : Dr. T.V.HYMAVATHI
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9836

ABSTRACT

The present investigation was conducted to find out the effects of heat or irradiation combined with heat on protein, total Phenolic content (TPC), in-vitro protein digestibility (IVPD) and in-vitro starch digestibility (IVSD). Sorghum, pearl millet, foxtail millet were used in the study. Whole (WC) and dehulled (DC) grains were treated either with heat (170°C) or irradiation at 1.0kGy / 2.5kGy and stored for 90 days. There was a significant (p<0.05) effect of treatments, storage and grain and their interactions on all the nutritional quality parameters with a result in decrease in protein and TPC and increase in IVPD and IVSD. The mean protein, IVPD, IVSD and TPC were 9.89 percent, 54.77 percent, 70.83 percent and 188.5(Pyrocatechol equivalent) percent respectively. There was a reduction in protein content of the grains due to treatments by 11.8% in DC and 8.8% in WC. Irradiation combination treatment could prevent the loss of protein in WC but not in DC over heat treatment. The mean loss of protein during storage was 3.56 percent. The loss of protein in heat treated grains was 6.0 and 5.4 percent in DC and WC. Heat treatment increased the losses by 6.0 and 5.4 percent which were reduced to 4.1 and 1.58 when irradiation was combined with 1.0kGy dose in DC and WC. The losses reduced with dosages of 2.5 kGy to 2.97 and 2.5 percent in DC and WC.

The IVPD in DC and WC was 54.86 and 52.16 percent, which were improved by irradiation combination treatment by 2.59 and 2.13 percent in DC and WC respectively. 2.5kGy dose had higher effect than 1.0 kGy on IVPD. Among the grains studied foxtail millet has highest IVPD followed by sorghum and pearl millet. In dehulled grains the percent increase of IVPD was highest in Foxtail millet, followed by pearl millet and sorghum; in contrast it was highest in sorghum followed by pearl millet and foxtail millet in whole grains. With the decreasing content of protein there was an increasing percentage IVPD. During 90 days storage there was an increase of IVPD to an extent ranging from 3.1 to 5.0 percent.
The mean IVSD in untreated grains was 66.99 and 70.6 percent in WC and DC, which were improved by 6 and 4 percent due to irradiation combination treatment. The percent increase from 1.0 kGy to 2.5kGy was 5.27 in DC and 3.23 percent in WC grains. Among the three grain sorghum had maximum IVSD followed by pearl millet and foxtail millet of whole and dehulled grains. Storage of both untreated and treated grains affected the IVSD (p<0.05) with a significant reduction (1.54%). Sorghum had slightly higher reduction during storage. Highest protein grains had lowest IVSD and vice versa.

The Phenolic content of DC and WC grains was 203.56 and 225.36 respectively. Heat treatment alone resulted in 4.3 and 7.9 percent reduction and irradiation combination treatment resulted in 20.3 and 22 reduction in TPC of WC and DC. Among the three millets irrespective of whole and dehulled, highest reduction was in sorghum, followed by foxtail millet and pearl millet. Significantly higher (p<0.05) reduction was found in foxtail millet (38.14%) followed by sorghum (34.26%) and pearl millet (12.89%) grain. During storage maximum loss reduction was in sorghum followed by foxtail millet and pearl millet.

The correlation and regression analysis revealed that TPC and IVPD(r=0.7988), IVSD and protein (r= -0.69), IVPD and protein (r=0.06) have correlations. Thus the study demonstrated heat and irradiation combination grain treatment is superior to heat alone treatment in maintaining the nutritional quality of the millets, by bringing favourable changes in terms of reduction in TPC and improvement in protein and starch digestibility, however the rheological and microbial quality of the grains needs to be studied before the implementation. On the nutraceutical stand point balancing of TPC and protein and starch of food grains is important.
FOODS & NUTRITION

Author : SUPTA SARKAR

Title of the thesis : STUDY OF SENSORY PROPERTIES, CONSUMER ACCEPTANCE & EFFECT OF SUPPLEMENTATION OF IRON-FORTIFIED RICE ON HEMOGLOBIN LEVELS IN ANEMIC GIRLS

Major Advisor : Dr. K. APARNA

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR

Accession Number : D 9838

ABSTRACT

Iron deficiency, a primary cause of anemia, is the most prevalent nutritional deficiency in the world. At any given moment globally, more individuals have Iron Deficiency Anemia (IDA) than any other health problem affecting 24.8% of the total population (WHO, 2005). The consequences of anemia can be severe and often irreversible impairing immunity, cognitive and motor ability, work capacity, infant and child growth and an overall decreased quality of life in case of mild to moderate anemia, while severe anemia can lead to maternal and infant morbidity and mortality.

The nutritional intervention strategies which can be used to combat IDA include increasing iron intake by dietary diversification to improve iron-rich diet and iron absorption, periodic supplementation, iron fortification, infection control and improved nutritional status. Iron fortification of food is regarded as the most cost-effective and the best long-term approach for reducing the prevalence of nutritional iron deficiency. Rice being the staple food for almost two thirds of the Indian population, it has the potential to be a good vehicle for fortification as even small increase in nutrient level could have a positive health impact. Therefore a study has been planned to study the sensory properties, consumer acceptance & effect of supplementation of iron-fortified rice on hemoglobin levels in anemic girls. It is essential to ensure that after fortification of food, the added nutrients are adequately bioavailable and improve health.

Six different rice based products were developed and standardized with normal (control) and iron fortified (experimental) rice, which were subjected to sensory evaluation by 15 semi-trained panel members using 7-point hedonic scale (1=Disliked very much to 7=Like very much). There was no significant difference in the sensory attributes like appearance, odour, tenderness, taste and overall acceptability of the normal and iron fortified rice except for the
According to overall acceptability, vegetable biryani (6.26±0.70) was the highest acceptable product from iron fortified rice products and hence it was selected to carry out the supplementation trial and consumer acceptability evaluation.

Supplementation trial of the iron-fortified rice was conducted on total of 22 anemic girls in the age group 18-20 years (15 girls in experimental group and 7 girls in control group). All the subjects in both the groups were further subcategorized into 3 groups: Mild anemia, Moderate anemia and Severe Anemia. Supplementation of 100g of raw rice and iron fortified rice was given per day to the control (n=7) and experimental (n=15) groups respectively for a period of 2 months (60 days) duration and estimation of hemoglobin (Hb) was done on 0, 30 and 60 days. There was no significant change in the hemoglobin level of the subjects in the control group, while, the hemoglobin level increased significantly (p<0.01) from the 0th to 60th day in subjects with moderate and severe anemia from the experimental group. In the subjects with mild anemia from the experimental group, the increase in hemoglobin level was found to be non significant.

Nutritional status of the subjects chosen for the supplementation trial was evaluated by assessment through anthropometry (height and weight) and dietary assessment through food frequency schedule to elicit information on general meal pattern and consumption of iron rich foods from different food groups by frequency and quantity at a time.

BMI calculated with the anthropometric measurement indicated no significant change in the BMI values of the subjects of both the groups all through the supplementation period which suggests that supplementation of placebo or iron fortified rice did not have any influence on the height, weight and BMI of subjects from 0th day to 60th day. Results of food frequency and mean iron rich food intake clearly indicated that, both the frequency and mean intake of iron rich food was less.

Consumer study was done on a total of 100 subjects in the age group of 18-60 years by using a consumer acceptability questionnaire consisting of two sections describing the demographic profile and the hedonic scoring (5-point hedonic scale) of attributes like appearance, color, odour, tenderness, taste and overall acceptability of the product. No significant differences were found between the hedonic ratings of the sensory attributes of normal and iron fortified rice product.

Results of the study revealed that there was no significant difference in the sensory attributes of the normal rice and iron fortified rice. The fortified rice product was well accepted by the respondents selected for consumer acceptability study, as well as it was found to have a significant (p<0.01) increasing effect in the blood hemoglobin level of the moderate and severe anemic subjects chosen for the supplementation trial.
FOODS & NUTRITION

Author : SWETHA INDRAJA, T.
Title of the thesis : SCREENING FOR QUALITY AND GLYCEMIC INDEX OF SELECTED NEWLY RELEASED RICE VARIETIES OF GODAVARI ZONE, ANDHRA PRADESH
Major Advisor : Dr. K.UMA MAHESWARI
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9841

ABSTRACT

Rice is one of the most important staple foods for more than half of the world’s population and influences the livelihood and economics of several billion people (IRRI, 2006). Rice is used as a source of nourishment for over half of the world’s population thus, making it as second most important cereal grain (Bhatia et al., 2009). More than 90% world rice is grown and consumed in Asia (Tyagi et al., 2004). India is one of the world’s largest producers of rice accounting for 20% of all world rice production. Rice is ranked as the number one human food crop in world (Itani et al., 2002). Glycemic response to rice depends on variations in the physicochemical properties of rice varieties as well as in the processing (Larsen et al., 2000). A low glycemic response is considered beneficial from a nutritional point of view, especially for individuals suffering from impaired glucose tolerance (Jenkins et al., 1982, 1983).

Although many studies were conducted on the glycemic index of different foods, there is lack of published data on the glycemic index profiling of the rice varieties in Andhra Pradesh. Therefore this study was undertaken to assess the quality and glycemic index profiling of the selected newly released rice varieties of Godavari Zone, Andhra Pradesh.

The rice varieties selected for the study are Indra (MTU-1061) and Amara (MTU-1064) which were released in the year 2007 and 2010 respectively.

Milling quality characteristics (brown rice, husk percentage, head rice yield and broken rice yield) were analyzed by using dehusker (Rice Sheller- Indosaw) and rice grader. The physicochemical and organoleptic characteristics (Grain hardness, 1000 kernel weight, kernel length, kernel breadth, L/B ratio, volume expansion, elongation ratio, water uptake, cooking time and weight of the cooked rice, moisture, ash, protein, fat, crude fibre, energy, carbohydrate, iron
and calcium) were analyzed by using standard procedures. Sensory evaluation of the samples was done using 5 point hedonic scale (5 -Very good to 1-poor). Glycemic index was determined by Wolever et al. (1985) method.

The percentage of brown rice was 78.83% and 79.14%, husk percentage was 21.14% and 20.80%, head rice yield was 39.71% and 41.44%, broken rice yield was 60.27% and 58.54% for Indra (MTU-1061) and Amara (MTU-1064) respectively. Head rice yield is less due to more chalkiness in grains as per the alkali spreading test.

The grain hardness, 1000 kernel weight, kernel length, kernel breadth, L/B ratio, volume expansion, elongation ratio, water uptake, cooking time and weight of the cooked rice was 6.43, 14.00g, 5.62 mm, 1.62 mm, 3.64, 2.4cm, 1.7, 200, 10minutes and 187g respectively for Indra (MTU-1061). The same was 6.59, 14.22g, 5.63 mm, 1.61 mm, 3.49 mm, 2.5cm, 1.6, 210, 15minutes and 195g respectively for Amara (MTU-1064). Based on L/B ratio the grains of both varieties were classified as slender according to Calderwood classification.

The percent moisture, ash, protein, fat, crude fibre, energy, carbohydrate, iron and calcium content was 8.65g, 0.38g, 7.27g, 0.48g, 0.3g, 68.08Kcal, 83.21, 0.76mg and 8.89mg respectively for Indra (MTU-1061). The same was 9.33g, 0.47g, 7.16g, 0.57g, 0.27g, 366.31Kcal, 82.23, 0.82mg and 9.18mg respectively for Amara (MTU-1064). Significant difference was observed (p<0.05) for moisture content between two samples studied. But significant difference was not observed in other nutrients between the two test samples.

The mean sensory scores for colour (3.13±0.74), appearance (2.73±0.46), flavor (3.26±0.46), taste (3.2±0.77), texture (2.53±0.52) and the scores obtained for overall acceptability was 3.13±0.64 for Indra (MTU-1061). The mean sensory scores for colour (3.8±0.68), appearance (3.26±0.70), flavor (3.8±1.08), taste (3.6±0.63), texture (3.13±0.74) and the scores obtained for overall acceptability was 3.4±0.74 for Amara (MTU-1064). Statistically significant difference in color, appearance, taste and overall acceptability was not observed. There was significant difference (p<0.05) in flavor and texture between the two samples studied.

The mean glycemic response of Indra (MTU-1061) and Amara (MTU-1064) showed maximum peak level of 120.73mg/dl and 125.13mg/dl respectively at 30 minutes. The glycemic index for Indra (MTU-1061) and Amara (MTU-1064) was 53.41mg/dl and 55.35mg/dl respectively. Both rice varieties can be categorized as low GI foods according to the classification of Jenkins et al. (1981). There was negative correlation between in-vitro starch digestibility and GI which was statistically significant (p<0.05).
ABSTRACT

In recent years, there has been a global trend towards the use of the natural substances present in the food as a source of antioxidant and functional ingredients. Especially natural antioxidants present in foods have received considerable interest because of their safety and potential nutritional and therapeutic effects.

Bread and bakery products have an important role in human nutrition. Generally, wheat bread is considered to be a good source of energy and irreplaceable nutrients for the human body. However, bread made with white flour is a food with a low antioxidant capacity. This study was focused on enriching the wheat bread with naturally antioxidant rich green coffee beans of *Coffee canephora* as this is one of the richest sources of chlorogenic acid (CGA). It was planned to study the effect of bioactive rich green coffee extract (GCE) on rheological, physico-sensory and nutritional characteristics of bread.

GCE was extracted from the coffee beans at 60 °C and was used for the further study. It was added at 1, 1.5 and 2% concentration in combination with wheat flour and other ingredients that were used in bread preparation. All other processing variables were kept constant.

Rheological, physico-sensory and nutritional characteristics were analysed. The results revealed that there was not much significant change in the rheological characteristics of dough measured using farinograph, extensograph, alveograph and amylograph up to 1.5% level. There was a significant decrease in dough development and stability in farinograph characteristics of GCE with wheat flour at 2% level. Extensibility decreased with the increase in GCE from 0-2%. Alveograph results showed an increase in swelling index and energy. Amylograph results
indicated that there was not much difference in other parameters except peak viscosity which was increased with the addition of GCE.

Physical characteristics were also studied. There was not much difference in weight, volume and moisture content of the GCE added breads with the control bread. Texture showed a slight decrease in hardness which ranged from 4.81 to 4.38. There was not much change in cohesiveness and springiness values but the values of gumminess increased from 2.45 to 2.86 with an increase in GCE concentration in breads. The results of colour analysis showed that lightness (L) and yellowness (b) decreased with the addition of GCE whereas greenness (-a) increased with the increasing GCE levels. Microscopic studies revealed the presence of small and large starch granules in wheat flour and irregular sharp structures glued with soluble gums in GCE. Wrapped starch granules embedded in protein matrix were also observed in baked breads added with GCE.

Sensory evaluation results concluded that the maximum level of incorporation of GCE without adverse effect on the overall quality of bread with special reference to the taste was at 1.5 % level.

The results of nutritional study indicated no significant change in protein, ash, fat and dietary fibre in all the bread samples. The antioxidant activity was measured by the amount of total polyphenols (TPP), radical scavenging activity (RSA) and chlorogenic acid (CGA). TPP increased from 20 to 330 mg /100g gallic acid equivalents (GAE) of phenolic compounds. RSA (100 ppm) increased from 10.14 to 66.41% and CGA also increased from 280 to 540 mg/100 g of bread and was not detected in the control bread (without GCE).

All the above results of the study show that breads incorporated with GCE (1.5g/100g) can be successfully developed as a functional food rich in antioxidant activity and good overall acceptability without significant change in sensory attributes.
FOOD SCIENCE & TECHNOLOGY

Author : ESWARI SAI PRIYA, K.
Title of the thesis : “DEVELOPMENT AND EVALUATION OF INSTANT RAGI BALL (Ragi mudda) MIX”
Major Advisor : Dr. K. UMAMAHESWARI
Degree : M.Sc. (H.Sc.)
College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR
Accession Number : D 9848

ABSTRACT

Finger millet (Eleusine coracana L.) is an important millet grown extensively in various regions of India and Africa, constitutes as a staple food for a large segment of the population in these countries which provides low cost protein, minerals and vitamins. Rice (Oryza sativa) is a staple food crop for a large part of the world’s population, making it the second most consumed cereal grain. In India, Ready to Eat (RTE) and Ready to Cook (RTC) food segment has emerged due to convenience, changing lifestyle and increasing prevalence of nuclear family structure.

Instant ragi ball mix was developed by using pregelatinized ragi and rice flours at different combinations (100:0, 75:25, 50:50 & 25:75) with two varieties of ragi (brown ragi (BR)- VJR 762 and white ragi (WR)- VJR 936). Totally eight variations were formulated viz. BR1, BR2, BR3, BR4, WR1, WR2, WR3 and WR4 for the study.

Statistically significant difference (P>0.05) was observed in cooking time among the instant mixes of two varieties (VJR762 and VJR936) in all the variations and control sample. However, significant difference was not observed in cooking time between the ‘ragi mudda’ prepared with instant ragi ball mixes of both the varieties of finger millet. The time taken to prepare ‘ragi mudda’ ranged from 30-50 minutes by normal traditional method and 6-8 minutes with the instant ragi ball mixes.

Sensory evaluation was done for the control sample and for all the eight variations to know the most acceptable mixes from each of the varieties. They were evaluated for taste, texture, appearance, colour and overall acceptability. The mean overall acceptability score was maximum for ‘ragi mudda’ prepared with the variations BR3 and WR3 (8.33 and 8.00 respectively) compared to all the other variations of instant ragi ball mixes and control sample.

Statistically significant difference (P>0.05) was observed in the colour values of control sample and instant ragi ball mixes prepared with VJR 762 and VJR 936 (L* value (43.10, 43.73 and 54.5), a* value (1.83, 1.63 and 0.76) and b* value (6.76, 6.93 and 6.26) respectively. Significant difference was not observed in the texture values of the three samples for all the
attributes studied like hardness (3.52, 3.58 and 3.55), cohesiveness (0.36, 0.37 and 0.38) and springiness (1.59, 1.65 and 1.60) respectively.

Statistically significant difference (P>0.05) was observed in moisture and calcium content of the samples but for other nutrients significant difference was not observed between the samples. The moisture content of control (11.11%) was significantly higher compared to the instant ragi ball mixes prepared with VJR 762 (8.24%) and VJR 936 (8.20%). Significant difference was not observed in the protein (7.93, 8.69 and 9.04%), carbohydrate (74.03, 72.47 and 73.28), crude fibre (1.66, 1.65 and 1.67), fat (1.11, 1.09 and 1.13), ash (0.90, 0.96 and 0.95), iron (1.05, 1.33 and 1.41) and calcium content (200, 250 and 266mg) content of the control sample and the instant ragi ball mixes prepared with VJR 762 and VJR 936 respectively.

Statistically no significant difference was observed among the samples in invitro digestibility of carbohydrate (59.67, 55.33 and 55% respectively), whereas statistically significant difference (P>0.05) was observed in invitro protein digestibility (55, 61.33 and 71.67 % respectively) of control sample and instant ragi ball mixes of VJR762 and VJR936 respectively.

Statistically no significant difference was observed in functional properties viz. flowability (39.67, 40.67 and 41.00°), bulk density (0.76, 0.76, 0.76kg/cm³), particle density (1.64, 1.65 and 1.80g/cm) and wettability (13.00, 7.66 and 10.33sec) of control sample and instant ragi ball mixes of both the varieties (VJR762 and VJR936) respectively.

Statistically significant difference (P>0.05) was observed between the control sample and instant ragi ball mixes of both varieties VJR762 and VJR936 in water absorptivity index (1.01, 1.06 and 1.08g/g respectively), whereas no significant difference was observed in water solubility index (33.22, 29.89 and 29.22% respectively).

Instant ragi ball mixes were studied for sensory properties and physico-chemical properties, invitro studies, functional properties, re-constitutional properties and shelf life studies for a storage period of three months with thirty days interval of time. The microbial load i.e., both TBC and TMC of both the samples studied was ≤ 2 CFU/ml during storage period of three months stored at normal room temperature and it is within the permissible limits.

The consumer acceptability (50 members) of the instant ragi ball mixes prepared with both the varieties of finger millets i.e. VJR 762 and VJR 936 was highly accepted by 100% of the consumers. Feasibility of commercialisation of the mixes was done through cost benefit analysis and popularized and marketed the product at different outlets with different edutainment methods. The results of the study showed that the ready to cook property of the product is the key consideration as it can be easily prepared with less cooking time without altering the nutritional properties and also the cost of the product, it had got was highly accepted by the consumers.

It was concluded that, significant difference was not observed in proximate analysis, texture values and functional properties viz. flowability, bulk density, particle density and wettability of control sample and both the instant ragi ball mixes prepared with VJR762 and VJR936. But statistically significant difference was observed in sensory properties, colour values, invitro properties and re-constitutional properties of control sample and both the instant ragi ball mixes prepared with VJR762 and VJR936. It was found that the instant mixes absorbed water readily compared to control sample due to pregelatinization process. Further commercialization of the product is necessary to improve the demand for the product.
FOOD SCIENCE & TECHNOLOGY

Author : FLORA-GLAD CHIZOBA EKEZIE

Title of the thesis : EVALUATION OF BIOSYNTHESIZED NANOPARTICLES FROM MOMORDICA charantia EXTRACTS FOR ITS ANTIOXIDANT AND ANTIMICROBIAL EFFICACY

Major Advisor : Dr. JESSIE SUNEETHA

Degree : M.Sc. (H.Sc.)

College : POST GRADUATE RESEARCH CENTRE, RAJENDRANAGAR

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ABSTRACT

For the first time, in this research, we report the green synthesis of zinc (ZnNps) and copper nanoparticles (CuNps) by reduction of zinc and copper nitrate respectively in various media (Ethanol, aqueous, citric acid, Na2CO3 and NaCl), using fruit extracts of Momordica charantia (bitter gourd), a commonly found plant in Southeast Asia. The reaction process for the synthesis is simple, cost-effective, novel, rapid and an eco-friendly route using the fruit extracts of M. charantia plant. It acts simultaneously as a reducing and stabilizing agent at room temperature. A preliminary qualitative phytochemical screening for bioactive components was first carried out and revealed the presence of alkaloids, phenols, terpenoids, flavanoids, cardiac glycosides, phenols etc. Among the various media used, ethanol extract contained all the phytochemicals analyzed and thus was considered a more effective media for extraction and substantial liberation of bioactive constituents.

Characterization of the ZnNps and CuNps was done by UV-Visible Spectroscopy, Dynamic Light Scattering (DLS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR). An intense surface plasmon resonance band at 235-300 in the UV–Visible spectrum clearly revealed the formation of zinc nanoparticles while absorbance peak at 225–250 corresponding to the characteristic localized surface plasmon resonance (LSPR) band for CuO nanoparticles confirmed the bio-reduction of Cu+2 to Cu. DLS was used to determine the size, size distribution profile and polydispersity index of particles in a colloidal suspension. The measurement results for copper nanoparticles showed the size of the copper nanoparticles to be 5.9, 14.3, 15.8, 4.2 and 22.9 nm respectively for ethanolic, aqueous, citric acid, Na2CO3 and NaCl with a charge of 30.0, -5.3, 14.3, 144.0 and 37.9 mV, respectively.
The hydrodynamic radius of the zinc nanoparticles was recorded as 25.9, 8.6, 6.0, 20.2 and 7.6 nm corresponding to ethanol, aqueous, citric acid, Na2CO3 and NaCl extracts respectively and the same order, zeta potential values were 111.2, -7.3, 12.6, -4.7 and -4.1 mV respectively.

Therefore, further characterization studies using SEM and TEM were used to confirm the size of the nanoparticles. They were generally found to be spherical in shape with variable size ranging from 50 – 86 nm and TEM analysis confirmed the particles were under 100 nm. XRD patterns confirmed the presence of highly crystalline and face-centered cubic structure XRD pattern of synthesized CuNps from ethanol extract demonstrated a good crystallinity level with diffraction angles of 32.43, 38.6, 44.80, 64.90 and 77.13 which correspond to the characteristic of face-centred cubic of copper lines indexed at (111), (200), (200), (311) and (222). XRD pattern of the ZnNps showed the peaks corresponding to Bragg’s diffraction signals from the crystal planes (111), (002), (020), (220), (112), (121) and (211). The intensity data were collected over a range of 30 o - 80 o. The diffraction peaks located at 31.84 o, 55.33 o, 57.63 o, 67.11 o, 75.60 o, 68.13 o and 78.56 o have been indexed as hexagonal wurtzite phase of ZnO.

The antioxidant activity of the raw extracts and mediated zinc and copper nanoparticles were investigated. The result obtained showed enhanced DPPH radical scavenging activity by the nanoparticles with IC50 values of 42.27μg/ml (ZnNps) and CuNps (51.59 μg/ml). However, it was not as potent as ascorbic acid used as standard (38.76 μg/ml). The ability of the samples to scavenge super oxide radical was also investigated; the result obtained showed an IC50 value of 44.57, 57.81 and 68.02 μg/ml for ascorbic acid, ZnNps and CuNps.

ZnNps and CuNps derived from ethanol extracts of *M. charantia* also displayed maximum inhibition against α-glucosidase enzyme with IC50 with values of 51.56 and 55.60 μg/ml respectively, thus being more effective than the standard drug acarbose 57.27 μg/ml. Similarly, the IC50 values recorded for inhibition of α-amylase enzyme was maximum for ZnNps (55.13 μg/ml) while CuNps and Acarbose had values of 59.88 and 57.49 μg/ml respectively. Therefore, provides an alternative and a less evasive strategy of reducing postprandial hyperglycemia in diabetic patients.

The bio-derived CuNps and ZnNps also showed higher anti-bacterial properties than their respective crude extracts with zone of inhibition above 7 mm especially ethanol extracts. These observations, as well their potent antioxidant activity creates the advent of nanoparticles based-nutricutical food products with greater targeted activity coalesced with medicinal phytochemicals derived from the fruits of *M. charantia* and may result in unprecedented opportunities directed at the discovery of a cheaper and more beneficial therapy for chronic lifestyles diseases such as CVDs, hyperglycemia and prevention of diabetic induced complications such as peripheral neuropathy that predisposes bacterial infections.
India is the second largest producer of fruits and vegetable and its annual fruit production is 74.88 million tons from an area of 6.38 million ha during 2012-2013 (National Horticultural Data Base, 2012). Fruits are important sources of minerals, carbohydrates and certain vitamins, particularly vitamins A and C. The moisture in most of the fruits is above 75% and fruits are prone to spoilage by molds and yeasts.

Due to the short shelf life of these crops, as much as 30-35% of fruits and vegetables perish during harvest, storage, grading, transport, packaging and distribution. Only 2% of these crops are processed into value-added products. Hence, there is a need for maximum commercial utilization of fruits and vegetables and to adopt production and marketing activities to the requirements of the world market and to cater to domestic demand which, over the past few years, has been increasing because of various socio-economic factors. If the nutritive value of the processed food products could be maintained, this sector will emerge as a major value-added food industry.

Preserving food to extend its shelf-life, ensuring its safety and quality, is a central preoccupation of the food industry. As a result, there has been a steady stream of new ‘minimal’ preservation techniques. At the same time, the development of the hurdle concept has led to renewed interest in the use of more traditional preservation methods and the way they can be combined with newer technologies.

Osmotic dehydration is a method of preservation in which the food is dipped in concentrated salt or sugar solutions. Osmotic dehydration is the phenomenon of removal of water from lower concentration of solute to higher concentration through semi permeable membrane resulting in an equilibrium condition on both sides of membrane (Tiwari 2005).
Standardization process for developing fruit crisps showed that an osmotic pretreatment with 55ºbrix sugar solution was more suitable for apple, jackfruit and pineapple, 60ºbrix more acceptable for mango and 65ºbrix for banana crisps at room temperature and further dehydration at 55 to 60 ºc for 29hr gave a final product for further testing of physico-chemical, organoleptic parameters, shelf life in HDPE, LDPE and MLP packages and for consumer acceptability and marketability study.

Fruit crisps in different packaging materials viz, HDPE, LDPE and MLP at different storage periods resulted in an increase in the moisture content during storage period. When compared the samples in all three packaging materials, the lowest moisture content was found in MLP and highest moisture content was observed in LDPE. Increase in moisture during storage period has been attributed to the permeability of moisture by LDPE package.

Titrable acidity in all the fruit crisps packed in different packaging material at different storage periods slightly decreased in all the packages, least being in LDPE package. Storage of fruit crisps in LDPE resulted in slight decline in acidity but the decrease was not significant. This could be attributed to hydrolysis of polysaccharide and non reducing sugars through utilization of acid converting them to hexose sugars.

During the storage period the ascorbic acid content of fruit crisps gradually decreased in all packaging material, but more in the LDPE package. Ascorbic acid decreased significantly during storage due to oxidation of ascorbic acid during osmosis and during dehydration process and also during storage due to high temperatures.

Apple crisps stored for different periods in LDPE packs and pineapple in HDPE showed a decreasing trend in both the total as well as reducing sugars which could be attributed to the breakdown of polysaccharides into monosaccharides as a result of acid hydrolysis. Reducing sugar and total sugars were higher in the other fruit crisps owing to removal of water leading to concentration of sugars due to increase in temperature which has hampered more penetration of sugars during osmosis.

Storage for long periods in different types of packaging material showed an increase in total soluble sugars (TSS) of fruit crisps due to osmo-dehydration which has transferred sucrose from the sugar syrup in to the fruit pieces.

Organoleptic evaluation of fruit crisps has shown that fresh apple and pine apple fruit crisps scored highest, very closely followed by jack fruit crisps and mango and least by banana. All five fruit crisps were scored less on the 30th day compared to 15 days storage. The fruit crisps stored in LDPE pouches scored less organoleptically for all varieties on 15th day and further less on 30th day of storage compared to the samples stored in HDPE and MLP, but the difference was not significant. For almost all the samples except apple, HDPE and MLP packaging could be suggested as more suitable packages to maintain organoleptic quality.

Samples stored in LDPE did not retain flavor and crispiness. The sensory quality reduced slightly in all packages during 30 days storage. The maximum deterioration of sensory quality was noticed in LDPE pack while, sample stored in MLP pouches showed least changes. Reduction in sensory quality during storage may be attributed to reduction of SO₂ and increase in moisture in samples resulting in the non enzymatic browning, oxidation and changes in other
chemical constituent of product. Keeping in view the changes during storage for 30 days, it was concluded that the packaging of fruit crisps in hermetically sealed laminated pouches preserved the composition with a little or no change in sensory attributes of the product.

The fresh fruit crisps were found to be safe with a nil record of total bacterial, mould and yeast count (TBC, TMC and TYC) in samples stored in HDPE, LDPE and MLP packs for 15 and 30 days. The TBC levels of fruit crisps stored in all the packaging materials for 15 and 30 days were within safe limits. None of the samples in the three packages showed either mold or yeast growth up to 30 days. Hence crisps could be recognized as microbially safe for consumption within the storage period.

Consumers have given an overall rating to the fruit crisps in the order of preference as mango (1st), apple (2nd), pineapple (3rd), jack fruit (4th) and banana (5th).

The marketability study was done on three consecutive days in super markets by selling the fruit crisps and found that 31% customers purchased the fruit crisp packs per hour appreciating the nutritional value and novelty of fruit crisps. Detail project plans for production of Fruit Crisps were developed and given for ready use for small and medium enterprises.
ABSTRACT

The study was conducted to analyze the milling, physico-chemical characteristics and glycemic index of two released rice varieties. Rice is grown in almost all parts of the state in all the seasons and in all kinds of soils, and is rightly called as “Annapurna State Rice bowl of India and granary of South India”. Rice is a staple diet for Indians. This study confirms that rice can be a part of healthy diet for the average consumer. In India rice is an important source of food as well as a source of income to the farming community. “Rice is vitality, rice is vigor too, and rice indeed is the means of fulfillment of all ends in life.

Information regarding production and cultivation of rice varieties was collected. The popular variety i.e. Samba Mashuri (BPT 5204) was released in the year 1986 with Duration of 150 days in Kharif season and yields 6.0 Tonnes per hectare. Akshaya (BPT 2231) was released in the year 2010 with Duration of 155 days in Kharif season and yields 6.5 Tonnes per hectare.

The milling quality characteristics of selected rice varieties were assessed. The head rice and broken rice percentages of Samba Mashuri (BPT-5204) and Akshaya (BPT- 2231) were 73.15%, 26.85% and 80.98%, 20.10% respectively. The low head rice of Samba Mashuri (BPT-5204) due to more chalkiness in the rice.

The physico-chemical characteristics of selected rice varieties were estimated. Samba Mashuri (BPT-5204) had kernel length of 5.10mm, kernel breadth of 1.41mm and L/B ratio of 3.61mm. Akshaya (BPT-2231) had kernel length of 6.06mm, kernel breadth of 1.63mm and L/B ratio of 3.69mm.
Nutrient analysis of selected rice varieties was done. Nutrients like ash, moisture, protein, fat, carbohydrate and energy were estimated and minerals like calcium and iron were analyzed. The nutrients were as per the nutritive values for both the rice varieties. In-vitro protein and In-vitro starch digestibilities were estimated. The in-vitro protein and starch digestibility of Samba Mashuri (BPT-5204) Akshaya (BPT-2231) were 62.52%, 30.8% and 67.02%, 37.2% respectively.

Organoleptic properties of selected rice varieties were carried out by 15 trained panel of judges. Samba Mashuri (BPT-5204) had higher scores for all sensory attributes compared to Akshaya (BPT-2231).

The Glycemic index of popular and newly-released rice varieties such as Samba Mashuri (BPT-5204) and Akshaya (BPT-2231) were determined. The mean glycemic response of Samba Mashuri (BPT-5204) and Akshaya (BPT-2231) showed peak levels at 30 minutes with 143.47±15.57 mg/dl and 132.93±15.48 mg/dl respectively. It was observed that the glycemic index of Samba Mashuri (BPT-5204) was 57.74 and glycemic index of Akshaya (BPT-2231) was 53.34.

The results of the study showed that the glycemic index of Samba Mashuri (BPT-5204) was higher than that of Akshaya (BPT-2231). As per glycemic index, foods were categorized as low (GI value < 55), medium (GI value 56-69) or high GI foods (> 70). Therefore Samba Mashuri (BPT-5204) would be placed as medium GI category and Akshaya (BPT-2231) would be placed as low GI category.
ABSTRACT

Safflower (Carthamus tinctorius L.), a multipurpose crop, has been grown for centuries in India for the orange-red dye (carthamin) extracted from its brilliantly colored flowers and for its quality oil rich in polyunsaturated fatty acids (linoleic acid, 78%). The tender leaves, shoots and thinnings of safflower are used as pot herb, green leafy vegetable and salad. Bundles of young plants are commonly sold as a green vegetable in markets in India and some neighboring countries. The thinned out plants are harvested during thinning and are consumed as leafy vegetable in many parts where the crop is grown. As the crop matures, the bottom leaves are also consumed during various stages till the completion of flowering stage. A study was taken up to study the “Nutrient and nutraceutical composition in various cultivars of Safflower leaves” during different stages of maturity.

The results of proximate analysis revealed that, the moisture content was higher at the earlier stages (30th day) as compared to 50th and 70th day in all the four cultivars of Safflower leaves. The carbohydrates content was higher during 30th day as compared to 50th day and 70th day in Annigeri-1, TSF-1 and NARI-6 varieties. Protein content varied between 2.51 to 4.04g/100g during all maturity stages in all the four cultivars studied. The fat content in the Safflower leaves was found to increase in all four cultivars from 30th day to 50th day to 70th day. This could be due to the fact that Safflower being an oilseed crop, the oil component increases in the leaves also as the plant matures. The crude fiber analysis results indicate Safflower leaves are a very rich source of crude fiber ranging from 8.77 to 9.58g/100g during various stages of maturity in the four cultivars. The ash content of Safflower leaves ranged between 13.68 to 17.36% which indicates that Safflower leaves are a rich source of minerals. The energy values of Safflower ranged between 58.82 to 111.44kcal/100g.
Results of iron and calcium estimation show that Safflower leaves are rich sources of both iron (3.42 – 5.33mg/100g) and calcium (240 – 333.33mg/100g) during various stages of maturity in all four cultivars. However, the differences in the calcium and iron content were not statistically significant, indicating that consumption of safflower leaves at any stage from any cultivar would give almost similar calcium and iron content.

The total carotenoids content was highest during the 30th day in all the four cultivars ranging from 7122.56 - 14892.80μg/100g, while it was lowest during 70th day ranging from 1476.00 – 4066.40μg/100g indicating that the stage of maturity does have a remarkable influence on the total carotenoid content. The results showed that, as the stage of maturity increased, there was a significant decrease in the total carotenoid content of Safflower leaves. The results indicate that, ascorbic acid content was highest during 50th day in Annigeri-1 and Manjira, whereas it was highest on 70th day in NARI-6 variety. The results also indicate that TSF-1 is a poor source of ascorbic acid when compared to Annigeri-1, Manjira and NARI – 6.

The DPPH scavenging activity and total flavonoids of Safflower leaves were higher at 30th day while superoxide anion activity and total phenolics were higher at later stages (70th day and 90th day in NARI-6 variety). This shows that the Safflower leaves exhibits antioxidant activity at various stages through different mechanisms such as acting as weakoxidant, scavenging singlet oxygen molecules (Superoxide anion activity and total flavonoids) when consumed at earlier stages and scavenging hydrogen peroxide radicals when consumed at matured stages (DPPH activity and total phenols). Hence, consumption of the safflower leaves at any stage of maturity provides antioxidants to the diet.

Two products namely Safflower leaves roti and Safflower leaf powder “Karam podi” were prepared during different stages of maturity with Annigeri-1, Manjira, TSF-1 and NARI-6 varieties and sensory evaluation was performed. Results of sensory evaluation revealed that 35 percent incorporation of Safflower leaves in roti and 15 percent incorporation of Safflower powder in “Karam podi” sample had high scores for overall acceptability andthere was not much difference among the cultivars used in the study. Hence, from this it can be interpreted that 35 and 15 percent incorporation of fresh and dried leaf powder respectively had no detrimental effects on sensory attributes and there was no statistically significant difference among the cultivars.

The results of the study show that, the optimum period to harvest Safflower leaves to be consumed as vegetable can be done during any stage of maturity - 30 days, 50 days and 70 days for spiny varieties of Safflower like Annigeri-1, Manjira and TSF-1, where as non spiny varieties like NARI-6 can be consumed up to 90 days. There is a very good distribution of carbohydrates, proteins, fiber, iron, calcium, carotenoids, antioxidants during all the stages of maturity though the content varies during the stages of maturity. Hence, harvesting age is not very crucial in case of Safflower leaves to be consumed as a green leafy vegetable but availability of the safflower leaves all through the year is more crucial. Safflower leaves and leaf powder which are potential sources of nutrients and antioxidants during various stages of maturity, can be popularized as a green leafy vegetable for attainment of nutritional security.
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