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AGRONOMY

Author	:	**ANUSHA, O.**
Title of the Thesis	:	**ORGANIC APPROACH FOR OPTIMISING PRODUCTIVITY OF Rabi GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. G. KRISHNA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5487**

ABSTRACT

A field experiment entitled "Organic approach for optimising productivity of *rabi* groundnut (*Arachis hypogaea* L.)" was carried out during *rabi*, 2017 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in randomized block design with three replications. There were nine treatments *viz*., control (T_1), 100% RDF (30-40-50 kg N, P_2O_5 & K_2O ha^{-1}) (T_2), 100% organic N through FYM (60%) + Neem cake (40%) (T_3), Seed treatment with ghanajeevamrutha + Soil application of jeevamrutha @ 500 l ha^{-1} before sowing, at every 10 days interval upto 15 days before harvest (T_4), Seed treatment with ghanajeevamrutha + Soil application of ghanajeevamrutha @ 500 kg ha^{-1} at the time of sowing + Foliar spray of jeevamrutha @ 500 l ha^{-1} at every 10 days interval upto 15 days before harvest (T_5), Seed treatment with ghanajeevamrutha + Foliar spray of panchagavya @ 3 % at every 10 days interval upto 15 days before harvest (T_6), 100% organic N through FYM (60%) + Neem cake (40%) + Seed treatment with ghanajeevamrutha + Soil application of jeevamrutha @ 500 l ha^{-1} before sowing, at every 10 days interval upto 15 days before harvest (T_7), 100% organic N through FYM (60%) + Neem cake (40%) + Seed treatment with ghanajeevamrutha + Soil application of ghanajeevamrutha @ 500 kg ha^{-1} at the time of sowing + Foliar spray of jeevamrutha @ 500 l ha^{-1} at every 10 days interval upto 15 days before harvest (T_8), 100% organic N through FYM (60%) + Neem cake (40%) + Seed treatment with ghanajeevamrutha + Foliar spray of panchagavya @ 3% at every 10 days interval upto 15 days before harvest (T_9). Organic sources are applied on the basis of N content. The test variety of groundnut was Dharani.

Various organic sources significantly influenced the growth parameters, yield attributes, yield, economic returns and nutrient uptake of groundnut as well as the post-harvest soil fertility status.

Application of 100% RDF (T_2) resulted in the tallest plants, largest leaf area index and highest dry matter production, which was significantly superior over rest of the nutrient management practices tried. The next best treatment was supply of 100% organic N + STG + FSP (T_9), which was followed by STG + FSP (T_6). Growth characters were recorded to be at their lowest with control (T_1), without nutrient application.

Total and effective number of nodules plant^{-1} were recorded highest with 100% organic N + STG + FSP (T_9), which was however comparable with 100% organic N through FYM (T_3) and 100% organic N + STG + SAG + FSJ (T_8).The lowest number of total as well as effective nodules plant^{-1} were recorded with the control (T_1).

The soil microbial count *viz.* bacteria, fungi and actinomycetes were recorded highest with 100% organic N + STG + FSP (T_9), which was comparable with 100% organic N + STG + SAG + FSJ (T_8) and 100% organic N + STG + SAJ (T_7). Control (T_1) recorded the lowest soil microbial count.

Regarding the yield attributes *viz.,* number of pods plant^{-1}, hundred pod and kernel weight and shelling percentage were the highest with application of 100% RDF (T_2). Among the various organic sources, application of 100% organic N + STG + FSP (T_9) followed by STG + FSP (T_6) resulted in improved yield attributes. Non-supply of nutrients in control (T_1) resulted in the deflated stature of all the above yield attributes.

Supply of 100% RDF (T_2) recorded the highest pod, kernel and haulm yields in groundnut which was distinctly superior over rest of the treatments. Among the various organic sources, 100% organic N + STG + FSP (T_9) resulted in higher pod, kernel and haulm yields, which was followed by STG + FSP (T_6). The lowest pod, kernel and haulm yields were recorded with control (T_1).

Nitrogen, phosphorus and potassium uptake were highest with 100% RDF (T_2). Among the various organic sources tried, supply of 100% organic N + STG + FSP (T_9) recorded highest nutrient uptake, which was followed by STG + FSP (T_6).The lowest uptake of nutrient was recorded with control (T_1).

The highest post-harvest soil available nutrient status was recorded with 100% RDF (T_2), which was however comparable with 100% organic N + STG + FSP (T_9). The post-harvest soil nutrient status was lower with control (T_1).

The highest gross returns, net returns and benefit cost ratio were recorded with 100% RDF (T_2). Among the various organic sources tried, application 100% organic N + STG + FSP (T_9) recorded higher gross returns, net returns whereas benefit cost ratio was recorded highest with STG + FSP (T_6). The lowest economic returns were obtained with control (T_1).

In conclusion, the investigation revealed that higher pod yield of groundnut as well as economic returns could be recorded with 100% recommended dose of nutrients through fertilizers. Among the various organic sources tested, 100% organic N + STG + FSP (T_9) as well as STG + FSP (T_6) were proved to be promising organic practices for higher yield and economics of *rabi* groundnut in the present domain of study. However, the economic returns under organic approach could be enhanced with premium price for the organic produce in the market after certification.

AGRONOMY

Author	:	**BHAGAVATHA PRIYA, TALUPURU.**
Title of the Thesis	:	**INFLUENCE OF VERTICAL TILLAGE AND NUTRIENT MANAGEMENT ON MOISTURE CONSERVATION AND PERFORMANCE OF GROUNDNUT-GREENGRAM SEQUENCE**
Chairperson	:	**Dr. V. CHANDRIKA**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5498**

ABSTRACT

A field experiment was conducted on sandy clay loam soil of Dry land farm of Sri Venkateswara Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, during *kharif*, 2015 and 2016 and *rabi* 2015-16 and 2016-17, to study the "**Influence of vertical tillage and nutrient management on moisture conservation and performance of groundnut-greengram sequence**". The treatments consisted of four tillage practices in main plots *viz*., conventional tillage (M_1), deep ploughing with disc plough upto a depth of 30 cm (M_2), vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) and vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) and five nutrient management practices in sub plots *viz*., control (S_1), 50 % RDF (S_2), 75 % RDF (S_3), 100 % RDF (S_4) and 125 % RDF (S_5). The experiment was laidout in a split-plot design with three replications.

Soil physical property *viz*., bulk density was significantly lower and aggregate stability was significantly higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) compared to other tillage practices. Whereas, aggregate stability was higher with 125 % RDF (S_5) with no significant disparity with rest of the nutrient management practices tried.

Soil chemical properties *viz*., pH, electrical conductivity and organic carbon were not significantly influenced by both tillage and nutrient management practices during both the years of experimentation.

Among the four tillage practices evaluated, growth characters of groundnut *viz*., plant height, leaf area index, total dry matter production, SPAD chlorophyll meter reading and relative leaf water content were significantly higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) compared to rest of the tillage practices. Lower values of these growth parameters were registered with conventional tillage (M_1).

Among the nutrient management practices tested, significantly higher plant height, leaf area index, total dry matter production, SPAD chlorophyll meter reading and relative leaf water content of groundnut were recorded with 125 % RDF (S_5), while all these growth parameters were significantly lower with control (S_1).

Available soil moisture content at different depths were significantly higher with the vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) compared to rest of the tillage practices at all stages of observations. Minimum soil moisture content was observed with conventional tillage (M_1). Among nutrient management practices maximum and minimum soil moisture content was recorded with control (S_1) and 125 % RDF (S_5), respectively during both the years of study.

Days to 50 per cent flowering and maturity of groundnut were minimum with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) and these parameters were maximum with conventional tillage (M_1). The minimum and maximum number of days to 50 per cent flowering and maturity were registered with control (S_1) and 125 % RDF (S_5), respectively.

Root growth parameters *viz*., root length, root fresh and dry weight of groundnut were significantly higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) compared to rest of the tillage practices. Lower values of these growth parameters were registered with conventional tillage (M_1). Among nutrient management practices 125 % RDF (S_5) recorded higher root growth parameters, while these were lower with control (S_1).

Number of pegs plant^{-1} and total number of pods plant^{-1} of groundnut were significantly higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4), while lower values were recorded with conventional tillage (M_1). Maximum and minimum number of pegs plant^{-1} and total pods plant^{-1} were recorded with 125 % RDF (S_5) and control (S_1), respectively.

The tillage practice of vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) resulted in significantly higher values of filled pods plant^{-1}, hundred pod and kernel weight, shelling percentage and harvest index of groundnut, compared to other tillage practices tried. Lower values of these characters were produced with conventional tillage (M_1). Higher values of the above parameters were recorded with 100 % RDF (S_4), while lower values were recorded with control (S_1).

Higher pod yield was obtained with vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) followed by vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4), deep ploughing with disc plough (M_2) and conventional tillage (M_1) with a significant disparity between any two of them. Higher pod yield was obtained with 100 % RDF followed by 75, 125, 50 % RDF and control with a significant disparity between any two of them. Oil yield of groundnut showed the similar trend as that of pod yield with same magnitude. There was no significant influence of tillage and nutrient management practices on oil content of groundnut.

Vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) resulted in higher haulm yield, while it was lower with conventional tillage (M_1). Among the nutrient management practices tried, haulm yield was increased with increasing fertilizer dose from control to 125 % RDF and higher haulm yield was obtained with 125 % RDF (S_5).

Quality parameters *viz*., protein, total carbohydrates, total free amino acids in groundnut was maximum with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) while it was minimum with conventional tillage (M_1) with no significant disparity among tillage practices studied during two years of experiment. Among the different nutrient management practices tested, maximum and minimum values of above mentioned quality parameters in groundnut was recorded with 125 % RDF (S_5) and control (S_1), respectively.

Total microbial mass in soil at harvest of groundnut crop was higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) while, it was minimum with conventional tillage (M_1) practice. Among nutrient management practices tried, higher total microbial mass in soil was recorded with 125 % RDF (S_5) while it was lower with control treatment (S_1).

Maximum gross and net returns and benefit-cost ratio of groundnut cultivation were obtained with vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) followed by vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4), while minimum values were registered with conventional tillage (M_1) which was significantly lesser than rest of the tillage practices tried during both the years of experiment. Among different nutrient management practices tried, maximum gross and net returns of groundnut cultivation was registered with 100 % RDF (S_4) followed by 75 % RDF (S_3) while minimum gross, net returns were obtained with control (S_1) in both the years of study. Maximum benefit-cost ratio was computed with 75 % RDF (S_3), while minimum benefit-cost ratio was observed with control (S_1).

Among tillage practices investigated in two years study, vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) recorded higher nutrient uptake by groundnut as well as post harvest nutrient availability in soil. Minimum nutrient uptake as well as nutrient availability after harvest of groundnut was observed with conventional tillage (M_1) during both the years of experiment. Among nutrient management practices tested, 125 % RDF (S_5) recorded higher nutrient uptake by groundnut as well as post harvest nutrient availability in soil. Minimum nutrient uptake as well as post harvest nutrient availability in soil was observed with control (S_1).

There was no significant residual effect of both tillage and nutrient management practices on succeeding crop of greengram in producing plant height, dry matter production, number of clusters plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, thousand seed weight, seed yield and haulm yield as well as gross returns, net returns and benefit-cost ratio of greengram cultivation during both the years of experimentation. Nutrient uptake by greengram at harvest and availability of nutrients after harvest of greengram were not influenced by residual effect of tillage and nutrient management practices during two years of study.

Groundnut equivalent yield and system productivity was significantly higher with tillage practice of vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) during both the years of experiment. Among the nutrient management practices tested during both the years of experimentation, maximum groundnut equivalent yield was recorded with 100 % RDF (S_4) which was significantly higher than rest of the treatments.

There was no significant interaction effect between tillage and nutrient management practices studied in two years experimentation.

During both the years of experimentation, gross returns, net returns and benefit-cost ratio of groundnut-greengram sequence were maximum with vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) in combination with 100 % RDF (S_4) while minimum gross returns, net returns and benefit-cost ratio were computed with conventional tillage (M_1) at control (S_1).

Net gain in soil available nitrogen was higher with vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) at 125 % RDF (S_5) and lower with conventional tillage (M_1) at 50 % RDF (S_2). Vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) at control (S_1) recorded higher net gain in soil available phosphorous while, there was a loss in soil available phosphorous under conventional tillage (M_1) at 125 % RDF (S_5). Positive change in balance of soil available potassium was registered under vertical tillage with subsoiler upto 60 cm depth at 1 m interval (M_4) at control (S_1) during both the years of study. A net loss in soil available potassium during both the years of experimentation was observed with conventional tillage (M_1) at 125 % RDF (S_5).

The present investigation revealed that vertical tillage with subsoiler upto 40 cm depth at 1 m interval (M_3) in combination with 100 % RDF (S_4) was productive, conservative and remunerative for groundnut-greengram sequence, while significant residual effect of tillage and nutrient management practices on succeeding greengram crop was not observed on sandy clay loam soils of Southern Agro-climatic Zone of Andhra Pradesh.

AGRONOMY

Author	:	**BHARGAVI, K.**
Title of the Thesis	:	**ORGANIC PRODUCTION OF SUMMER GREENGRAM [*Vigna radiata* (L.) Wilczek]**
Chairperson	:	**Dr. V. SUMATHI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5488**

ABSTRACT

A field experiment entitled **"Organic Production of Summer Greengram [*Vigna radiata* (L.) Wilczek]"** was carried out during summer, 2017 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in split plot design with three replications. The main plot consisted of four treatments of organic manures *viz.,* Control (M_1), Farm yard manure (M_2), Vermicompost (M_3) and Poultry manure (M_4) and sub plots consisted three treatments of organic sprays *viz.,* Control (S_1), *Panchagavya* (S_2) and *Jeevamrutha* (S_3).Various organic manures and organic sprays significantly influenced the growth parameters, yield attributes,

yield, quality parameters, economic returns and nutrient uptake of greengram as well as the post-harvest soil fertility status and microbial load.

Among the organic manures tried, incorporation of the poultry manure recorded the tallest plants, maximum LAI and higher dry matter production of greengram at all the crop growth stages and lower values of parameters at all stages were observed in plots which were not incorporated with any of the manure. Among the organic sprays tested, *panchagavya* spray resulted in the higher stature of plant growth parameters *viz.,* plant height, LAI and dry matter production of greengram and lower values of plant growth parameters were recorded in plots which have not received any organic spray. Interaction effect, wherever it was significant (dry matter production at 40 and 60 DAS), the combination of poultry manure incorporation with *panchagavya* spray (M_4S_2) has resulted in the taller plants.

All the yield attributes of greengram *viz.,* number of pods plant^{-1}, length of the pod, number of seeds pod^{-1} and test weight, were found to be the higher with poultry manure incorporation and all the yield attributes were found to be at their lower in the plots which have not incorporated with any of the organic manure. *Panchagavya* application has resulted in the higher stature of all the yield attributes of greengram and were at their lower in plots which have not received any organic spray. Interaction was found only in respect of number of pods plant^{-1} among yield attributes of greengram. The higher number of pods plant^{-1} were obtained with the combination of poultry manure incorporation with *panchagavya* spray (M_4S_2), while the lower number of pods plant^{-1} were obtained in plots with non application of organic manure and organic spray (M_1S_1).

Among the organic manures tried, incorporation of the poultry manure resulted in the higher seed yield and haulm yield. The lower seed yield and haulm yield were produced in plots which have not received any of the organic manure. Among the organic sprays tried, *panchagavya* spray resulted in the higher seed yield and haulm yield. The lower seed yield and haulm yield was recorded in control plots i.e. without any organic spray.

Interaction effect of different organic manures and organic sprays was found to be non significant in influencing the seed yield and haulm yield.

Quality parameters *viz.,* protein and aminoacid content of greengram seed was not influenced significantly by different organic manures and organic sprays.

The higher uptake of N, P and K was registered with the incorporation of poultry manure, while the uptake of all the three major nutrients was lower in control. Among the organic sprays, higher uptake of N, P and K by the crop was obtained with *panchagavya* spray tested, while uptake of nutrients was lower in control plots which have not received any organic spray. The higher values of nitrogen uptake was obtained with the combination of poultry manure incorporation with *panchagavya* spray (M_4S_2), while they were found lower in the plots without incorporation of organic manure, without any organic spray (M_1S_1).

Organic manures and organic sprays failed to exert any significant influence on p^H and EC of soil after harvest of crop.

The higher post harvest nutrient status of soil available N, P_2O_5 and K_2O was recorded with poultry manure incorporation which was superior to rest of the treatments,

while it was found to be the lower with the plots of non manurial incorporation. As regards the organic sprays, *panchagavya*

AGRONOMY

Author	:	**DEEPTHI, CH.**
Title of the Thesis	:	**NUTRIENT MANAGEMENT IN RABI SESAME FOR NORTH COASTAL ANDHRA PRADESH**
Chairperson	:	**Dr. A.V. RAMANA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, NAIRA**
Accession Number	:	**D5546**

ABSTRACT

A field experiment entitled "**Nutrient management in rabi sesame for North-Coastal Andhra Pradesh**" was conducted at Agricultural College Farm, Naira, on sandy loam soils during *rabi*, 2016-2017. The treatments consisted of four levels of NPK viz., M_1-100% RDF (40:20:20 kg NPK ha^{-1}), M_2 (75% RDF), M_3 (125% RDF) and M_4 (75% RDF + 25% nitrogen through vermicompost) which were assigned to main plots and four foliar nutrition treatments viz., control (F_1), foliar application of 19:19:19 @ 1.0% at early budding stage (F_2), foliar application of KNO_3 @ 1.0% at early budding stage (F_3) and foliar application of 19:19:19 @ 1.0% at early budding stage followed by 1.0% KNO_3 at early capsule formation stage (F_4) were assigned to sub plots. The design adopted was split-plot and each treatment replicated thrice.

Significantly taller plants were noticed at all the intervals of sampling with the highest dose of NPK supplied to soil (M_3). While, foliar feeding of nutrients failed to exert significant influence on plant height at 20 and 40 DAS. Foliar application of 19:19:19 @ 1.0% at early budding stage followed by 1.0% KNO_3 at early capsule formation stage (F_4) recorded the tallest plants at 60 DAS and at maturity. The interaction effect between soil application of varied levels of NPK and foliar feeding nutrients was not significant.

At all the intervals of sampling, significantly higher drymatter accumulation was obtained with M_3. Foliar feeding of nutrients did not exert any influence at 20 and 40 DAS whereas, application of 19:19:19 @ 1.0% through foliar feeding at early budding stage followed by 1.0% KNO_3 at early capsule formation stage (F_4) registered the highest drymatter accumulation at 60 DAS and at maturity. With regard to interaction effect, the highest drymatter accumulation at maturity was noticed with M_3 at F_4 which was however, on par with F_2 at the same level of NPK applied to soil (M_3).

Soil application of the highest dose of NPK (M_3) produced significantly higher number of branches plant^{-1} at 60 DAS and at maturity. Among the foliar feeding treatments, maximum number of branches plant^{-1} was recorded with F_4. With regard to interaction effect between soil application of NPK and foliar feeding of nutrients, M_3 at F_4 recorded significantly higher values.

Maximum number of leaves plant^{-1} and leaf area index were recorded with the highest level of NPK applied to soil (M_3) whereas, foliar application of nutrients did not alter number of leaves plant^{-1} significantly. However, significantly higher values for leaf area index were noticed due to foliar feeding of 19:19:19 @ 1.0% at early budding stage followed by 1.0% KNO_3 at early capsule formation stage (F_4). Number of days to 50 % flowering and days to maturity did not alter significantly either due to soil application of varied levels of NPK or foliar feeding of nutrients or their interaction.

Larger yield structure, comprised of number of capsules plant^{-1}, capsule length, number of seeds capsule^{-1} and test weight were observed due to application of the highest dose of NPK applied to soil (M_3), while they were found to be the lowest with the lowest level of NPK tried (M_2). Application of F_4 produced significantly superior yield attributes compared to rest of the foliar nutrition treatments. The interaction effect was found to be significant only for number of capsules plant^{-1} and the highest values were recorded with M_3 at F_4.

Maximum seed and stalk yield were obtained with the highest dose of NPK applied to soil (M_3). Among foliar feeding treatments, application of F_4 recorded the highest seed and stalk yield. With regard to interaction effect, M_3 at F_4 recorded higher values which were however, on par with F_2. Harvest index could not be altered significantly either due to soil application of varied levels of NPK or foliar feeding of nutrients while**,** the interaction effect between these two factors was also absent.

With regard to quality parameters viz., protein content, oil content and oil yield, significantly higher values were associated with the highest level of NPK applied to soil (M_3). Maximum values for quality parameters were recorded with foliar application of F_4. The interaction effect between these two factors was found absent.

Significantly higher uptake of N, P and K by seed and stalk were registered with application of the highest dose of NPK tried (M_3). As regards foliar application, F_4 recorded maximum uptake of NPK which was however, comparable with F_3 and which in turn found parity with F_2 in case of N uptake by seed. The interaction effect between varied levels of NPK applied to soil and foliar feeding of nutrients was not statistically measurable.

The highest gross returns, net returns and B: C ratio was obtained with the highest dose of NPK supplied to soil (M_3). As regards foliar nutrition, F_4 recorded maximum gross returns, net returns and B: C ratio. With regard to the interaction effect, maximum gross returns, net returns and B: C ratio was observed with M_3 at F_4 which was however, found on par with F_2 at same level of NPK supplied (M_3).

Overall, the results revealed that maximum seed yield, stalk yield, gross returns, net returns and B: C ratio obtained with the highest level of NPK applied to soil (M_3) and supplemented with F_4 which were however, found parity with F_2 at the same level of NPK application to soil (M_3) indicating the sufficiency of one foliar application of 19:19:19 @

1.0% (F_2) along with the highest dose of NPK (125% RDF), which is the best and the most economical nutrient management package for rabi sesame in North Coastal Zone of Andhra Pradesh.

AGRONOMY

Author	:	**DEVI, BOBBILI.**
Title of the Thesis	:	**PERFORMANCE OF COTTON UNDER HIGH DENSITY PLANTING WITH VARIED SPACING AND LEVELS OF NITROGEN**
Chairperson	:	**Dr. S. BHARATHI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5387**

ABSTRACT

A field experiment was conducted on clay soils of the Agricultural College Farm, Bapatla to study " Performance of cotton under high density planting with varied spacing and levels of nitrogen" during the year 2016 – 2017 under rainfed conditions. The treatments consisted of four plant spacings S_1 - 60 cm × 10 cm , S_2- 75 cm × 10 cm , S_3- 90 cm × 10 cm , S_4- 90 cm × 45 cm in combination with four nitrogen levels N_1- 60 kg N ha^{-1}, N_2- 90 kg N ha^{-1}, N_3-120 kg N ha^{-1}, N_4- 150 kg ha^{-1} and replicated thrice in split plot design. Test variety was Suraj.

Plant height of cotton was significantly influenced by varied spacing and levels of nitrogen at different stages except at 30 DAS. Further, plant height was not influenced by spacings at 60 DAS. The highest plant height was recorded with closer spacing of 60 cm × 10 cm and was significantly superior to other spacings tested at 90 DAS and at harvest. Maximum plant height was observed at 150 kg N ha^{-1} than other levels of N tested at all the stages of crop growth. Interactions were non significant.

Drymatter accumulation was significantly higher at closer spacing of 60 cm × 10 cm than other spacings at all the growth stages. Highest drymatter accumulation was recorded with 150 kg N ha^{-1} and interactions were not significant.

The number of monopodial branches per plant were zero due to varietial character. Maximum number of sympodial branches per plant were recorded at wider spacing of 90 cm × 45 cm than other spacings tested. Further, sympodial branches per plant recorded were maximum with application of 150 kg N ha^{-1} and were significantly superior to the other nitrogen levels tested. The interaction effect was non significant.

Number of bolls per m^2 was significantly higher at closer spacing of 60 cm × 10 cm than other spacings tested and was on a par with 75 cm × 10 cm. Maximum number of bolls per m^2 was recorded at 150 kg N ha^{-1} than other nitrogen levels tested. Interactions were non significant.

Maximum boll weight was recorded at wider spacing of 90 cm × 45 cm than other spacings tested, however, the recorded boll weight at closer spacing of 60 cm × 10 cm was on a par with 75 cm × 10 cm. Regarding nitrogen leves maximum boll weight was recorded at 150 kg N ha^{-1} and was significantly superior to other nitrogen levels tested. Interaction effect was non significant.

Maximum seed cotton yield was recorded at closer spacing of 60 cm × 10 cm than other spacings tested and was on a par with 75 cm × 10 cm. Highest seed yield was recorded with application of 150 kg N ha^{-1} than other nitrogen levels tested. Interaction effect was non significant.

Maximum stalk yield was recorded at a closer spacing of 60 cm × 10 cm than other spacings tested. Highest stalk yield was recorded at 150 kg N ha^{-1} than other nitrogen levels tested. Interaction effect was not significant.

NPK content in plants was not significantly affected by plant spacing and levels of nitrogen.

NPK uptake by plants at harvest was significantly higher at closer spacing of 60 cm × 10 cm than other spacings tested. Maximum NPK uptake by plants was recorded with application of 150 kg N ha^{-1} than other nitrogen levels tested. Interactions were not significantly influenced.

Overal, the results of the trial showed that spacing of 60 cm × 10 cm was found to be optimum to realize higher growth, seed cotton yield and net returns under high density planting system. Secondly, increase in nitrogen levels from 60 kg N ha^{-1} to 150 kg N ha^{-1} recorded higher growth and seed cotton yield.

AGRONOMY

Author	:	**DIVYAMANI, BIRRU.**
Title of the Thesis	:	**BIO-EFFICACY OF HERBICIDE MIXTURES FOR WEED MANAGEMENT IN RABI GROUNDNUT**
Chairperson	:	**Dr. Y. REDDI RAMU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5489**

ABSTRACT

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati, campus of Acharya N.G. Ranga Agricultural University of Andhra Pradesh, during *rabi,* 2016, to identify the suitable pre-and post-emergence herbicides for effective control of weeds in groundnut.

The present investigation was laid out in a randomized block design with three replications. There were ten weed management practices *viz.,* pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} (W_1), pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} + one hand weeding at 20 DAS (W_2), pre-emergence application of pendimethalin + imazethapyr (pre-mix) @ 1000 g *a.i* ha^{-1} (W_3), post-emergence application of imazethapyr @ 75 g *a.i* ha^{-1} (W_4), post-emergence application of imazethapyr + imazamox (pre-mix) @ 70 g *a.i* ha^{-1} (W_5), post-emergence application of sodium salt of aciflurofen + clodinofop propargyl (pre-mix) @ 75 g *a.i* ha^{-1} (W_6), post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl @ 25 g ha^{-1} (tank-mix) (W_7), post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + propaquizafop @ 25 g ha^{-1} (tank-mix) (W_8), two hand weedings at 20 and 40 DAS (W_9) and unweeded check (W_{10}).

The weed flora associated with groundnut experimental field belongs to eight taxonomic families, of which three species were grasses, two species were sedges and ten species were broad leaved weeds. The predominant weed species associated with groundnut are *Cyperus rotundus* (52.0 %), *Digitaria sanguinalis* (10.0 %) *Commelina benghalensis* (8.0 %), *Phyllanthus niruri* (6.0 %) *Cleome viscosa* (5.0 %), *Boerhavia diffusa* (5.0 %) and *Dactyloctenium aegyptium* (5.0 %).

The lowest density and dry weight of weeds, as well as the highest weed control efficiency was observed with two weedings at 20 and 40 DAS, which was however, on par with pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS (W_2) and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl @ 25 g *a.i* ha^{-1} and these three treatments were distinctly more effective than the rest of the weed management practices tried.

Pre-emergence application of pendimethalin alone @ 1000 g *a.i* ha^{-1}, post-emergence application of imazethapyr in combination with imazamox (premix) @ 70 g *a.i* ha^{-1} or propaquizafop (37.5 g *a.i* ha^{-1} + 25 g *a.i* ha^{-1}) or along with pendimethalin (pre-mix) @ 1000 g *a.i* ha^{-1} as pre-emergence or imazethapyr 75 g *a.i* ha^{-1} alone as PoE, were the next best treatments for the above said weed parameters, which maintained statistical similarity with each other and significantly superior over sodium salt of aciflurofen + clodinofop propargyl (pre-mix) @ 75 g *a.i* ha^{-1}. The highest density and dry weight of weeds along with the lowest weed control efficiency were recorded with unweeded check.

Among the weed management practices studied, hand weeding twice at 20 and 40 DAS resulted in the highest values of growth parameters *viz.,* plant height, LAI, number of branches plant^{-1} and dry matter production and the highest values of yield attributes *viz.,* number of pods plant^{-1}, hundred pod, kernel weight as well as shelling percentage. These parameters were in parity with pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop @ 25 g *a.i* ha^{-1}. All the above said growth parameters and yield attributing characters were at their lowest with unweeded cheek. Different weed management practices failed to exert significant influence on the number of nodules plant^{-1} in groundnut.

The highest pod, kernel, oil and haulm yield as well as harvest index of groundnut were recorded with two hand weedings at 20 and 40 DAS, which was comparable with pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS, and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl @ 25 g *a.i* ha^{-1}. These weed management practices recorded 46.0, 44.1 and 43.3 per cent higher pod yield, respectively over unweeded check, which recorded the lowest pod, kernel, oil and haulm yield as well as harvest index in groundnut among the weed management practice.

Among the different weed management practices tried, the lowest nutrient uptake by weeds and the highest uptake of nitrogen, phosphorus and potassium by groundnut was recorded with hand weeding twice at 20 and 40 DAS, which was on par with application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS (W_2) and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop-p-ethyl @ 25 g *a.i* ha^{-1}. The nitrogen, phosphorus and potassium drain by weeds in the unweeded check is 33.13, 16.54 and 26.67 kg ha^{-1} respectively.

Among the weed management practices tried, the highest gross returns were observed with hand weeding twice at 20 and 40 DAS, which was on par pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop @ 25 g *a.i* ha^{-1}. However, pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS practice recorded significantly higher net returns and benefit-cost ratio.

In conclusion, the present study has revealed that hand weeding twice at 20 and 40 DAS resulted in the highest grain yield and monetary returns, but it was comparable with pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS and post-emergence application of imazethapyr @ 37.5 g *a.i* ha^{-1} + quizalofop @ 25 g *a.i* ha^{-1}. Pre-emergence application of pendimethalin @ 1000 g *a.i* ha^{-1} *fb* hand weeding at 20 DAS was proved to be economically feasible and ecologically sustainable weed management option for *rabi* groundnut to best fit in integrated approach.

AGRONOMY

Author	:	**GAYATREE, MISHRA.**
Title of the Thesis	:	**WEED MANAGEMENT OPTIONS TO ENHANCE THE PRODUCTIVITY OF DIRECT SEEDED RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. M. MARTIN LUTHER**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5388**

ABSTRACT

A field experiment entitled **"Weed management options to enhance the productivity of direct seeded rice (*Oryza sativa* L.)"** was conducted on sandy loam soil of the Agricultural College Farm, Bapatla during *kharif*, 2016-17. The experiment consisted of twelve treatments *viz*., Weedy check (T_1); Manual weeding twice at 20 and 40 DAS (T_2); Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1} as pre emergence at 1 to 2 DAS (T_3); Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS (T_4); Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 25 DAS (T_5); Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 25 DAS (T_6); Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* propanil @ 3.75 kg ha^{-1} as post emergence at 25 DAS (T_7); Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* propanil @ 3.75 kg ha^{-1} as post emergence at 25 DAS (T_8); Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_9); Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_{10}); Pretilachlor + pyrazosulfuron ethyl @ 615 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* propanil @ 3.75 kg ha^{-1} as post emergence at 35 DAS (T_{11}); Pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* propanil @ 3.75 kg ha^{-1} as post emergence at 35 DAS (T_{12}). The experiment was laid out in a Randomized block design and replicated thrice.

The predominant weed flora identified in the experimental field was *Echinochloa colona, Cynodon dactylon, Digitaria sanguinalis, Dactyloctenium aegyptium, Paspalum conjugatum, Leptochloa chinensis, Chloris barbata, Cyperus rotundus, Cyperus iria, Scirpus articulatus, Eclipta alba, Euphorbia hirta, Ammania baccifera* and *Bergia capensis*.

The results of the investigation revealed that all the weed management practices significantly reduced the density and dry weight of weeds and increased the weed control efficiency at all stages compared to weedy check. All the integrated weed management practices recorded the lowest weed growth when compared to pre and post emergence herbicides applied in sequence and one time application of pre emergence herbicides. However, integrated application of pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_{10}) was proved superior and was on a par with other integrated weed management practices and hand weeding at 20 and 40 DAS was comparable with it.

All the crop growth characters like plant height, dry matter accumulation and total number of tillers m^{-2} were maximum with application of pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_{10}), which was on a par with other integrated weed management practices. However, application of pre and post emergence herbicides in sequence and one time application of pre emergence herbicides were found inferior to T_{10}.

Among the herbicidal treatments, the higher yield attributing characters and yield such as panicle length, number of productive tillers, total number of grains $panicle^{-1}$, number

of filled grains panicle^{-1}, grain and straw yield (kg ha^{-1}) were significantly higher with integrated application of pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_{10}), which was on a par with other integrated weed management practices and also hand weeding twice (T_2) but significantly superior over weedy check (T_1).

Hand weeding twice at 20 and 40 DAS found to be on a par with integrated weed management practices (T_9 to T_{12}) but significantly superior over the sequential and one time application of herbicides in respect of weed parameters, crop growth parameters and yield attributing characters during all the stages of crop growth.

The present investigation indicated that all the integrated weed management practices (T_9 to T_{12}) were found to be effective for better weed control in direct seeded rice and hand weeding twice (T_2) was comparable with these practices. On considering economics, pendimethalin + pyrazosulfuron ethyl @ 920 g a.i ha^{-1} as pre emergence at 1 to 2 DAS *fb* manual weeding at 20 DAS *fb* halosulfuron @ 35 g ha^{-1} as post emergence at 35 DAS (T_{10}) recorded the highest net returns and benefit : cost ratio, proved as cost effective method.

AGRONOMY

Author	:	**GAYATHREE DEVI, P.**
Title of the Thesis	:	**WEATHER HEALTH INDICES FOR SEED PRODUCTION OF JUTE (*Corchorus olitorius* L.) UNDER DIFFERENT SOWING DATES**
Chairperson	:	**Dr. M. SREE REKHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5390**

ABSTRACT

A field experiment entitled "**Weather health indices for seed production of jute (*Corchorus olitorius* L.) under different sowing dates**" was carried out on clayey soil of Agricultural College Farm, Bapatla during *kharif*, 2016. The experiment was laid out in RBD with factorial concept and replicated thrice. The treatments consisted of three jute varieties (JRO-524, Ira and S-19) and four dates of sowing (1st FN of July, 2nd FN of July, 1st FN of August and 2nd FN of August).

The results of the experiment revealed that growth parameters such as drymatter production, days to 50% flowering, yield attributes and yield were significantly influenced by dates of sowing and varieties. Interaction between dates of sowing and varieties could not reach the level of significance for all growth parameters and yield parameters except drymatter production at 30DAS. Plant height, days to maturity and harvest index were significantly influenced by dates of sowing only. However, varieties and their interaction were not significantly influenced.

Sowing of jute varieties during 2nd FN of July recorded significantly higher plant height which was on a par with 1st FN of July. Maximum drymatter production was observed with S-19 variety sown during 1st FN of July and it was significantly superior to other two varieties and dates of sowing. Late sowing of jute during 1st FN of August and 2nd FN of August resulted in early flowering leading to reduced days for 50% flowering and days to maturity. The S-19 variety of jute sown during 1st FN of July took maximum number of days for 50% flowering and maturity stages. Among the varieties, S-19 recorded significantly the higher number of capsules per plant, number of seeds per capsule and test weight which was on par with JRO-524 variety and both were significantly superior to Ira, while for dates of sowing, 1st FN of July sowing recorded significantly highest compared to other sowings.

When jute was sown under different sowing dates, significantly highest seed yield and stalk yield of 1355 kg ha^{-1} and 5191 kg ha^{-1}, respectively was obtained with 1st FN of July sowing over other sowing dates. Among the varieties, significantly highest seed yield and stalk yield was obtained with S-19 variety compared to other two varieties.

Days to attain each phenological stage for varieties differed in their duration. Delay in sowings resulted in decreased duration of crop growth. The mean maximum days to maturity was observed with S-19 variety.

Higher values of all weather health indices *viz*., Growing Degree Days (GDD), Helio Thermal Units (HTU), Photo Thermal Units (PTU), Thermo Photo Ratio (TPR), Heat Use Efficiency (HUE), Helio Thermal Use Efficiency (HtUE), Photo Thermal Use Efficiency (PtUE), Pheno Thermal Index (PTI), Temperature Disparity (TD) and Humidity Disparity (HD) were obtained with 1st FN of July sowing (D_1) compared to 2nd FN of July (D_2), 1st FN of August (D_3) and 2nd FN of August (D_4).

Significant linear relationships were obtained for drymatter and seed yield of the three jute varieties with weather health indices such as GDD, HTU, PTU, TPR, HUE, HtUE, PtUE and PTI. The regression equations can be applied to predict jute growth and yield using daily information on temperature, photoperiod, daylength and sunshine hours during the crop season.

The highest net income (26070 Rs. ha^{-1}) and returns per rupee invested (Rs. 2.80) was obtained with S-19 variety sown during 1st FN of July (D_1) while the lowest net returns (824 Rs. ha^{-1}) and returns per rupee invested (1.05) were noticed with JRO-524 sown during 2nd FN of August.

AGRONOMY (WATER MANAGEMENT)

Author	:	**HAINDAVI, PALAVALASA.**
Title of the Thesis	:	**WATER PRODUCTIVITY AND PROFITABILTY OF DRY SOWN RICE (*Oryza sativa* L.) AS INFLUENCED BY IRRIGATION SCHEDULES AND WEED MANAGEMENT OPTIONS**
Chairperson	:	**Dr. K. CHANDRASEKHAR**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5537**

ABSTRACT

A field experiment was conducted on sandy loam soils of the Agricultural Research Station, Janghamaheshwarapuram, entitled "Water productivity and profitability of dry sown rice (*Oryza sativa* L.) as influenced by irrigation schedules and weed management options" during *kharif*, 2016-17 under rainfed condition. The treatments consisted of four irrigation schedules (I_1-1.5 IW/CPE ratio, I_2-2.0 IW/CPE ratio, I_3-3.0 IW/CPE ratio and I_4- continuous submergence from 25 DAS) assigned to main plots and five weed management treatments (W_1-control, W_2 -hand weeding at 20 DAS and 35 DAS, W_3 - pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb.* hand weeding at 25 DAS, W_4 - pendimethalin @ 1kg a.i. ha^{-1} (PE) *fb.* bispyribac sodium 25 g a.i. ha^{-1} at 15- 20 DAS, W_5 - pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb.* bispyribac sodium 25 g a.i. ha^{-1} at 15 – 20 DAS *fb.* metsulfuron methyl + chlorimuron ethyl 8 g a.i. ha^{-1} at 35 – 40 DAS as sub plots arranged in a split plot design design and were replicated thrice.

Continuous submergence (I_4) recorded significantly higher plant height, number of tillers and dry matter production, though on a par with irrigation at 3.0 IW/CPE ratio, over irrigations given at 1.5 and 2.0 IW/CPE ratios. The differences were not significant among irrigation levels through IW/CPE ratios 3.0, 2.0 and 1.5 in increasing number of filled grains per panicle. The maximum grain yield produced under continuous submergence (I_4) was comparable with that of 3.0 IW/CPE ratio (I_3). Difference between irrigation levels scheduled at IW/CPE ratio 1.5 (I_1) and 2.0 (I_2) was not significant in increasing the grain yield. Similarly, the straw yield produced by irrigation at I_3 (3.0 IW/CPE) found significantly superior to other irrigation levels (I_2 and I_1). The maximum harvest index was computed with irrigation with 1.5 IW/CPE ratio. Irrigation schedule (I_1) 1.5 IW/CPE ratio recorded significantly the maximum weed density and drymatter over rest of the treatments all the stages of crop growth. Similar trend as that of weed density was observed except at 60 DAS where I_4 found superior to other levels of irrigation in reducing weed dry matter. Irrigation scheduled at 3.0 IW/CPE observed with higher WCE over lower frequency of irrigations at 60 and 90 DAS. Continuous submergence treatment (I_4) found with higher WCE over other irrigation schedules based on IW/CPE, irrigation given at 1.5 IW/CPE was observed with

significantly lower consumptive use of water and water use efficiency followed by irrigation at 2.0 and 3.0 IW/CPE ratios. Alternatively, the highest daily rate of water use of attained with 3.0 IW/ CPE ratio was significantly higher than irrigation scheduled with other IW/CPE ratios.

Apart from manual weeding twice at 20 and 35 DAS (W_2), no significant differences in plant height was observed in other weed management treatments. Number of tillers m^{-2} counted with the application of pre-emergence herbicide + hand weeding (W_3) and with sequential application of herbicides (W_4 and W_5) at most of the crop growing period was found at par with each other. Application of pendimethalin *fb* hand weeding (W_3) recorded more drymatter accumulation over pendimethalin + bispyribac sodium (W_4) and control (W_1); though, the treatmental differences between W_3 and W_5 were not observed at all the stages of crop growth. At each level of irrigation two hand weedings found to be with highest drymatter accumulation on a par with treatment pendimethalin + hand weeding. The treatmental differences between two hand weedings (W_2) and pendimethalin + hand weeding (W_3) with respect to increasing productive tillers and number of grains per panicle was not significant. Whereas, in case of filled grains per panicle the differences were not significant among the treatments W_3, W_4 and W_5 wherein, application of pendimethalin along with one hand weeding (W_3) observed with more number of filled grains. Application of pendimethalin + hand weeding (W_3) recorded significantly higher grain yield over other herbicides alone treatments (W_4 and W_5). Whereas, the differences between the sequential application of herbicide treatments (W_4 and W_5) were not significant in increasing grain and straw yields. Application of pendimethalin with one hand weeding (W_3) found superior with less weed density and drymatter over W_4 and W_5 treatments. Pre-emergence application of pendimethalin + one HW at 25 DAS (W_3) recorded higher weed control efficiency at 30 DAS, followed by (W_2) two hand weedings at 20 and 35 DAS. Hand weeding twice at 20 and 35 DAS (W_2) recorded with significantly higher weed control efficiency of 63.8 % at 60 DAS and 66.6 % at 90 DAS over other weed management options which was closely followed by pendimethalin+ hand weeding (W_3). Application of pendimethalin + hand weeding (W_3) recorded the lowest weed index (19.2%). The differences observed in WUE obtained among the treatments W_2, W_3 and W_5 were not significant.

Overall, herbicide application along with manual weeding (W_3) or sequential application of herbicides (W_4 and W_5) with alternate irrigations based on 3.0 IW/CPE ratio found advantageous comparatively with higher net returns and BC ratio.

AGRONOMY (WATER MANAGEMENT)

Author	:	**HARI KRISHNA, P.**
Title of the Thesis	:	**PERFORMANCE OF *RABI* MAIZE (*Zea mays* L.) UNDER DIFFERENT IRRIGATION SCHEDULES AND NITROGEN MANAGEMENT**
Chairperson	:	**Dr. N. VENKATA LAKSHMI**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5538**

ABSTRACT

The experiment was conducted on sandy loam soils of Agricultural Research Station, Jangamaheswarapuram during *rabi*, 2016-17 to study the "**Performance of *rabi* maize (*Zea mays* L.) under different irrigation schedules and nitrogen management".** The experiment was laid out in a split plot design with three irrigation schedules and three nitrogen management treatments in three replications.The main plots consisted of three irrigation schedules *viz.,* I_1:1.0 IW/CPE ratio, I_2: 0.8 IW/CPE ratio and I_3: 0.6 IW/CPE ratio and three nitrogen levels *viz.,* N_1 (100% RDN), N_2 (100% RDN through urea + 25% RDN through FYM), N_3 (100% RDN through urea + 50% RDN through FYM) as subplots.

The influence of irrigation schedules and nitrogen levels on plant height of *rabi* maize was found to be significant at all the stages of crop growth. Irrigation at 1.0 IW/CPE ratio recorded significantly higher plant height over 0.6 IW/CPE, whereas, the differences between irrigations scheduled at 1.0 and 0.8 IW/CPE ratios were not significant in increasing plant height at maturity. In case of drymatter accumulation the maximum drymatter accumulation was recorded at 1.0 IW/CPE ratio which was significantly superior to that of irrigations at 0.8 and 0.6 IW/CPE ratios. Early tasseling and silking occurred with the irrigation scheduled at IW/CPE ratio of 1.0, which was significantly lower than the irrigation scheduled at IW/CPE ratio of 0.8 (I_2) and 0.6 (I_3).

Among yield components of maize, higher cob length (cm), test weight, and shelling percentage was observed with 1.0 IW/CPE ratio and found on a par with that of 0.8 IW/CPE ratio. Whereas, in case of kernel rows and number of kernels per cob, irrigation scheduled at 1.0 IW/ CPE found superior to that of 0.8 and 0.6 IW/CPE ratios. Similarly, kernel yield and stover yields recorded with 1.0 IW/CPE ratio were significantly higher compared to that of other irrigation treatments. The data on nutrient uptake revealed that the maximum NPK uptake at maturity was recorded with irrigation scheduled at 1.0 IW/CPE ratio which was statistically on a par with IW/CPE ratio of 0.8. Alternatively, higher values of available nutrients (N, P_2O_5 and K_2O) in soil after harvest of maize was observed with that of irrigations provided at 0.6 IW/CPE ratio (I_3) over 0.8 and 1.0 IW/CPE ratios. The maximum

consumptive use of water was recorded with irrigation scheduled at I_1, which was significantly superior to I_2 and I_3. The lowest consumptive use of water was recorded with I_3 irrigation regime (IW/CPE ratio of 0.6).The maximum moisture use efficiency was recorded with I_2**,** and found statistically on a par with I_3. The maximum moisture use rate was recorded with irrigation scheduled at 1.0 IW/CPE ratio which was significantly superior to irrigation scheduled at 0.8 IW/CPE and irrigation scheduled at 0.6 IW/CPE.

Among the nitrogen levels tested, the maximum plant height and drymatter recorded with N_3 (100% RDN through urea + 50% RDN through FYM) was found at par with that of N_2 (100% RDN through urea + 25% RDN through FYM) and both observed significantly superior to that of 100% RDN through urea at maturity. The interaction between irrigation schedules and N levels was found significant at 90 DAS, and the treatment that received application of 100 % RDN plus 50 % RDN through FYM) registered significantly taller plants with irrigations scheduled at 1.0 IW/CPE ratio (I_1N_3) over the rest of treatments.

Among the nitrogen levels tried, N_3 *i.e.* 100% RDN through urea + 50% RDN through FYM recorded the highest cob length, number of kernels cob^{-1}, test weight (g), shelling percentage which were significantly superior to that of other nitrogen levels. The highest maximum kernel rows per cob was recorded with irrigation provided at 1.0 IW/CPE along with 100% RDN through urea plus 50 % N through FYM and the lowest mean kernel rows per cob was recorded with irrigation scheduled at 0.6 IW/CPE along with 100% RDN only. Across the nitrogen levels tested, higher kernel yield was recorded with N_3 *i.e.* 100% RDN through urea + 50% RDN through FYM, which was significantly superior over N_2 (100% RDN through urea + 25% RDN through FYM) and N_1 (100% RDN). The lowest kernel yield was recorded with 100% RDN.

The highest nutrient (N, P and K) uptake was recorded with application of 100% RDN through urea + 50% RDN through FYM (N_3), which was significantly higher over 100% RDN through urea + 25% RDN through FYM (N_2 and 100% RDN through urea (N_1). However these differences were not significant between the treatment N_3 and N_2 in case of available nitrogen, phosphorus and potassium status in soil. Similarly, the maximum consumptive use of water was recorded with N_3 *i.e.* 100% RDN through urea + 50% RDN through FYM, which was significantly superior to that of other nitrogen levels. Irrigation at 1.0 IW/CPE ratio realized with higher net returns and BC ratio with application of 100 % RDN through urea (N_1), and it was followed by N_2 *i.e.* 100 % RDN + 25 % N through FYM at the same level of irrigation (I_1).

Overall, the study revealed that irrigation scheduled at 1.0 IW/CPE ratio along with application of 100% RDN through urea + 25% RDN through FYM was found better in increasing the growth, yield and water productivity of *rabi* maize with higher BC ratio.

AGRONOMY

Author	:	**HIMASREE, BANDI.**
Title of the Thesis	:	**INTERCROPPING OF PULSES IN FOXTAIL MILLET (Setaria italica L.) UNDER LATE SOWN CONDITIONS"**
Chairperson	:	**Dr. V. CHANDRIKA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5490**

ABSTRACT

A field experiment entitled **"Intercropping of pulses in foxtail millet (*Setaria italica* L.) under late sown conditions"** was carried out during late *kharif*, 2016 on sandy loam soils of Dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in a split - plot design and replicated thrice. The treatments consisted of three times of sowing *viz*., first fortnight of August (T_1), second fortnight of August (T_2) and first fortnight of September (T_3) and four intercropping systems *viz*., foxtail millet + pigeonpea (5 : 1) (C_1), foxtail millet + castor (5 : 1) (C_2), foxtail millet + black gram (3 : 3) (C_3) and foxtail millet + cowpea (3 : 3) (C_4).

Results indicated that among the three times of sowing evaluated, taller plants, higher total number of tillers hill^{-1}, leaf area index and dry matter production at all the crop growth stages of foxtail millet were recorded when the crop was sown during first fortnight of August (T_1). While, lower values of these growth parameters were registered when foxtail millet was sown during first fortnight of September (T_3).

Among the different intercropping systems tried, intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1) resulted in taller plants, higher leaf area index, number of tillers hill^{-1} and total dry matter production of foxtail millet. While all these growth parameters were at their lower value with intercropping system of foxtail millet + cowpea (3 : 3) (C_4).

The number of days taken to 50 per cent flowering and to maturity were minimum with first fortnight of September (T_3) sowing and these parameters were maximum when sowings were done during first fortnight of August (T_1). Minimum and maximum number of days to 50 per cent flowering and days to maturity of foxtail millet were registered with intercropping system of foxtail millet + cowpea (3 : 3) (C_4) and intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1), respectively.

Number of productive tillers hill^{-1} and number of panicles m^{-2} of foxtail millet at harvest was found to be higher with first fortnight of August (T_1) sown crop and lower when sowings were done during first fortnight of September (T_3). Among the intercropping systems, higher number of productive tillers hill^{-1}and number of panicles m^{-2} of foxtail millet were recorded with intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1), while the lower number were recorded with intercropping system of foxtail millet + cowpea (3 : 3) (C_4).

Maximum panicle weight, grain weight panicle^{-1} and panicle length of foxtail millet was registered with first fortnight of August sowing (T_1) which was significantly superior to the other times of sowing tried, while minimum values of these attributes were recorded when sowings were done during first fortnight of September (T_3). Higher values of these attributes of foxtail millet were recorded with intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1) and lower values were observed with intercropping system of foxtail millet + cowpea (3 : 3) (C_4).

Thousand grain weight of foxtail millet was not significantly influenced by different times of sowing and all the intercropping systems were on par with each other.

Significantly higher grain and straw yields of foxtail millet were produced with first fortnight of August sowing (T_1), while they were lower when sowings were done during first fortnight of September (C_4). Grain and straw yields of foxtail millet were significantly higher with intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1), which was comparable with intercropping system of foxtail millet + castor (5 : 1) (C_2), while lower yields were produced with intercropping system of foxtail millet + cowpea (3 : 3) (C_4).

Different times of sowing were in parity with each other in terms of harvest index of foxtail millet and intercropping systems did not show any significant influence on it.

Growth and yield attributes *viz.,* plant height, number of branches plant^{-1}, number of pods cluster^{-1}, pod length, number of spikes plant $^{-1}$, number of capsules spike^{-1}, number of seeds pod $^{-1}$, 100 seed weight, seed yield and haulm yield of different intercrops tested (pigeonpea, castor, black gram and cowpea) were at their higher values when sowing was done during first fortnight of August (T_1), while all these attributes were at their lower value with first fortnight of September (T_3) sowings.

Significantly higher gross returns, net returns and benefit-cost ratio were recorded with first fortnight of August sowings, while these values were less when sowings were done during first fortnight of September. Intercropping system of foxtail millet + pigeonpea (5 : 1) (C_1) recorded significantly higher gross and net returns and benefit-cost ratio which was comparable with intercropping system of foxtail millet + castor (5 : 1) (C_2). Intercropping system of foxtail millet + black gram (3 : 3) (C_3) recorded lower values.

Land equivalent ratio (LER), area time equivalent ratio (ATER) and foxtail millet grain equivalent yield were significantly higher with August first fortnight (T_1) sown intercropping systems, while lower with first fortnight of September (T_3) sowings. Significantly higher LER, ATER and foxtail millet grain equivalent yields were observed with intercropping system of foxtail millet + pigeonpea (5 : 1) which was comparable with intercropping system of foxtail millet + castor (5 : 1) (C_2) and lower values were registered with intercropping system of foxtail millet + black gram (3 : 3) (C_3).

In conclusion, the study has revealed that higher productivity of foxtail millet could be obtained with intercropping system of foxtail millet + pigeonpea (5 : 1) sown during first fortnight of August under late sown conditions during *kharif* season. The above system was found to be remunerative over the other systems tried in the Southern Agro-climatic zone of Andhra Pradesh.

AGRONOMY

Author	:	**JEEVANA LAKSHMI, EPPALA.**
Title of the Thesis	:	**RESPONSE OF BLACKGRAM [*VIGNA MUNGO* (L.) Hepper] TO SECONDARY NUTRIENTS AND ZINC NUTRITION**
Chairperson	:	**Dr. P.V. RAMESH BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5492**

ABSTRACT

A field experiment entitled **"Response of blackgram [*VIGNA MUNGO* (L.) Hepper] to secondary nutrients and zinc nutrition"** was carried out during *RABI*, 2016-17 on sandy loam soils of College Farm, Agricultural College, Mahanandi, Acharya N.G. Ranga Agricultural University.

The experiment was laid out in a randomized block design with eight treatments and replicated thrice. The treatments consisted of eight nutrient management practices *VIZ.,* control (T_1), RDF (20-50-0 kg N-P_2O_5-K_2O ha^{-1}) (T_2), RDF + foliar application of one per cent $CaNO_3$ (T_3), RDF + foliar application of one per cent $MgNO_3$ (T_4), RDF + foliar application of one per cent Sulphur (T_5), RDF + foliar application of one per cent each of $CaNO_3$, $MgNO_3$ and Sulphur (T_6), RDF + foliar application of $ZnSO_4$ @ 0.2 per cent (T_7), T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8). The test variety of blackgram used in the present investigation was TBG - 104.

At 30, 60 DAS and at harvest, higher stature of growth parameters *VIZ.,* plant height, leaf area index and dry matter production were recorded with T_6 + foliar application $ZnSO_4$ @ 0.2 per cent (T_8) treatment. Among the individual secondary nutrients and zinc foliar sprays, RDF + foliar application of one per cent $MgNO_3$ (T_4) treatment recorded the taller plants with maximum LAI and higher dry matter production. While RDF + foliar application of $ZnSO_4$ @ 0.2 per cent (T_7) treatment recorded non significant increase over RDF with regard to plant height, leaf area index and dry matter production at all the growth stages. Lower values of growth parameters were recorded with control (T_1) treatment.

The treatment T_6 + foliar application $ZnSO_4$ @ 0.2 per cent (T_8) achieved higher number of pods plant^{-1}, seeds pod^{-1} and 1000-seed weight among the different treatments. Regarding individual secondary nutrients and zinc foliar sprays, RDF + foliar application of one per cent $MgNO_3$ (T_4) treatment was superior with respect to number of pods plant^{-1}, seeds pod^{-1} but, RDF + foliar application of one per cent sulphur (T_5) treatment recorded higher 1000-seed weight. RDF + foliar application $ZnSO_4$ @ 0.2 per cent (T_7) was equally effective with RDF + foliar application of one per cent sulphur (T_5) treatment for number of seeds pod^{-1}. While, control (T_1) recorded lower values of yield attributes.

The treatment RDF + foliar application of one per cent each of $CaNO_3$, $MgNO_3$ and sulphur + $ZnSO_4$ @ 0.2 per cent (T_8) recorded higher seed yield, straw yield and harvest index among all the treatments tried in the experimentation. With regard to individual foliar sprays of secondary nutrients and zinc, RDF + foliar application of one per cent $MgNO_3$ (T_4) treatment was superior. RDF + foliar application of $ZnSO_4$ @ 0.2 per cent (T_7) treatment recorded non significant increase over RDF (T_2) treatment with regard to seed and straw yields.

Higher nutrient uptake (N, P, K, Ca, Mg, S and Zn) by blackgram was registered with T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8) among all the treatments tested, where as lower with application of recommended dose of fertilizers (T_1). Among the individual foliar sprays of secondary nutrients and zinc, RDF + foliar application of one per cent $MgNO_3$ (T_4) treatment recoded higher uptake of all the nutrients except calcium and sulphur.

Higher gross returns, net returns and B:C ratio were obtained with T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8) treatment between the combination sprays and with respect to individual secondary nutrients and zinc foliar sprays, RDF + foliar application of one per cent $MgNO_3$ (T_4) treatment was superior.

The treatment T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8) recorded lower soil available nitrogen and potassium. The treatment control (T_1) recorded the lower soil phosphorus status. Higher soil exchangeable calcium, magnesium and zinc were recorded with T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8) treatment after their corresponding individual foliar sprays.

From the above experimentation, it may be concluded that higher growth parameters, yield attributes, seed yield and monetary returns of blackgram would be obtained with T_6 + foliar application of $ZnSO_4$ @ 0.2 per cent (T_8) at 25 and 45 DAS in sandy loam soils during *RABI.* Foliar application of secondary nutrients and zinc is an effective approach to enhance the production potential in blackgram.

AGRONOMY

Author	:	**JYOTHI BASU, B.**
Title of the Thesis	:	**BIO-EFFICACY OF SEQUENTIAL APPLICATION OF HERBICIDES IN DIRECT SOWN RICE-GREENGRAM SEQUENCE**
Chairperson	:	**Dr. P. V. N. PRASAD**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5392**

ABSTRACT

A field experiment entitled "Bio-efficacy of sequential application of herbicides in direct sown rice-greengram sequence" was conducted for two consecutive years (2015 -16 and 2016-17) at Agricultural College Farm, Bapatla. The experimental site was uniform in topography and the soil was sandy loam in soil texture. The soil pH was slightly alkaline in reaction, low in organic carbon, low in available nitrogen and available phosphorus and medium in available potassium.

The experiment consisted of 14 treatments laid out in complete randomized block design with three replications comprising three pre-emergence herbicides, three post emergence herbicides culminating at twelve combinations of pre and post-emergence herbicides compared with weed free and weedy check.

The predominant weed flora observed in the experimental field with direct sown rice included grasses *viz.*, *Echinochloa colonum*, *Cynodon dactylon*, *Echinochloa crusgalli, Leptochloa chinensis,* and *Dactyloctenium aegypticum:* sedges *viz.*, *Cyperus rotundus*, *Cyperus difformis* and *Fimbristylis miliaceae*; broad leaved weeds *viz.*, *Eclipta alba, Ammannia baccifera, Ludwigia parviflora* and *Euphorbia hirta* during both the years of study.

The results of the investigation revealed that among the weed management practices, weed free treatment registered significantly the lowest total weed density and dry weight as compared to the weed check (T_{14}), and it was closely followed by pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener @ 500 g a.i. ha^{-1} *fb* post emergence application of azimsulfuron @ 20 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metasulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} at 45 DAS (T_9) and treatment T_{10} (pre emergence application of bensulfuron methyl @ 60 g a.i. ha^{-1} + pretilachlor with safener @ 500 g a.i. ha^{-1} *fb* post emergence application of bispyribac-sodium @ 25 g a.i. ha^{-1} at 25 DAS *fb* post emergence application of metasulfuron methyl and chlorimuron ethyl @ 4 g a.i. ha^{-1} applied at 45 DAS) at all stages of crop growth and recorded the highest weed control efficiency and lower weed index during both the years of study.

Growth parameters *viz.,* plant height, total number of tillers m^{-2}, drymatter accumulation, yield attributes *viz.,* productive tillers m^{-2}, total grains $panicle^{-1}$, filled grains $panicle^{-1}$, grain yield, straw yield and nutrient uptake of rice were significantly influenced by different weed management treatments. Across the herbicidal performance, the treatment T_{13} (weed free), registered the maximum yield over weedy check (T_{14}) closely followed by treatments T_9 and T_{10}.

Among the weed management treatments, pre emergence application of bensulfuron methyl + pretilachlor with safener *fb* post emergence application of azimsulfuron at 25 DAS *fb* post emergence application of metasulfuron methyl and chlorimuron ethyl 45 DAS (T_9) recorded the highest net returns of Rs. 42513 and Rs. 47801 and return per rupee investment of 1.12 and 1.22 during 2015-16 and 2016-17, which was closely followed by the treatment T_{10}.

AGRONOMY

Author	:	**LAKSHMI THANMAI, PONNAM.**
Title of the Thesis	:	**BIOEFFICACY OF POST-EMERGENCE HERBICIDES IN PEARLMILLET (*PENNISETUM TYPHOIDES*)**
Chairperson	:	**Dr. K. SRINIVASULU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5385**

ABSTRACT

A field experiment entitled ‘‘Bioefficacy of post-emergence herbicides in Pearlmillet (Pennisetum typhoides)’’ was conducted during kharif, 2016 on sandy soils of Agricultural College Farm, Bapatla. The experiment was laid out in a randomized block design with nine treatments comprising of T_1-Weedy check, T_2 - Hand weeding at 20 and 40 DAS, T_3 - Cyhalofop butyl @ 100 g a.i. ha^{-1} as PoE at 20DAS, T_4-Fenoxaprop ethyl+ safenor @ 63 g a.i. ha^{-1} as PoE at 20 DAS, T_5-Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} as PoE at 20 DAS, T_6-Bisphyribac sodium @ 25 g a.i. ha^{-1} as PoE at 20 DAS, T_7-Penoxsulam @ 22.5 g a.i. ha^{-1} as PoE at 20 DAS, T_8-2, 4-D @ 800 g a.i. ha^{-1} as PoE at 20 DAS, T_9-Ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 20 DAS. The treatments were replicated four times.

The predominant weed species which infested the experimental plot were Cleome viscose, Amaranthus viridis, Croton bonplandianum, Boerhavia diffusa, Ipomea pestrigridis, Portulacea oleracea, Phyllanthus niruri, Mollugo pentaphylla, Trichodesma indicum, Acalypha indica, Boreria hispida, Commelina benghalensis, Euphorbia hirta, Sesamum

rigidum, Dactyloctenium aegyptium, Echinochloa colona, Panicum repens, Cyperus rotundus, Fimbristylis milliacea.

Results of the investigation revealed that all weed management treatments were found significantly superior to weedy check in reducing the weed growth and increasing crop growth, yield attributes and yield of pearlmillet.

The lowest weed density, dry weight of weeds and highest weed control efficiency were recorded with hand weeding at 20 and 40 DAS. Among herbicidal treatments application of Penoxsulam @ 22.5 g a.i. ha^{-1} (T_7) at 20 DAS registered significantly lower weed density, weed drymatter and high weed control efficiency and this was on par with the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) and were significantly superior to other herbicide treatments.

Among the herbicides under study, application of Fenoxaprop ethyl+ safenor @ 63 g a.i. ha^{-1} (T_4) as PoE at 20 DAS caused phytotoxicity to crop, which resulted in complete crop stand loss.

The highest grain yield was obtained with hand weeding twice at 20 and 40 DAS (3393 kg ha^{-1}). Among the weed management treatments, the highest grain yield (2994 kg ha^{-1}) was observed with Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} which was on par with the application of Penoxsulam @ 22.5 g a.i. ha^{-1} (2631 kg ha^{-1}), 2, 4-D @ 800 g a.i. ha^{-1} (2387 kg ha^{-1}), Ethoxysulfuron @ 18.75 g a.i. ha^{-1} (2295 kg ha^{-1}) . Weedy check caused a yield reduction of 43 per cent over hand weeding treatment.

The present investigation indicated that all the treatments were found to be effective and comparable to hand weeding treatment (T_2) in getting higher grain yield. However, on considering economics, application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) was found to be effective and economical for managing weeds in pearlmillet as an alternative to manual weeding.

AGRONOMY

Author	:	**MAHESWARA REDDY, P.**
Title of the Thesis	:	**NURSERY AND NUTRIENT MANAGEMENT TECHNIQUES FOR MECHANIZED SYSTEM OF RICE INTENSIFICATION (MSRI)**
Chairperson	:	**Dr. G. KRISHNA REDDY**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5499**

ABSTRACT

The present study entitled "**Nursery and nutrient management techniques for Mechanized System of Rice Intensification (MSRI)**" for Southern agro climatic zone of Andhra Pradesh was conducted on clay loam soil during *rabi*, 2014-15 and 2015-16 in two stages viz., nursery management and crop management with an objective of standardizing bedding material for tray nursery technique in rice and for optimizing the nutrient requirement under Mechanized System of Rice Intensification (MSRI). Experiment on nursery management was carried out at Regional Agricultural Research Station, Tirupati campus of Acharya N.G. Ranga Agricultural University and experiment on crop management was conducted at farmer's field of Sri P. Damodar Reddy located at K.C. Peta village of Tirupati mandal of Chittoor district.

Experiment on nursery management was conducted with treatments consisting of four bedding materials (soil alone, soil : farm yard manure, soil : vermicompost and soil : pressmud cake in the ratio of 70 : 30) and five foliar applications (control, urea @ 0.5%, DAP @ 0.5%, 19-19-19 @ 0.5% and 13-00-45 @ 0.5%) tested in RBD with factorial concept, replicated thrice.

The bedding material comprised of soil with pressmud cake in 70 : 30 ratio recorded significantly better seedling shoot length, root length, dry matter production and seedling vigour index over soil with farmyard manure and soil alone as bedding materials but, comparable to soil with vermicompost at 13 and 16 DAS and the lowest seedling vigour index was recorded with soil alone as bedding material during both the years of study. Foliar sprays and their interaction with bedding materials recorded non significant differences with growth parameters (seedling shoot length, root length and dry matter production) at 13 and 16 DAS. However, better growth parameters were recorded numerically with the foliar application of urea @ 0.5% as compared to other foliar applications.

Experimental site of crop management experiment was geographically situated at an altitude of 182.9 m above mean sea level at $13^0$32'0" N latitude and 79^o24'25" E longitude in Southern agro climatic zone of Andhra Pradesh. The soil was clay loam in texture, slightly alkaline in reaction (pH 7.9 and 8.0) with normal electrical conductivity (0.92 and 1.06 dS m^{-1}), medium in organic carbon (0.51% and 0.54%), low in available nitrogen (216 and 228 kg ha^{-1}), high in available phosphorus (82 and 96 kg ha^{-1}) and potassium (438 and 516 kg ha^{-1}).

Experiment on crop management was laid out in randomized block design with factorial concept with 4 nitrogen levels (80, 120, 160 and 200 kg N ha^{-1}) and 3 phosphorus levels (40, 60 and 80 kg P2O5 ha^{-1}) replicated thrice. Nursery was raised in plastic trays filled with the best bedding material of nursery management experiment (soil and press mud cake in 70:30 ratio) and placed in raised beds. Foliar spray of urea @ 0.5% was imposed at 10 DAS and machine transplanting was done at a spacing of 30 cm × 13-15 cm using 16 days old seedlings of Nellore mahsuri (NLR-34449), with Yanmar - VP8D transplanter.

The machine transplanted rice responded positively to the higher level of nitrogen (200 kg N ha^{-1}) and produced significantly better growth parameters of plant height, root length, root dry matter $hill^{-1}$, number of productive tillers m^{-2}, leaf area m^{-2}, leaf area index and dry matter production with 200 kg N ha^{-1} which was comparable with 160 kg N ha^{-1} and significantly superior over the lower levels of nitrogen (80 and 120 kg N ha^{-1}). Lowest growth parameters were recorded with 80 kg N ha^{-1}. Levels of phosphorus and their interaction with

nitrogen had no significant influence on growth parameters. However, numerically better growth parameters were recorded with 80 kg P2O5 ha^{-1}.

Significantly more number of panicles m^{-2} and panicle length were recorded with 200 kg N ha^{-1} and was at par with 160 kg N ha^{-1} and superior over 80 and 120kg N ha^{-1}. Higher number of filled grains and minimum chaffy grains $panicle^{-1}$ and sterility percentage was with 200 kg N ha^{-1} which was at par with 160 kg N ha^{-1}. Application of 120 kg N ha^{-1} resulted in significantly lesser number of filled grains $panicle^{-1}$, higher sterility percentage as compared to 160 and 200 kg N ha^{-1} but, comparable with 80 kg N ha^{-1} . Phosphorus levels and their interaction with nitrogen had no significant influence on yield attributes during both the years.

Higher grain and straw yields were recorded with 200 kg N ha^{-1} which were comparable with 160 kg N ha^{-1} and superior over 120 and 80 kg N ha^{-1}. Significantly lowest grain and straw yield was with 80 kg N ha^{-1} during both the years. Inspite of the fact that the rice could not respond to phosphorus application and its interaction with nitrogen, due to high initial soil available phosphorus, numerically higher grain and straw yield was with 80 kg P2O5 ha^{-1} which was however comparable with 40 and 60 kg P2O5 ha^{-1}.

Application of 200 kg N ha^{-1} resulted in higher N, P and K uptake by grain and straw which was at par with 160 kg N ha^{-1} and superior over 120 and 80 kg N ha^{-1}. Uptake of NPK by grain and straw varied non significantly with phosphorus levels and their interaction with nitrogen during both the years.

Soil chemical properties *viz.,* pH, EC and OC were not significantly influenced by nitrogen and phosphorus levels and their interaction. Progressive increase in nitrogen levels increased the soil available nitrogen and decreased the soil available P and K. Soil available N was highest with 200 kg N ha^{-1}, while P and K decreased with increased N levels. Cost of cultivation, gross returns, net returns and B:C ratio were increased with increased N levels. Application of 200 kg N ha^{-1} registered maximum net returns and B : C ratio, which was comparable with 160 kg N ha^{-1} and better over lower levels of nitrogen. Levels of phosphorus and their interaction with nitrogen had no significant effect on gross returns, net returns and B : C ratio.

From the investigation, it could be concluded that application of 160 kg N ha^{-1} and 40 kg P2O5 ha^{-1} was found to be optimum for realizing higher yields and economic returns in Southern agro climatic zone of Andhra Pradesh under Mechanized System of Rice Intensification (MSRI).

AGRONOMY

Author	:	**MANIKANTA, DUDI.**
Title of the Thesis	:	**CLIMATE RESILIENT WEATHER HEALTH INDICES FOR PREDICTION OF GROWTH AND YIELD OF RICE (*ORYZA SATIVA* L.)**
Chairperson	:	**Dr.V. RADHA KRISHNA MURTHY**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5396**

ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla on sandy clay loam soils during *kharif,* 2016 to investigate on "**Climate resilient weather health indices for prediction of growth and yield of rice (*Oryza sativa* L.)**". The experiment was laid out in randomized block design with factorial concept and replicated thrice. The treatments consisted of three varieties of rice *viz.,* BPT-5204(V_1), NLR-33892(V_2) and BPT-2270(V_3) as first factor and four dates of transplanting *viz.,* 1st fortnight of August (D_1), 2nd fortnight of August (D_2), 1st fortnight of September (D_3) and 2nd fortnight of September (D_4) as second factor.

The results indicated that the growth parameters such as plant height, drymatter production, days to 50% flowering, days to maturity, yield attributes and yield were significantly influenced by dates of planting and varieties. Harvest index could not reach the level of significance with both varieties and dates of planting. Interaction between dates of planting and varieties was found to be non significant for all the plant growth parameters.

Plant height was significantly influenced by dates of planting at all stages of crop growth. Planting of rice varieties during 1st fortnight of August (D_1) recorded significantly highest plant height, maximum number of tillers m^{-2}, number of productive tillers m^{-2}, number of grains per panicle and drymatter. Among the varieties, significantly highest drymatter, and yield attributes were observed with the variety BPT-2270 as compared to other varieties i.e., BPT-5204 and NLR-33892 which were on par with each other. Among the varieties, BPT-2270 took maximum number of days for 50% flowering and maturity which was significantly superior to BPT-5204 and NLR-33892 varieties.

The highest grain yield of 5578 kg ha^{-1} was recorded with 1st fortnight of August planting (D_1). Among the varieties, the highest grain yield of 5725 kg ha^{-1} was recorded with BPT-2270, which was significantly superior to BPT-5204 and NLR-33892. The latter two varieties were on par with each other. The highest straw yield was also recorded with the variety BPT-2270 when planted on 1st fortnight of August, which was superior to BPT-5204 and NLR-33892 also transplanted on 1st fortnight of August.

Days to attain each phenological stage for varieties differed in their duration. The maximum days to attain maturity were with varieties BPT-2270 followed by NLR-33892 and BPT-5204.

Higher values of all weather health indices *viz.,* GDD, HTU, PTU, TPR, HUE, HtUE, PtUE, PTI, TD and HD were observed with 1st fortnight of August planting followed by 2nd fortnight of August planting. Among the varieties BPT-2270 recorded the optimum values of all weather health indices. These weather health indices were found to be optimum to produce highest yields.

Significant linear relationship was observed for drymatter and grain yield of all the three varieties with weather health indices *viz.,* GDD, HTU, PTU, TPR, HUE, HtUE, PtUE, and PTI. The regression equations could be applied to predict rice growth and yield using daily information on temperature, photoperiod, day length and sunshine hours during the crop season.

The highest gross returns (Rs. 112068 ha^{-1}), net returns (Rs. 76608 ha^{-1}) and B:C ratio(2.2) were obtained with variety BPT-2270 when transplanted during 1st fortnight of August.

AGRONOMY

Author	:	**MRUNALINI, KANCHETI**
Title of the Thesis	:	**IMPACT OF HARVEST – AID DEFOLIANTS IN COTTON (*Gossypium hirsutum* L.) UNDER HIGH DENSITY PLANTING**
Chairperson	:	**Dr. M. SREE REKHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5386**

ABSTRACT

A field experiment entitled “Impact of harvest – aid defoliants in cotton (*Gossypium hirsutum* L.) under high density planting” was conducted on a clay soil at Agricultural College Farm, Bapatla, during *kharif* 2016. The experiment was laid out in Randomized Block Design replicated thrice with nine treatments comprising of T□ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 150 ml ha^{-1}; T□ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha^{-1}; T□ - Etherel @ 1500 ppm; T□ - Etherel @ 2000 ppm; T□ - Urea @ 10%; T□ - Urea @ 15%; T□ - NaCl @ 15%; T_8 - NaCl @ 20%; T_9 – Control. Suraj (CCH 510-4) was the cotton variety used for the study.

Plant height was not influenced by different defoliant treatments at different growth stages of cotton and after defoliants application. At 15 days after defoliant spray, plant height recorded was numerically high (115.6 cm) with Urea @ 15% (T_6). However, in Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha^{-1} (T_2), there was reduction in plant height (103.5 cm) at 15 days after defoliant spray.

At 30, 60 and 90 DAS, drymatter accumulation did not reach level of significance. At harvest, significantly higher drymatter accumulation was recorded with Urea @ 15% (T_6). However, there was decrease in drymatter accumulation with Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha^{-1} (T_2) at harvest.

The selected cultivar for the study Suraj (CCH 510-4) had no monopodial branches. The effect of defoliant application on number of sympodial branches per plant was non-significant.

Significant increase in per cent defoliation showed a similar trend at 3, 5, 7, 9, 11, 13 and 15 days after defoliant spray. A significant increase in percent defoliation was observed with Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha^{-1} (T_2) which was higher than remaining treatments.

Application of various defoliants had no influence on number of bolls per plant, boll weight and 100-seed weight. However, Etherel @ 2000 ppm (T_4) recorded numerically higher number of bolls per plant. Maximum number of picked bolls per plant was recorded with Etherel @ 2000 ppm (T_4) which was on par with T_3, T_2, T_6, and T_1 treatments and significantly higher than others. Significantly highest boll opening percentage was recorded with Etherel @ 2000 ppm (T_4).

Highest seed cotton yield (2359 kg ha^{-1}) was obtained with Etherel @ 2000 ppm (T_4) and it was on par with all the other treatments except NaCl @ 15% (T□) (1975 kg ha^{-1}) and control (T_9- 1829 kg ha^{-1}). Maximum stalk yield was obtained with Urea @ 15% (T_6- 19031 kg ha^{-1}) which was on par with T_5, T_7, T_8 and T_9 treatments and significantly higher than remaining treatments.

Application of defoliants i.e., Dropp Ultra and Etherel at 60 BOP resulted in reduction in crop duration by 20 days and application of dessicants i.e., Urea and NaCl reduced crop duration by 5 days as compared to control.

Influence of defoliants on quality parameters was non-significant except for fibre fineness and elongation (%), which were higher in Etherel @ 2000 ppm treatment.

Degree-days unit of above 100°C day (270.7 °C day) were received during defoliation period to complete the process. The atmospheric minimum and maximum temperatures of 17.7 and 32.1°C were found conducive for inducement of defoliation process.

Higher gross returns (Rs. 1,17,967 ha^{-1}) was recorded with the application of Etherel @ 2000 ppm (T_4) mainly due to higher seed cotton yield. The net returns (Rs. 61,223 ha^{-1}) and B:C ratio (2.18) were markedly higher with Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha^{-1} (T_2) applied at 60 boll opening percentage, due to high cost of Etherel.

AGRONOMY

Author	:	**NARAYANA SWAMY, GUTTA.**
Title of the Thesis	:	**SOIL HEALTH AND PRODUCTIVITY OF GROUNDNUT AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT UNDER RAINFED ALFISOLS**
Chairperson	:	**Dr. A.V. NAGAVANI**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5500**

ABSTRACT

Present investigation entitled '**Soil health and productivity of groundnut as influenced by integrated nutrient management under rainfed *alfisols*'** was carried out for two consecutive *kharif* seasons of 2014 and 2015 at Agricultural Research Station, Ananthapuramu, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The investigation comprised of two blocks one is under rainfed condition and second is under protective irrigated situation. Experiment was laid out in randomized block design, with three replications. The treatments comprised of eleven different combinations of organic and inorganic sources of nitrogen *viz*., Control (no organics and inorganics) (T1), recommended dose of fertilizer (T2), 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3), 100 per cent nitrogen through FYM (T4), 50 per cent nitrogen through urea + 50 per cent nitrogen through leaf compost (T5), 100 per cent nitrogen through leaf compost (T6), 50 per cent nitrogen through urea + 50 per cent nitrogen through sheep manure (T7), 100 per cent nitrogen through sheep manure (T8), 100 per cent nitrogen through sheep penning (T9), 100 per cent nitrogen through enriched groundnut shells (T10) and 50 per cent nitrogen through urea + 50 per cent nitrogen through enriched groundnut shells (T11). The test variety of groundnut used in the present investigation was 'Kadiri-6'.

Different combinations of organic and inorganic sources of nitrogen exerted significant influence on the growth parameters, yield attributes, yield, economic returns, soil physical properties, moisture content of soil, microbial load and nutrient uptake of groundnut as well as post-harvest soil fertility status both under rainfed and protective irrigation conditions.

Under rainfed condition, the tallest plants with largest leaf area and highest dry matter production in groundnut were produced with the supply of 100 per cent N through sheep penning (T9) at all the stages of crop growth, which was at par with 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3) and recommended dose of fertilizer (T2), which was inturn, comparable with supply of 50 per cent nitrogen through urea + 50 per

cent nitrogen through leaf compost (T5) under protective irrigation during both the years of study. All these growth parameters were found to be at their lowest with control (T1), without nutrient application at all the stages of observation.

Different combinations of organic and inorganic sources of nitrogen failed to exert a significant influence on days to 50 per cent flowering under both farming situations. Number of branches plant^{-1} did not differ significantly due to different combinations of organic and inorganic sources of nitrogen under rainfed situation. Whereas, under protective irrigation, supply of 100 per cent nitrogen through sheep penning (T9) recorded higher number of branches plant^{-1}, which was significantly superior to rest of the nutrient management practices tried.

The highest level of yield attributes *viz.,* number of filled pods palnt^{-1}, 100 pod weight, 100 kernel weight, shelling percentage and the lowest number of ill filled pods plant^{-1} were registered with the supply of 100 per cent of N through sheep penning (T9), which was at par with 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3) and recommended dose of fertilizer (T2) under rainfed condition, which was however comparable with supply of 50 per cent nitrogen through urea + 50 per cent nitrogen through leaf compost (T5) under protective irrigation. Non-supply of nutrients in control (T1) resulted in the deflated stature of all the above said yield attributes.

Supply of 100 per cent of nitrogen through sheep penning (T9) recorded significantly higher pod and haulm yield of groundnut, which was however comparable with 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3) and recommended dose of fertilizer (T2) under rainfed situation. Whereas under protective irrigation, which was inturn comparable with supply of 50 per cent nitrogen through urea + 50 per cent nitrogen through leaf compost (T5). Control (T1) recorded the lower pod and haulm yield in groundnut in both the situations during two consecutive years of investigation.

Application of organic manure alone or in conjunction with inorganic fertilizer nitrogen failed to exert a significant influence on harvest index and quality parameters *i.e.,* oil, protein and oleic acid as well as aflatoxin content in groundnut both under rainfed and protective irrigated condition.

Under rainfed condition, the highest gross returns in groundnut were obtained with supply of 100 per cent of N through sheep penning (T9), which was at par with 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3) and recommended dose of fertilizer (T2). Under protective irrigation, the highest gross returns were recorded with supply of 100 per cent of N through sheep penning (T9), which was comparable with 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3) and the latter was inturn comparable with recommended dose of fertilizer (T2) during first year and 50 per cent nitrogen through urea + 50 per cent nitrogen through leaf compost (T5) during second year.

Under rainfed condition, supply of 100 per cent of N through sheep penning (T9) recorded higher net returns in groundnut, which was however, comparable with application of recommended dose of fertilizer (T2) and 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM (T3), which were comparable among themselves. Under protective irrigation, the highest net returns were realized with supply of 100 per cent of N through sheep penning (T9), which was at par with recommended dose of fertilizer (T2) and the latter was intun comparable with application of 50 per cent N through urea and 50 per cent nitrogen

through either FYM or leaf compost (T3 and T5) during the *kharif*, 2015. The lowest gross and net returns were registered with control (T1) during both the situations in *kharif,* 2014 and 2015.

The highest benefit-cost ratio was registered with supply of 100 per cent N through sheep penning (T9), which was however comparable with recommended dose of fertilizer (T2) under both situations except during second year under protective irrigation, where it was significantly superior over rest of the nutrient management practices tried.

Statistical disparity was not observed with respect to physical properties of soil *viz.*, bulk density and aggregate stability during the two consecutive years of study both under rainfed and protective irrigated condition. However, numerically and comparatively lower and higher values of bulk density and aggregate stability were recorded with application of 100 per cent nitrogen through FYM (T4) and 100 per cent nitrogen through sheep penning (T9). Whereas, slightly higher and lower values of bulk density and aggregate stability were observed with control (T1) respectively.

Supply of 100 per cent N through organic manures *viz.*, FYM, sheep penning, leaf compost, sheep manure, enriched groundnut shells (T4, T9, T6, T8 and T10) recorded significantly higher water holding capacity and infiltration rate over substitution of 50 per cent N through urea with the above organic manures (T3, T5, T7 and T11) and recommended dose of fertilizers (T2) both under rainfed and protective irrigated condition. The deflated stature of above said parameters were recorded with control (T1).

At all the stages of the crop growth, maximum values of moisture content in the soil was recorded with supply of 100 per cent nitrogen through FYM (T4), which was at par with application of 100 per cent nitrogen through sheep penning (T9), leaf compost (T6), sheep manure (T8) and enriched groundnut shells (T10) *i.e.,* where 100 per cent N was supplied through organics. However, it was comparable with substitution of 50 per cent nitrogen through sheep manure (T7) during the second year of investigation under both the situations. Control (T1) recorded the minimum values of moisture content in the soil.

Under rainfed and protective irrigated condition, application of either organics alone or in combination with inorganic sources of nitrogen has not shown any statistical disparity on pH and EC of the soil after harvesting of the groundnut. Post-harvest organic carbon content in the soil was comparable among the nutrient management practices except control (T1), which recorded the lowest organic carbon content.

During two consecutive years of study, supply of 100 per cent nitrogen through sheep penning (T9) recorded significantly higher number of colony forming units of bacteria, fungi and actinomycetes over rest of the nutrient management practices tried after harvesting of the groundnut, while it was recorded lowest with control plot (T1) both under rainfed and protective irrigated situations.

During two consecutive years of experimentation, at all the stages of the crop growth the highest nitrogen uptake of groundnut was registered with supply of 100 per cent nitrogen through sheep penning (T9), which was in parity with recommended dose of fertilizers (T2) under rainfed condition, which was inturn comparable with 50 per cent nitrogen through urea + 50 per cent nitrogen either through leaf compost or FYM (T3 or T5) at all the stages of crop growth except at 30 DAS, where it was on par with recommended dose of fertilizers (T2) under protective irrigation.

During two consecutive years of the study, at all the stages of crop growth, maximum phosphorus uptake of groundnut was recorded with supply of 100 per cent nitrogen through sheep penning (T9) under rainfed condition, which was significantly superior over rest of the treatments tried. Whereas under protective irrigation, it was comparable with application of either inorganic fertilizers (T2) or substitution of 50 per cent nitrogen through FYM or leaf compost (T3 or T5) at latter stages of crop growth *i.e.,* at 90 DAS and at harvest. The highest potassium uptake in groundnut was recorded with supply of 100 per cent nitrogen through sheep penning (T9). Whereas, the lowest N, P and K was associated with control (T1).

Significantly higher post-harvest soil available nitrogen status was recorded with supply of 100 per cent nitrogen through organic sources *viz.,* FYM, sheep penning, leaf compost, sheep manure and enriched groundnut shells (T4, T9, T6, T8 and T10) over rest of the nutrient management practices tried during *kharif,* 2014 and 2015 both under rainfed and protective irrigated situations. The post-harvest soil available phosphorus recorded with supply of 100 per cent nitrogen through sheep penning, leaf compost, enriched groundnut shells and sheep manure (T9 T6 T10 and T8) was comparable among themselves and significantly superior over rest of the treatments. Supply of 100 per cent nitrogen through sheep penning (T9) recorded maximum post-harvest soil available potassium, which was in parity with application of 100 per cent nitrogen either through sheep manure (T8) or enriched groundnut shells (T10). Whereas, the minimum values of post-harvest soil available nitrogen, phosphorus and potassium were registered with control (T1).

In conclusion, the present study has revealed that there is ample scope for enhancing the productivity and economic returns of groundnut as well as soil health in rainfed *alfisols* with supply of 100 per cent nitrogen through sheep penning or 50 per cent nitrogen through urea + 50 per cent nitrogen through FYM. However, sheep penning practice is proved as most promising, economically viable, environmentally safe and ecologically sustainable option for rainfed *alfisols* of Scarce Rainfall Zone of Andhra Pradesh.

AGRONOMY

Author	:	**NAZREEN, SHAIK.**
Title of the Thesis	:	**WEED MANAGEMENT IN MAIZE (*Zea mays* L.)WITH SEQUENTIAL APPLICATION OF HERBICIDES AND THEIR RESIDUAL EFFECTON SUCCEEDING GREENGRAM**
Chairperson	:	**Dr. D. SUBRAMANYAM**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5493**

ABSTRACT

A field experiment was conducted at S.V. Agricultural College Farm, Tirupati campus of Acharya N.G. Ranga Agricultural University of Andhra Pradesh, during *kharif* 2016, to identify the suitable pre-and post-emergence herbicide for broadspectrum weed control in maize and their residual effect on succeeding greengram.

The present investigation was laid out in a randomized block design with three replications. Ten weed management practices *viz.,* pre-emergence application of alachlor 1000 g ha^{-1} (W_1), post-emergence application of halosulfuron-methyl 67.5 g ha-1 (W2), post-emergence application of tembotrione 100 g ha-1 (W3), post- emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} (W_4), pre-emergence application of alachlor 1000 g ha^{-1} + post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} (W_5), pre-emergence application of alachlor 1000 g ha^{-1} + post-emergence application of tembotrione 100 g ha^{-1} (W_6), pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} (W_7), pre-emergence application of atrazine 1000 g ha^{-1} + post-emergence application of 2,4 D- sodium salt 800 g ha^{-1} (W_8), two hand weedings at 20 and 40 DAS (W_9) and unweeded control (W_{10}). The test variety of maize and greengram used in the present study was DHM-117 and WGG-42, respectively Weed flora of the experimental field belongs to nine taxonomic families was observed, of which three species were grasses, ten species were broad leaved weeds and only one species of sedge, purple nutsedge, *Cyperus rotundus* was observed in the experimental field. The predominant weed species observed in the experimental field were *Cyperus rotundus* (55%), *Digitaria sanguinalis* (12%), *Boerhavia erecta* (8%), *Borreria hispida* (6%), *Trichodesma indicum* (5%), *Phyllanthus niruri* (4%), *Digera arvensis* (3%) in unweeded check plots.

Lower density and dry weight of total weeds as well as lower nutrient uptake by weeds and higher weed control efficiency were recorded with hand weedings at 20 and 40 DAS. The next best weed management practice was pre-emergence application of alachlor 1000 g ha^{-1} + post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} in recording above said weed parameters. Post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} was found to be effective for control of purple nutsedge and tembotrione 100 g ha^{-1} was effective to control grassy and broad leaved weeds. Sequential application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} or tembotrione 100 g ha^{-1} or tank mix combination found to be effective for broadspectrum weed control in maize.

Pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS resulted in higher stature of growth parameters *viz.,* plant height, number of leaves plant^{-1}, leaf area index and dry matter production and yield componets *viz*., number of grain rows cob^{-1}, number of grains row^{-1}, numbers of grains cob^{-1} and 100-grain weight including cob girth and length. The next best weed management practice was two hand weedings at 20 and 40 DAS resulted in higher values of above said growth and yield parameters of maize. Post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} or tembotrione 100 g ha^{-1} or in combination applied at 20 DAS did not show any phytotoxicity on maize crop.

Higher grain and straw yield of maize was recorded with pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS, which were significantly higher than with two

hand weedings at 20 and 40 DAS. The former weed management practice resulted in higher harvest index and the lowest weed index, among the herbicidal treatments.

Higher nutrient uptake by crop and the lowest nutrient uptake by weeds were estimated with the sequential application of alachlor 1000 g ha^{-1} as pre-emergence *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS, among the herbicidal treatments.The major nutrients depleted by weeds in unweeded control was estimated to be 34.22, 13.67 and 16.17 kg ha^{-1} of nitrogen, phosphorus and potassium, respectively.

Higher gross and net returns were realized with pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS. However, higher benefit-cost ratio was computed with pre-emergence application of atrazine 1000 g ha^{-1} + post-emergence application of 2,4 D-sodium salt 800 g ha^{-1} applied at 20 DAS.

Pre- and post-emergence herbicides applied to maize crop did not show any residual/ inhibitory effect on succeeding greengram. Growth parametrs *viz*., root and shoot length & seedling vigour index of greengram were significantly higher with the best weed management practice *i.e*. pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS to maize.

In conclusion, the present study has revealed that pre-emergence application of alachlor 1000 g ha^{-1} *fb* post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} + tembotrione 100 g ha^{-1} applied at 20 DAS considered as best weed management practice for increasing the productivity and maximum net returns, besides effective control of mixed weed flora associated with *kharif* maize. Pre-emergence application of alachlor 1000 g ha^{-1} + post-emergence application of halosulfuron-methyl 67.5 g ha^{-1} at 20 DAS found to be effective to control purple nutsedge, *Cyperus rotundus*. The present experiment also indicated that wherever the labour availability for hand weedings is abundant and cheaper, one can go for hand weeding; or opt for the said herbicide recommendation taking into the economical considerations.

AGRONOMY

Author	:	**PRUTHVI GOUD, V.**
Title of the Thesis	:	**PERFORMANCE OF DUAL PURPOSE SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH) VARIETIES UNDER VARIED CROP GEOMETRY**
Chairperson	:	**Dr. A.V. NAGAVANI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5494**

ABSTRACT

A field experiment entitled **Performance of dual purpose sorghum (*Sorghum bicolor* (L.) Moench) varieties under varied crop geometry** was carried out during *rabi*, 2016 on sandy clay loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in a randomized block design with factorial concept and replicated thrice. The treatments consisted of four varieties *viz*., CSV-15 (V_1), CSV-20 (V_2), NTJ-2 (V_3) and M-35-1(V_4) and three crop geometry levels *viz*., 30 cm x 20 cm (C_1), 45 cm x 15 cm (C_2) and 60 cm x 10 cm (C_3).

Among the dual purpose sorghum varieties tested, the variety M-35-1 (V_4) recorded the tallest plants at all the crop growth stages which was significantly superior to other varieties tried and it was followed by CSV-15 (V_1). Significantly the short statured plants were registered with CSV-20 (V_2). Among the crop geometry practices, 60 cm x 10 cm (C_3) resulted in the highest plant height, which was however, comparable with 45 cm x 15 cm (C_2). The lowest plant height was registered with 30 cm x 20 cm (C_1). The interaction effect was found significant only at 75 DAS and at harvest, where the higher plant height was measured with M-35-1 at crop geometry at 60 cm x 10 cm (V_4C_3).

The sorghum variety M-35-1 (V_4) recorded the maximum LAI and the highest dry matter production, at all the crop growth stages and it was at par with CSV-15 (V_1), while, all of them were found to be at their lowest with the variety CSV-20 (V_2). Among the crop geometry levels, 60 cm x 10 cm (C_3) recorded the higher values of LAI and dry matter production of dual purpose sorghum and all of them were at their lowest with 30 cm x 20 cm (C_1). The interaction between varieties and crop geometry was found non-significant.

The maximum light intensity was recorded with CSV-15 (V_1) while, it was minimum with M-35-1 (V_4). Among the crop geometry levels, at 60 cm x 10 cm (C_3), the light intensity was maximum and minimum light intensity was recorded with 30 cm x 20 cm (C_1). Among the treatmental combinations, the highest light intensity was recorded with CSV-15 (V_1) planted at 60 cm x 10 cm (V_1C_3).

Days to 50 per cent flowering and maturity was observed earlier with the variety NTJ-2 (V_3) which was significantly superior to other varieties tested. Delayed flowering was observed with M-35-1 (V_4). As regards the crop geometry levels, 45 cm x 15 cm (C_2) resulted in early flowering and maturity whereas delayed flowering and maturity was observed under 60 cm x 10 cm (C_1).

All the yield attributes of sorghum viz., panicle length, grain weight panicle^{-1} and thousand grain weight were found to be the highest with the variety CSV-15 (V_1) which was at par with NTJ-2 (V_3) and all of them were at their lowest with M-35-1 (V_4). Crop geometry of 45 cm x 15 cm (C_2) resulted in the highest stature of all the yield attributes of sorghum, while they were at their lowest with 30 cm x 20 cm (C_1). Interaction effect of varieties and crop geometry was found to be significant and the higher values of yield attributes were recorded with the variety CSV-15 planted at crop geometry of 45 cm x 15 cm (V_1C_2). The lowest values were registered with M-35-1 with the crop geometry of 30 cm x 20 cm (V_4C_1).

Among the varieties tested, CSV-15 (V_1) recorded the highest grain yield, which was comparable with NTJ-2 (V_3). The lowest grain yield was produced with M-35-1(V_4). At the crop geometry of 45 cm x 15 cm (C_2) sorghum produced the highest grain yield, while they

were at their lowest with 30 cm x 20 cm (C_1). Regarding the interaction, the combination of CSV-15 planted at 45 cm x 15 cm (V_1C_2) produced the highest grain yield.

Fodder yield was the highest with the variety M-35-1 (V_4), which was at par with CSV-15 (V_1). The crop geometry 60 cm x 10 cm (C_3) resulted in the highest fodder yield while they were at their lowest with 30 cm x 20 cm (C_1). The interaction effect was significant and the highest fodder yield was recorded with the combination of M-35-1 (V_4) planted at 60 cm x 10 cm (V_4C_3).

The highest crude protein content was registered with the variety CSV- (V_1) which was comparable with NTJ-2 (V_2). It was lowest with the variety M-35-1 (V_4). The crude protein content of dual purpose sorghum was not influenced by varied crop geometry. However, higher crude protein was obtained with the crop geometry of 45 cm x 15 cm (C_2), while it was lowest with 30 cm x 20 cm (C_1).

The crude fibre content was the highest with M-35-1 (V_4), while it was the lowest with CSV-15 (V_1). Varied crop geometry levels failed to exert significant influence on the crude fibre content of dual purpose of sorghum.

The highest gross returns, net returns and benefit-cost ratio were realized with CSV-15 (V_1), while they were found to be at their lowest with M-35-1 (V_4). Significantly higher values of gross returns, net returns and benefit-cost ratio were obtained with the crop geometry of 45 cm x 15 cm (C_2). The lowest economic returns were recorded with 30 cm x 20 cm (C_1).

In conclusion, the study revealed that among the different dual purpose sorghum varieties tried, the variety CSV-15 (V_1) at the crop geometry of 45 cm x 15 cm (C_2) registered the highest yield attributes, yield and improved quality parameters. The variety M-35-1 (V_4) eventhough produced the highest growth parameters and fodder yield, the qualitative characters are at their lowest.

Hence, the variety CSV-15 at crop geometry of 45 cm x 15 cm was the best combination for obtaining maximum grain yield and qualitative fodder yield of sorghum.

AGRONOMY

Author	:	**RAJITHA, GOVINDANNAGARI**
Title of the Thesis	:	***IN-SITU* MOISTURE CONSERVATION PRACTICES FOR RAINFED GROUNDNUT**
Chairperson	:	**Sri A. MUNEENDRA BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5491**

ABSTRACT

A field experiment entitled " *In-situ* moisture conservation practices for rainfed groundnut" was carried out during *kharif*, 2016 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in randomized block design with three replications. There were eight treatments *viz*., Conventional tillage (T_1), Vertical tillage with subsoiler upto a depth of 60 cm at an interval of 1.0 m followed by secondary tillage (T_2), Deep ploughing with mouldboard plough upto a depth of 40 cm followed by secondary tillage (T_3), Conservation furrow after every row (T_4), Conservation furrow after every four rows (T_5), Broad bed and furrows (90/30 cm) (T_6), Straw mulch @ 5 tonnes ha^{-1} (T_7) and Soil mulch (frequent intercultivation) (T_8). The test variety of groundnut was 'Dharani'.

Various moisture conservation practices significantly influenced the growth parameters, yield attributes, yield, root growth, economic returns and as well as pre and post-harvest physico-chemical properties of the soil.

The lowest pre and post-harvest soil bulk density was recorded with broad bed and furrows (T_6), which was on par with vertical tillage (T_2) and significantly superior to rest of the treatments. The highest bulk density was recorded with conventional tillage (T_1).

Vertical tillage (T_2) maintained higher soil moisture content at 0 - 30 and 30 - 60 cm soil depths at all the crop growth stages followed by deep ploughing (T_3). Broad bed and furrows (T_6) also shown higher moisture content which was on par with straw mulch (T_7) and significantly superior to conservation furrow after every row (T_4), conservation furrow after every four rows (T_5) and soil mulch (T_8). Conventional tillage (T_1) recorded the least soil moisture content as compared to rest of the treatments.

Plant height, leaf area index, dry matter production and relative water content were highest with broad bed and furrows (T_6) and vertical tillage (T_2) which was closely followed by deep ploughing (T_3). On comparision of different moisture conservation practices, it was observed that all the growth and yield attributes were maximum with broad bed and furrows (T_6). All these parameters were lowest with conventional tillage (T_1).

The results indicated that among different moisture conservation practices, the minimum and maximum number of days to 50 per cent flowering and maturity was registered with broad bed and furrows (T_6) and conventional tillage (T_1), respectively. Days to maturity was minimum with broad bed and furrows (T_6) and this parameter was maximum with conventional tillage (T_1).

Broad bed and furrows (T_6) resulted in higher number of pegs and pods $plant^{-1}$ which was however on par with vertical tillage (T_2) but significantly more than that under deep tillage (T_3) and straw mulch (T_7), while conventional tillage (T_1) recorded the lowest number of pegs and pods $plant^{-1}$.

Broad bed and furrows (T_6) recorded the highest values of number of filled pods $plant^{-1}$, hundred pod weight, hundred kernel weight and shelling percentage, which was however on par with vertical tillage (T_2) and was significantly superior to deep ploughing (T_3) and straw mulch (T_7). The lowest values of these yield attributes were produced with conventional tillage (T_1).

Maximum root length and root dry weight were registered with broad bed and furrows followed by vertical tillage (T_2) and deep ploughing (T_3). Root growth was minimum with conventional tillage (T_1).

Broad bed and furrows (T_6) recorded the highest pod yield, haulm yield and harvest index which was comparable with vertical tillage (T_2) and significantly superior to rest of the treatments. Lowest yields and harvest index was recorded with conventional tillage (T_1).

Significant differences could not be noticed among the moisture conservation practices with regard to protein and oil content.

Moisture conservation practices had significantly influenced the gross returns, net returns and benefit cost ratio. The highest gross returns, net returns and benefit cost ratio were realized with broad bed and furrows (T_6), while they were found to be the lowest with conventional tillage (T_1).

In conclusion, the investigation revealed that among the various moisture conservation practices, broad bed and furrows was proved to be the promising *in-situ* moisture conservation practice for higher yield and economics of groundnut along with maintenance of soil physico-chemical properties under rainfed conditions in the present domain of study.

AGRONOMY

Author	:	**RAMESH, G.**
Title of the Thesis	:	**EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND PRODUCTIVITY OF FOXTAIL MILLET-CHICKPEA SEQUENCE**
Chairperson	:	**Dr. Ch. PULLA RAO**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5394**

ABSTRACT

A field experiment entitled "**Effect of integrated nutrient management on growth and productivity of foxtail millet-chickpea sequence"** was conducted for two consecutive years (2014-15 and 2015-16) on clay soil at Obbannavaripalem, Nagauppalapadu Mandal, Prakasam district, Andhra Pradesh with an objective to find out the influence of integrated nutrient management practices in *kharif* foxtail millet and nitrogen levels and boron application on the performance of chickpea crop. The experiment was laid out in Randomized complete Block Design and replicated four times. The treatments consisted of five integrated nutrient management, *viz*., control (T_1), 100 % RDN (T_2),100% RDN + FYM @ 5 t ha^{-1}(T_3),

125 % RDN (T_4) and 125% RDN + FYM @ 5 t ha^{-1} (T_5) as main plot treatments during the *kharif* season.

Three nitrogen levels with and without combination of boron viz., control (B_1), 50 % RDN (B_2), 100 % RDN (B_3), Control + boron @ 2.5kg ha^{-1} (B_4), 50% RDN + boron @ 2.5kg ha^{-1} (B_5) and 100% RDN + boron @ 2.5kg ha^{-1} (B_6) as sub plot treatments allocated to chickpea during *rabi* season. Therefore, each *kharif* main treatment was divided into 6 sub treatments during *rabi* season. During two years of the study, Sreelakshmi variety of foxtail millet and JG-11 of chickpea variety were raised during *kharif* and *rabi* respectively.

All growth parameters of foxtail millet *viz*., plant height, drymatter accumulation and No. of tillers per m^{-2} were influenced by integrated nutrient management practices to foxtail millet. The integrated nutrient management practice *i.e.,* 125% RDN + FYM @ 5 t ha^{-1} registered maximum plant height, drymatter accumulation, No. of tillers per m^{-2} and it was on par with 125% RDN (T_5). Similarly. yield attributes like length of the ear head, No. of filled grains per ear head, weight of the ear head and test weight were significantly higher with the 125% RDN + FYM @ 5 t ha^{-1} over control, 100 % RDN and 100% RDN + FYM @ 5 t ha^{-1} but it was on par with the 125 % RDN in both the years of study. Similarly, higher seed and stover yields and N uptake of foxtail millet were recorded with 125% RDN + FYM @ 5 t ha^{-1}. The highest seed yield of 2701 and 2708 kg ha^{-1} was recorded with 125% RDN + FYM @ 5 t ha^{-1} but it was on par with the 125 % RDN in both the years of study respectively, but significantly superior to control, 100% RDN and 100 % RDN + FYM @ 5 t ha^{-1} in both the years. The same trend was observed in straw yield also but 125 % RDN was comparable with 100 % RDN + FYM @ 5 t ha^{-1}. Total uptake by foxtail millet was the highest with 125% RDN + FYM @ 5 t ha^{-1} in both years of the study.

The growth parameters of succeeding *rabi* chickpea like plant height, drymatter production were significantly influenced by the preceding integrated nutrient management practices to foxtail millet and combination of N levels with and without boron application applied to chickpea. 125 % RDN + FYM @ 5 t ha^{-1} to preceding foxtail millet and 100 % RDN + boron @ 2.5 kg ha^{-1} to succeeding chickpea resulted in maxium plant height and drymatter accumulation at maturity in both years of the study.

Similarly, number branches per plant and yield attributes like number pods per plant and test weight were significantly higher when 125 % RDN + FYM @ 5 t ha^{-1} was applied to *kharif* foxtail millet and combination of N applied at 100 % RDN + boron @ 2.5 kg ha^{-1} to succeeding chickpea in both years. Higher seed and haulm yields, economic return, and nutrient uptake of succeeding chickpea were recorded when 125 % RDN + FYM @ 5 t ha^{-1} was applied to preceding foxtail millet and N applied at 100 % RDN + boron @ 2.5 kg ha^{-1} to succeeding chickpea. Application of boron @ 2.5 kg ha^{-1} in combination 100 % RDN recorded higher seed and haulm yield as compared to without boron application to succeeding chickpea. Higher net returns was observed 125 % RDN + FYM @ 5 t ha^{-1} to preceding *kharif* crop and 100 % RDN + boron @ 2.5 kg ha^{-1} to succeeding *rabi* chickpea.

Nutrient uptake of chickpea was significantly high when it is preceded by 125 % RDN + FYM @ 5 t ha^{-1} to foxtail millet and 100 % RDN + boron @ 2.5 kg ha^{-1}. The soil available N, P, K after harvest of foxtail millet was the maximum in 125 % RDN + FYM @ 5 t ha^{-1} to foxtail millet and 100 % RDN + boron @ 2.5 kg ha^{-1}. The soil bulk density of the soil decreased considerably with application of FYM @ 5 t ha^{-1} along with 125 % RDN to *kharif* crop.

From the investigation of foxtail millet and chickpea sequence conducted for two consecutive years with different integrated nutrient management practices, it clearly indicated that foxtail millet-chickpea sequence is profitable when 125 % RDN + FYM @ 5 t ha^{-1} to foxtail millet followed by chickpea sown at 100 % RDN + boron @ 2.5 kg ha with B: C ratio of 2.4 under Krishna agro climatic conditions of Andhra Pradesh.

AGRONOMY

Author	:	**RAVI, U.**
Title of the Thesis	:	**STANDARDIZATION OF SOWING WINDOW AND PHOSPHORUS REQUIREMENT FOR *kharif* MAIZE (*Zea mays* L.) IN VERTISOLS**
Chairperson	:	**Dr. P. MUNIRATHNAM**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5495**

ABSTRACT

A field experiment entitled **"STANDARDIZATION OF SOWING WINDOW AND PHOSPHORUS REQUIREMENT FOR *kharif* MAIZE (*Zea mays* L.) IN VERTISOLS"** was carried out during *kharif*, 2016 in black cotton soils of RARS, Nandyal, Acharya N.G. Ranga Agricultural University. The experiment was laid out in a split plot design with three replications. The treatments consisted of four dates of sowing *viz.,* I FN of July, II FN of July, I FN of August and II FN of August and three phosphorus levels *viz.,* 75, 100 and 125% recommended dose of phosphorus. (*i.e.* 100% RDP 60 kg P_2O_5 ha^{-1})

The results indicated that among four sowing dates, the taller plants were produced by the crop sown during II FN of July followed by I FN of August. However, the shorter plants were produced with I FN of July. Higher leaf area index and dry matter production were recorded with the II FN of July. The next best time for higher leaf area index and dry matter production was recorded with crop sown during I FN of August which was on par with II FN of August. The lower values for these growth parameters were registered with I FN of July.

Among the phosphorus levels tried, application of 75% recommended dose of phosphorus resulted into higher plant height, leaf area index, and dry matter production, while all these growth parameters were comparable with 100 and 125% recommended dose of phosphorus.

Number of cobs $plant^{-1}$ was found to be significant with sowing dates. Among the sowing dates II FN of July recorded higher number of cobs $plant^{-1}$, however it was on par

with I FN of August. The lower number of cobs plant^{-1} was recorded with I FN of July. Whereas phosphorus level did not influence the number of cobs plant^{-1}.

The crop sown during II FN of July recorded the higher number of kernels cob^{-1} and test weight which was statistically superior over other sowing dates. The next best time for sowing of maize was I FN of August which was however at par with II FN of August. The lower values of these yield attributes were recorded with I FN of July. Phosphorus levels did not influence the number of kernel cob^{-1} and test weight of maize. However, 75% recommended dose of phosphorus recorded higher number of kernel cob^{-1} and test weight than 100 and 125% recommended dose of phosphorus.

The higher kernel and stover yields were produced by the crop sown during II FN of July. The next best time for kernel and stover yield for maize was I FN of August which was on par with II FN of August. The minimum values for these parameters were recorded with crop sown during I FN of July. Application of different levels of phosphorus did not significant influence on kernel and stover yields of maize. However, 75% recommended dose of phosphorus recorded higher kernel and stover yield as compared to 100% and 125% recommended dose of phosphorus.

The harvest index higher with crop sown during II FN of July and I FN of August which were at par with II FN of August. The lower harvest index was recorded with crop during I FN July. Phosphorus levels did not influence the harvest index of maize.

Nitrogen, phosphorus and potassium uptake was higher with the crop sown during II FN of July. The lower nutrient uptake was recorded with crop sown during I FN of July. Phosphorus levels did not affect nutrient uptake.

The higher values of post-harvest status of soil available nitrogen, phosphorus and potassium were recorded with the crop sown during I FN of July. The lower nutrient content in the soil was recorded with crop sown during II FN of July. Different phosphorus levels did not influence the nitrogen and potassium content in the soil, but higher soil available phosphorus was recorded with application of 125% recommended dose of phosphorus.

The higher gross returns, net returns and benefit cost ratio were realized with the crop sown during II FN of July, while they were found to be the lower with I FN of July. Significantly higher values of net returns and benefit cost ratio were obtained with the application of 75% recommended dose of phosphorus which was significantly superior to 125% recommended dose of phosphorus. The lower net returns and benefit cost ratio were recorded with 125% recommended dose of phosphorus.

In conclusion, the study has revealed that maximum productivity of maize could be obtained with crop sown during II FN of July with application of 75% recommended dose of phosphorus in vertisols (45 kg P_20_5 ha^{-1}).

AGRONOMY

Author	:	**RAZIA, SHAIK.**
Title of the Thesis	:	**HERBICIDAL EFFICACY OF CERTAIN HERBICIDES AND INFLUENCE ON SOIL MICROFLORA IN *RABI* BLACKGRAM (*VIGNA MUNGO* L.)**
Chairperson	:	**Dr. B.PRAMILA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5391**

ABSTRACT

A field experiment entitled **"Herbicidal efficacy of certainherbicides and influence on soil microflora in *rabi* blackgram (*Vigna mungo* L.)"** was conducted at Regional Agricultural Research station, Lam, on clay soils during *rabi,* 2016. The experiment was laid out in RBD with three replications and thetreatments consisted of ten different weed management practices viz., T_1 - Pendimethalin @ 0.75 kg ha^{-1} (PE) *fb* one intercultivation at 20 DAS*fb* hand weeding at 30 DAS, T_2 – Pendimethalin @ 0.75 kg ha^{-1}(PE) *fb* Quizalofop ethyl @ 50 g ha^{-1} (PoE) at 20 DAS, T_3-Pendimethalin @ 0.75 kg ha (PE) *fb* Imazethapyr @50 g ha^{-1} (PoE) at 20 DAS, T_4 -Pendimethalin @ 0.75 kg ha^{-1} (P E) *fb* Acifluorfen +ClodinafopPropargyl @ 124+60 g ha^{-1}(PoE) at 20DAS, T_5 - Alachlor @1.0kg ha^{-1} (PE) fb one intercultivation 20 DAS *fb* hand weeding at 30 DAS), T_6 - Alachlor @ 1.0 kg ha^{-1} (P E) *fb* Quizalofop ethyl 50 g ha^{-1} (PoE) at 20 DAS, T_7 - Alachlor @ 1.0 kg ha^{-1} (P E) *fb* Imazethapyr @ 50 g ha^{-1} (PoE) at 20 DAS, T_8 - Alachlor @ 1.0 kg ha^{-1} (PE) *fb* Acifluorfen + ClodinafopPropargyl @ 124+60 g ha^{-1} (PoE) at 20 DAS, T_9- Hand weeding twice (20 and 40 DAS), T_{10} - Unweeded check.

The important weed flora observed in the experimental field consisted of Abutilon indicum, Acalyphaindica, Commelinabenghalensis, Celosia argentia, Chorchorustrilocularis, Digeraarvensis, Cleome viscose, Physalis minima, Portulaca quadrifida,Phyllanthus madaraspatanense, Trianthema portulacastrum, Echinocloacolonum, Dactyloctenium aegyptium, Dinerba retroflex and Cyperus rotundus.

All the weed management treatments recorded significantly lower density of weeds when compared to weedy check. The lowest weed density, weed dry matter and high WCE was observed with pre emergence application of either pendimethalin @ 0.75 kg ha^{-1} or alachlor @ 1.0 kg ha^{-1} followed by one intercultivation at 20 DAS and hand weeding at 30 DAS (T_1 and T_5) than sequential application of herbicides. Among post emergence herbicides the treatments receiving imazethapyr @ 50 g ha^{-1} recorded the significantly lowest weed density and weed dry matter followed by pendimethalin @ 0.75 kg ha^{-1} (P E) *fb* acifluorfen + clodinafop propargyl @ 124+60 g ha^{-1} (PoE) at 20 DAS (T_4) at harvest stage.

The germination, growth and dry matter production of blackgram was not affected by application of any of the herbicides and recorded zero values of phytotoxicity score after 14 DAA. Optimum plant height was recorded at harvest with treatments receiving pre emergence followed by either post herbicide or intercultivation or hand weeding. Plants were lean and lanky in weedy check with less crop dry matter production at all the stages of crop growth and also with treatments receiving post emergence application of quizalofop ethyl @ 50 g ha^{-1} due to higher weed competition.The higher plant dry matter accumulation was recorded with pendimethalin @ 0.75 kg ha^{-1} *fb* intercultivation at 20 DAS and hand weeding at 30 DAS(T_1).

The yield attributing characters viz., number of pods $plant^{-1}$, seeds pod^{-1}, 100 seed weight and harvest index were significantly influenced by weed management treatments.The highest values were obtained with $T_1$and T_5 receiving pre emergence herbicide *fb* intercultivation at 20 DAS and hand weeding at 30 DAS. Maximum seed and haulm yield were obtained with $T_1$and T_5 and followed by T_3,T_4,T_7,T_9which were on par with each other.

No marked change in the soil nutrition status was observed after crop harvest and Nitrogen, phosphorus and potassium status of soil after harvest remained low, medium and high respectively as observed in the initial status. The reduction in the soil microbial population was high at 20 days stage with pre emergence application of pendimethalin @ 0.75 kg ha^{-1} when compared to pre emergence application of alachlor @ 1.0 kg ha^{-1}. Intercultivation and hand weeding increased the soil microbial population significantly when compared with sequential application of herbicides. Application of post emergence herbicides did not show any detrimental effect on soil microflora at harvest stage.

The maximum benefit cost ratio was obtained with pre emergence application of pendimethalin @ 0.75 kg ha^{-1} *fb* imazethapyr @ 50 g ha^{-1} at 20 DAS which was closely followed by pendimethalin @ 0.75 kg ha^{-1} fb post emergence application of acifluorfen + clodinafop propargyl @ 124+ 60 g ha^{-1}.

AGRONOMY

Author	:	**SEKHAR, D.**
Title of the Thesis	:	**INTEGRATED NITROGEN MANAGEMENT IN RICE-BASED CROPPING SYSTEMS OF HIGH ALTITUDE TRIBAL REGION OF ANDHRA PRADESH**
Chairperson	:	**Dr. P. V. N. PRASAD**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5395**

ABSTRACT

A field experiment entitled **"Integrated nitrogen management in rice-based cropping systems of high altitude tribal region of Andhra Pradesh"** was carried out for two consecutive years (2014-15 and 2015-16) in sandy clay loam soils of Regional Agricultural Research Station, Chintapalli of Acharya N.G Ranga Agricultural University, Visakhapatnam district, Andhra Pradesh. In this investigation, rice was raised during *kharif* followed by three succeeding crops *viz.*, wheat, rajmash and mustard in *rabi* season**.** The first season (*kharif*) experiment was laid out in randomized block design replicated thrice comprising seven nitrogen management practices to rice *viz.*, T_1) FN_{100}; T_2) FN_{125}; T_3) FN_{150}; T_4) FN_{100}+FYM_{25}; T_5) FN_{125}+FYM_{25}; T_6) FN_{100}+BGA and T_7) FN_{100}+GM. Each of the treatment plot of *kharif* was subdivided into six plots during *rabi* to accommodate three crops *viz.,* wheat, rajmash and mustard crops with two fertilizer schedules (50% RDF and 100% RDF). The N management practices to *kharif* rice were considered as main plots and six plots covered by three crops with two fertilizers schedules as sub plots and the data analysed in split plot design. The residual effect of N management practices imposed to rice were studied on succeeding wheat, rajmash and mustard crops with 50% and 100% fertilizer schedules. The cultivars tested for rice, wheat, rajmash and mustard were MTU-1075(Pushyami), Sagarika, CTPL Red and varun, respectively.

The influence of integrated N management practices exhibited significant influence on all the growth characters of *viz.*, plant height, total number tillers m^{-2} and drymatter accumulation and yield attributes of rice like number of panicles m^{-2}, number of grains panicle^{-1} and filled grains panicle^{-1} with similar trend in both the years of study. Combination of FN_{100} + GM produced taller plants, more number of tillers, maximum drymatter at all the growth stages and more number of panicles m^{-2}, highest number of grains and filled grains panicle^{-1}, but were comparable with other combinations that those received FN_{100} + FYM_{25} (T_4) and FN_{125} + FYM_{25} (T_5), but significantly superior to FN_{100} + BGA (T_6). The treatments FN_{125} (T_2) and FN_{150} (T_3) did not differ each other but were significantly inferior to T_4, T_5 and T_6. Supply of 100% RDN through fertilizer (FN_{100}) resulted in the lowest stature of growth and yield attributes during both the years of study. Different N management practices did not influence the grain weight of rice during both the years of study.

Combined supply of 100% recommended dose of nitrogen and green manure *in- situ* produced the highest grain and straw yields of rice and it is on par with other sources of combinations, but exhibited significant superiority over the 125% and 150% RDN through fertilizer alone. Application of 100% recommended dose of nitrogen through fertilizer recorded the lowest grain and straw yields during both the years of study. Harvest index of rice did not altered to a noticeable extent due to different N management practices during both the years of experimentation.

Nitrogen management with different sources and combinations has altered both the agronomic efficiency and apparent recovery of N by rice, but did not alter the physiological efficiency to a noticeable extent during both the years of study. The highest value of agronomic efficiency and apparent recovery of N by rice was noticed with FN_{100} + GM combination. The lowest value of agronomic efficiency and apparent recovery of nitrogen were recorded with 100% RDN supply through fertilizer.

Conjunctive use of 100% RDN through fertilizer and green manure recorded the highest values of N uptake and post harvest available nitrogen, available phosphorus and

available potassium status of soil. The lowest values were associated with the supply of 100% RDN through fertilizer (FN_{100}) during both the years of study. Combined use of FN_{100} + GM has recorded the highest gross returns, net returns and benefit cost ratio during both the years of study.

Drymatter production as well as economic yield of *rabi* crops were significantly influenced by the residual effect of integrated N management practices to *kharif* rice in both the years of study. The residual effect of N supplied to *kharif* rice through FN_{100}+GM resulted in the highest drymatter production and rajmash equivalent yields of *rabi* crops. Among the three crops, wheat produced the highest biological as well as economic yield, followed by rajmash and mustard crops, which manifested significant disparity among them. As regards the interaction effect, the highest economic yield was produced by wheat under the residual effect of FN_{100} + GM applied to rice, while the lowest productivity was associated with mustard with 100% RDN supply through fertilizer to *kharif* rice during first year of study. Nitrogen uptake by *rabi* crops under the residual influence of N management practices to *kharif* rice, followed the similar trend as that of yield.

The residual effect of different N management practices to *kharif* rice significantly influenced the post harvest soil available nitrogen, phosphorus and potassium after *rabi* crops during both the years of study. The highest soil available nitrogen, phosphorus and potassium after *rabi* crops were registered with the residual effect of N supplied to *kharif* rice through FN_{100} + GM during both the years of study.

Among the three *rabi* crops rajmash left the soil fertility status at higher level than mustard and wheat, which in turn maintained clear disparity between them.

The residual effect of nitrogen supplied to *kharif* rice through conjunctive use of FN_{100} + GM recorded the highest gross returns, net returns and BCR, which were statistically on a par with other sources of combinations, but significantly superior to 100% RDN supply through fertilizer, which has resulted in the lowest economics during both the years of study.

Rice-rajmash and rice-mustard cropping systems registered the highest gross return, net return and BCR during 2014-15 and 2015-16 years of study, respectively, while rice-wheat cropping system realized the lowest gross return, net return and least BCR during both the years of study.

The highest rice grain equivalent yield of *rabi* crops was recorded with the residual effect of N supplied to *kharif* rice through FN_{100} + GM which was however, comparable with that of combination of organic and inorganic source of N supply through FN_{100} + FYM N_{25} and FN_{125} + FYM N_{25}, but significantly superior to those which received FN_{100} + BGA.

The *rabi* crops differed among themselves in RGEY during both the years of study. Wheat crop has produced the lowest quantity of RGEY, which was significantly inferior to rajmash as well as mustard and the latter two crops were comparable with each other in both the years.

From the two years study on integrated nitrogen management in rice-based cropping systems of high altitude region of Andhra Pradesh, it is indicated that supply 100% recommended dose of nitrogen through fertilizer and green manure *in-situ* to *kharif* rice has extended its residual effect on succeeding *rabi* crops in the rice-based cropping system.

Among the cropping systems studied, rice-rajmash system was found to be more productive and remunerative cropping system.

AGRONOMY

Author	:	**SRIKANTH REDDY, B.**
Title of the Thesis	:	**RESPONSE OF CERTAIN NEW VARIETIES OF CHICKPEA *(CICER ARIETINUM L.)* TO PHOSPHORUS FERTILIZATION**
Chairperson	:	**Dr. S.B.S. NARASIMHA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5393**

ABSTRACT

A field experiment entitled **"Response of certain new varieties of chickpea (*Cicer arietinum L.)* to phosphorus fertilization"** was conducted at Agricultural College Farm, Bapatla during *rabi* season of 2016-17 with an objective to find out the suitable variety of chickpea for Krishna Agro Climatic Zone of Andhra Pradesh and to work out optimum and economic level of phosphorus. The twelve treatments consisted of three varieties (NBeG 47, NBeG 49 and NBeG 3) and four levels of phosphorus (0, 25, 50 and 75 kg P_2O_5 ha^{-1}) laid out in randomized block design with factorial concept and replicated thrice.

Results of the investigation revealed that both varieties and phosphorus levels significantly influenced both growth and yield attributing characters. Significant increase in all the growth parameters except plant height were recorded with variety V_2 (NBeG 49) at 50 kg P_2O_5 ha^{-1} which was found to be statistically at par with 75 kg P_2O_5 ha^{-1} at all the three stages of crop growth. However, due to erect growing habit of variety V_1 (NBeG 47) it resulted in significantly highest plant height compared to V_2 (NBeG 49) and V_3 (NBeG 3). However, maximum values for both growth and yield parameters were obtained with 75 kg P_2O_5 ha^{-1} and there was no marked improvement due to 75 kg P_2O_5 ha^{-1} at any stage in any one of the three varieties over 50 kg P_2O_5 ha^{-1} level.

Among the growth parameters, days to 50% flowering and maturity were not significantly influenced by varieties. However, better phosphorous nutrition favoured the early flowering and maturity.

Number of pods per plant, seed yield, haulm yield and harvest index were also significantly increased with the application upto 50 kg P_2O_5 ha^{-1} which was at par with the 75 kg P_2O_5 ha^{-1} and both were significantly superior to control (0 kg P_2O_5 ha^{-1}) and 25 kg P_2O_5

ha^{-1}. However, application of 75 kg P_2O_5 ha^{-1} did not bring significant improvement over 50 kg P_2O_5 ha^{-1}. Maximum test weight (30.24 g) was recorded by the variety V_2 (NBeG 49) and it was found significantly superior to V_3 (NBeG 3). The varieties, V_1 (NBeG 47) and V_3 (NBeG 3) were at par with each other. However, the test weight was not significantly influenced by phosphorus levels. Both varieties and phosphorus levels did not reach to the level of significance in respect of number of seeds per pod.

Significant enhancement in phosphorus uptake at all growth stages and at harvest by seed and haulm were recorded with variety V_2 (NBeG 49) at 50 kg P_2O_5 ha^{-1} which was statistically on par with 75 kg P_2O_5 ha^{-1} and proved significantly superior to control and 25 kg P_2O_5 ha^{-1}.

The available soil phosphorus after the crop harvest and uptake of phosphorus by the plant were significantly higher in NBeG 49 variety as compared to the variety NBeG 3 at 30 DAS, 60 DAS and at harvest (seed and haulm) with the application of 50 kg P_2O_5 ha^{-1} which was on par with 75 kg P_2O_5 ha^{-1}. Significant depletion of N and K availability in soil over initial status was observed with application of 50 kg P_2O_5 ha^{-1} which remained statistically at par with 75 kg P_2O_5 ha^{-1} and both were significantly superior to control and 25 kg P_2O_5 ha^{-1}.

The highest gross returns, net returns and returns per rupee investment were recorded by NBeG 49 variety with the application of 50 kg P_2O_5 ha^{-1}. Based on the results of this experimental trial, owing to good growth, higher yield, nutrient uptake and economic returns were maximum with NBeG 49 variety with the application of 50 kg P_2O_5 ha^{-1} and proved as the best variety in Krishna Agro Climatic Zone of Andhra Pradesh.

It can be concluded that application of 50 kg P_2O_5 ha^{-1} with NBeG 49 variety was best for Krishna Agro Climatic Zone of Andhra Pradesh compared to higher level of phosphorous and other varieties tested.

AGRONOMY

Author	:	**SRI SAI SIDDARTHA NAIK, B.**
Title of the Thesis	:	**PERFORMANCE OF SORGHUM HYBRIDS UNDER DIFFERENT NITROGEN LEVELS IN RICE-FALLOW CONDITIONS OF NORTH COASTAL A.P.**
Chairperson	:	**Dr. K.V. RAMANA MURTHY**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, NAIRA**
Accession Number	:	**D5547**

ABSTRACT

A field experiment entitled **"Performance of Sorghum hybrids under different nitrogen levels in rice-fallow conditions of North coastal A.P."** was conducted at Agricultural College Farm, Naira in a sandy loam soil during *rabi* 2016-17 to identify the suitable hybrid(s) and optimum dose of nitrogen for higher growth and yield and economics of sorghum under rice-fallows of this zone. The treatments comprised combination of four sorghum hybrids *viz.,* V_1- CSH 15R, V_2- CSH 16, V_3- CSH 25 and V_4- MLSH 296 and four nitrogen levels *viz.,* N_1- 0 kg N ha^{-1}, N_2-80 kg N ha^{-1}, N_3- 100 kg N ha^{-1} and N_4-120 kg N ha^{-1} laid out in Split plot design with three replications.

The results of the trial revealed that growth parameters (plant height and dry matter production) pertaining to CSH 25 (V_3) were the highest while the lowest growth of rice fallow sorghum were recorded with MLSH 296 (V_4). At all stages of observation, growth parameters obtained were highest with N_4 (120 kg ha^{-1}) followed by N_3 (100 kg ha^{-1}).The lowest growth was recorded with N_1 (0 kg ha^{-1}). Interaction effect revealed that plant height was highest with the hybrid CSH 16 at 120 kg N ha^{-1}(V_2N_4) and for dry matter was highest with the hybrid CSH 25 at 120 kg Nha^{-1}(V_3N_4).

Regarding yield attributes, number of panicles m^{-2} was non-significant both for hybrids as well as N levels. Panicle length with CSH 16 (V_2) and with the highest nitrogen level (N_4) was significantly superior as compared to all the other treatments. Number of grains per panicle obtained with CSH 25 (V_3) was significantly higher than all the other hybrids and lowest with CSH 15R (V_1). Application of 120 kg N ha^{-1} (N_4) recorded significantly higher number of grains per panicle but was comparable with (N_3) and the highest with the combination V_2N_4.Test weight of hybrids did not differ and at 120 kg ha^{-1} (N_4) was significantly superior as compared to all N levels.

Grain yield of sorghum obtained with CSH 25 (V_3) was significantly higher than all the other hybrids except CSH 16 (V_2) and lowest was with CSH 15R (V_1). Yield obtained at highest nitrogen level (N_4) was significantly superior followed by N_3 and N_2 while lowest was obtained with N_1. Stover yield obtained with CSH 15R (V_1) and at the highest nitrogen level (N_4) were significantly superior to all the treatments. Harvest index was highest with MLSH -296 and with 120 Kg ha^{-1}.

Nitrogen uptake by grain and stover showed that CSH 25 (V_3) was higher than all other hybrids and with N levels was highest with N_4. Agronomic efficiency and physiological efficiency of nitrogen was found to be superior with V_3 which clearly indicated the efficiency of that particular hybrid. At harvest, soil nitrogen recorded with CSH 16 (V_2)and at N_4 was significantly superior as compared to all the other the levels. Economics registered with hybrid CSH 25 and highest nitrogen level of nitrogen (N_4) was significantly higher and the lowest was recorded with CSH 15R.

Hence, it can be concluded sorghum can be successfully grown by choosing hybrid CSH 25 and with application of 120 kg N ha^{-1} for obtaining the highest yield under rice fallow conditions of North Coastal Zone of Andhra Pradesh.

AGRONOMY

Author	:	**SUBBA RAMI REDDY, A.**
Title of the Thesis	:	**IMPACT OF HERBICIDES AND MICROBIAL INOCULANTS ON WEED AND SOIL HEALTH MANAGEMENT OF *RABI* MAIZE - GREENGRAM CROP SEQUENCE IN VERTISOLS**
Chairperson	:	**Dr. A.S.RAO**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5389**

ABSTRACT

The field experiment entitled "Impact of herbicides and microbial inoculants on weed and soil health management of *rabi* maize-greengram crop sequence in vertisols" was conducted for successive *rabi* and summer seasons of 2013-14 and 2014-15 on clay loam soils of Regional Agricultural Research Station, Lam Farm, Guntur. The experiment was conducted in split plot design with nine weed management practices as main plots viz., weedy check(T1), atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence (T2), pendimethalin @ 0.75 kg a.i ha^{-1} as pre-emergence (T3), topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T4), tembotrione @110 g a.i ha^{-1} at 20 DAS as post-emergence (T5), atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb*topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6), atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* tembotrione @110 g a.i ha^{-1} at 20 DAS as post-emergence (T7), pendimethalin @ 0.75 kg a.i ha^{-1} as pre-emergence *fb*topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T8) and pendimethalin @ 0.75 kg a.i ha^{-1} as pre-emergence *fb* tembotrione @110 g a.i ha^{-1} at 20 DAS as post-emergence (T9) and three nutrient management practices as subplots viz., 50% recommended dose of fertilizer + bio consortium (Azospirillum (5 kg ha^{-1}) + phosphate solubilizing bacteria (5 kg ha^{-1}) + potash solubilizing bacteria (5 kg ha^{-1}) + vasicular arbuscular mycorrhiza (12.5 kg ha^{-1}) + vermicompost (500 kg ha^{-1}) (F1),75% recommended dose of fertilizer + bio consortium (Azospirillum (5 kg ha^{-1}) + phosphate solubilizing bacteria (5 kg ha^{-1}) + potash solubilizing bacteria (5 kg ha^{-1}) + vasicular arbuscular mycorrhiza (12.5 kg ha^{-1}) + vermicompost (500 kg ha^{-1}) (F2) and 100% recommended dose of fertilizer (F3) and replicated thrice . After harvesting of the maize crop, succeeding greengram crop was taken and there was no herbicidal and nutrient management treatments were imposed.

Among the grassy weeds *Cynodon dactylon was* predominant, in sedges only *Cyperus rotundus* was recorded where as in case of dicots, *Trianthema portulacastrum, Cleome viscosa, Euphorbia hirta* and *Phyllanthus niruri* were the major weeds observed.

Results revealed that the lowest weed density, dry weight and highest WCE was recorded with atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) and was on par with pendimethalin @ 0.75 kg a.i ha^{-1} as pre-

emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T8). Nutrient management practices were non significant with regard to weed density and dry weight during both the years.

The highest growth parameters, yield and yield attributes were obtained with atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) and it was at par to other sequential treatment pendimethalin @ 0.75 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T8). Among the nutrient management practices, the highest yield was recorded in F3 (100% RDF) which was on par with F2 (75% RDF + bio consortium (Azospirillum (5 kg ha^{-1}) + phosphate solubilizing bacteria (5 kg ha^{-1}) + potash solubilizing bacteria (5 kg ha^{-1}) + vasicular arbuscular mycorrhiza (12.5 kg ha^{-1}) + vermicompost (500 kg ha^{-1}).

The highest nutrient uptake of maize was observed in atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence followed by topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) and it was on par with pendimethalin @ 0.75 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T8)at all stages of crop growth. Among the nutrient management practices, the highest nutrient uptake was recorded in F3 (100% RDF) which was on par with F2 (75% RDF + bio consortium).

Nutrient uptake by weeds was maximum in weedy check and minimum in sequential treatments at all stages of crop growth. Nutrient management practices did not show any significant influence on uptake of nutrients by weeds at any stage of the crop. Application of bioconsortium influenced the soil enzymatic activity as well as soil microflora in the study.

Regarding economics, the highest net returns and BCR were recorded in atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) F2 (75% RDF + bio consortium and atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) F3 (100% RDF).

Studies on succeeding greengram crop grown after maize revealed that both the weed management and nutrient management practices had no impact on growth, drymatter accumulation, yield and yield attributing characters, number of nodules and nutrient uptake by crop as well as weeds.

Thus, from the present investigation it was concluded that sequential application of atrazine @ 1.25 kg a.i ha^{-1} as pre-emergence *fb* topramezone @ 25 g a.i ha^{-1} at 20 DAS as post-emergence (T6) was found to be the most effective and economical in managing weeds in maize. Among the nutrient management practices, F2 (75% of RDF+ bio consortium (Azospirillum (5 kg ha^{-1}) + phosphate solubilizing bacteria (5 kg ha^{-1}) + potash solubilizing bacteria (5 kg ha^{-1}) + vasicular arbuscular mycorrhiza (12.5 kg ha^{-1}) + vermicompost (500 kg ha^{-1}) found to be more economical and effective in getting the highest BCR. Further, it was also concluded that the impact of herbicides and microbial inoculants applied to maize didn't influence the succeeding greengram crop in any way.

AGRONOMY

Author	:	**SWATHI, Y.M.**
Title of the Thesis	:	**PRODUCTIVITY OF IRRIGATED REDGRAM (*Cajanus cajan* (L) Millsp.) AS INFLUENCED BY DENSITY, PATTERN OF SOWING AND MULCHING**
Chairperson	:	**Dr. M. SRINIVASA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5496**

ABSTRACT

A field experiment was conducted on a sandy clay soil at Agricultural College, Mahanandi, Kurnool district of Andhra Pradesh during the late *kharif* season of 2016-17 to study the **"Productivity of irrigated redgram (*Cajanus cajan* (L) Millsp.) as influenced by density, pattern of sowing and mulching"** .

The experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments comprised of sowing with 120 cm × 20 cm spacing (T_1), sowing with 90 cm × 20 cm spacing (T_2), sowing with 60 cm × 20 cm spacing (T_3), sowing with spacing of 180/60cm × 20 cm as paired rows (T_4), sowing with spacing of 120/60cm × 20 cm as paired rows (T_5), sowing with spacing of 90/30cm × 20 cm as paired rows (T_6), sowing with spacing of 180/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_7), sowing with spacing of 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8) and sowing with spacing of 90/30 cm × 20 cm as paired rows with plastic mulch in pairs (T_9). Surface drip irrigation system was used in the study and consisted of 16 mm integral dripper lines laid out on the surface along the crop rows with emitters spaced at 0.60 m apart delivering 4 l hr^{-1} giving an application rate 6.6 mm h^{-1}.The black-silver LDPE sheet of 25 µ thickness was used in the study as mulch as mulch for the respective treatments.

Plant height of irrigated redgram was not significantly influenced by density, pattern of sowing and mulching except at 60 DAS. Stem diameter and dry matter production of irrigated redgram was increased with increase in age of the crop up to maturity. Maximum stem diameter of irrigated redgram was with spacing of of 180/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_7).

Dry matter production was higher at spacing 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8) at harvest stage. Maximum Leaf area index (LAI) was noticed at spacing of 90/30 cm × 20 cm as paired rows with plastic mulch in pairs (T_9) however, on par

with 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8) at 60, 90 DAS and harvest. While these parameters were lowest with 120 cm × 20 cm spacing (T_1).

All the treatments with plastic mulch (T_7, T_8 and T_9) took significantly lesser time (days) to reach 50% flowering and physiological maturity compared to densities and pattern of sowing treatments.

Yield attributes *viz*., pods branch^{-1}, pods plant^{-1}, seeds pod^{-1} pod yield plant^{-1} and hundred seed weight were maximum with 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8). Spacing of 180/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_7) recorded more number of pod bearing branches plant^{-1} which was on par with spacing of 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8). Number of seeds pod^{-1} and hundred seed weight did not vary significantly between treatments. While these yield parameters were lowest with spacing 60 cm × 20 cm (T_3).

Maximum seed yield of irrigated redgram were recorded at spacing of 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8) (2,302 kg ha^{-1}) which was however on par with spacing of 180/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_7) (2,210 kg ha^{-1}), spacing of 90/30 cm × 20 cm as paired rows with plastic mulch in pairs (T_9) (2,104 kg ha^{-1}) and were significantly superior to other treatments and the lowest was recorded with spacing of 120 cm x 20 cm (T_1) (1,548 kg ha^{-1}). Higher stalk yield was noticed with spacing of 180/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_7) (6,863 kg ha^{-1}) and the lowest were recorded at 90 cm × 20 cm (T_2) (5,556 kg ha^{-1}). Harvest index of irrigated redgram did not differ significantly among the treatments.

Nutrient uptake by irrigated redgram was not significantly altered by density, pattern of sowing and mulching. The highest and lowest values of nitrogen, phosphorus and potassium uptake by irrigated redgram were associated with a spacing of 90/30 cm × 20 cm as paired rows with plastic mulch in pairs (T_9) and at 120 cm × 20 cm spacing (T_1).

Higher gross returns (₹ 1,16,251 ha^{-1}) were recorded at spacing of 120/60 cm × 20 cm as paired rows with plastic mulch in pairs (T_8).The highest net returns and benefit: cost ratio were realized with paired row spacing of 90/30 cm **×20** cm (T_6) (₹ 68,989 ha^{-1}) (3.30) followed by paired row spacing of 180/60 cm **×20** cm (T_4) (₹. 64,788 ha^{-1}) (3.21) and was superior to other treatments. The lowest gross returns (₹ 78,174 ha^{-1}) were recorded at 120 cm × 20 cm.

Based on the above observations it can be concluded that paired row sowing with spacing of 90/30 cm × 20 cm (T_6) was proved as best for improving productivity and profitability of irrigated redgram during late *kharif* season. However if the cost of the plastic mulch reduced in future, mulching can also be adopted by the farmers for better economic returns.

AGRONOMY

Author	:	**SWETA, SHIKTA MAHAPATRA.**
Title of the Thesis	:	**NUTRIENT MANAGEMENT THROUGH ORGANICS FOR SUSTAINED PRODUCTIVITY OF FINGER MILLET (*Eleusine coracana* (L.) Gaertn.)**
Chairperson	:	**Dr. N. SUNITHA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5497**

ABSTRACT

A field experiment entitled **"NUTRIENT MANAGEMENT THROUGH ORGANICS FOR SUSTAINED PRODUCTIVITY OF FINGER MILLET (*Eleusine coracana* (L.) Gaertn.)"** was carried out during *kharif*, 2016 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University. The experiment was laid out in randomized block design with three replications. There were eight treatments *viz*., control (T_1), 100% RDF (60:30:30 kg ha^{-1} N: P_2O_5: K_2O) (T_2), 100% N through farm yard manure (FYM) (T_3), 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum*+ PSB) (T_4), Seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval upto 15 days before harvest (T_5), Seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray at every 10 days interval upto 15 days before harvest (T_6), T_3 + T_5 (T_7) and T_3+ T_6 (T_8). The test variety of finger millet was 'Vakula'.

Various organic sources of nutrients significantly influenced the growth parameters, yield attributes, yield, economic returns, nutrient uptake of finger millet as well as the post-harvest soil microbial and fertility status.

Application of 100% recommended dose of nutrients through fertilizers (T_2) resulted in the tallest plants, largest leaf area index and highest dry matter production, total number of tillers m^{-2}, which was significantly superior over rest of the nutrient management practices. Among the organic sources tried, supply of 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7) recorded higher stature of growth parameters followed by supply of 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4) and 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8), which were

statistically on par with each other. Application of 100% N through FYM (T_3) and seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5), were comparable with each other. The seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6) was in parity with control (T_1), which produced the lowest growth characters.

Regarding the yield attributes *viz.,* number of productive tillers m^{-2}, fingers ear^{-1}, ear length, ear weight, grain weight $ear^{-1}$and test weight were the highest with application of 100% recommended dose of nutrients through fertilizers (T_2). Among the various organic sources of nutrients, application of 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7) was found to be the next best treatment. Application of 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4) and 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8) were statistically on par with each other, followed by 100% N through FYM (T_3), which inturn maintained parity with seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5). The seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6) was on par with control (T_1), in which non-supply of nutrients resulted in the deflated stature of all the above yield attributes.

Supply of 100% recommended dose of nutrients through fertilizers (T_2) recorded the highest grain and straw yields in finger millet, which was distinctly superior over rest of the nutrient management practices. Among the various organic sources of nutrients, 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7) resulted in higher grain and straw yields, which was followed by 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4) and 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8), which were statistically on par with each other. The next treatments of 100% N through FYM (T_3) and seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5), were noticed to be comparable with each other. The seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6) was on par with control (T_1), which produced the lowest grain and straw yields.

Nutrient (nitrogen, phosphorus and potassium) uptake of finger millet was the highest with 100% recommended dose of nutrients through fertilizers (T_2). The next best nutrient uptake was noticed to be with supply of 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at

every 10 days interval up to 15 days before harvest (T_7). Supply of 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4) was on par with 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8), followed by 100% N through FYM (T_3) and seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5), which were in turn comparable with each other. The seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6) was on par with control (T_1), which registered the lowest uptake of nutrient.

Post-harvest soil fertility status (available nitrogen, phosphorous and potassium) as well as microbial count (fungi, bacteria and actinomycetes) were found to be significantly enriched with 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7), which was however comparable with 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8). Application of 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4), 100% N through FYM (T_3) and seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5), maintained parity with each other. The seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6) was followed by 100% recommended dose of nutrients through fertilizers (T_2), which was statistically on par with control (T_1), that recorded the lowest post-harvest soil nutrient status.

With regard to economics, gross returns realized with different nutrient management practices followed the same trend as such of grain and straw yields of finger millet. The highest net returns and benefit-cost ratio were obtained with 100% recommended dose of nutrients through fertilizers (T_2). Among the nutrient management through organic sources, 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7) resulted in higher net returns and benefit-cost ratio, which was on par with 100% N through FYM + seedling treatment with biofertilizers (*Azospirillum* + PSB) (T_4). The later was in parity with application of seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_5) and 100% N through FYM + seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_8). Further, it was noticed that nutrient management practice of T_8 was statistically on par with 100% N through FYM (T_3). The net returns and benefit-cost ratio obtained with T_3 were comparable with control (T_1) and seedling treatment with beejamrutha + foliar application of panchagavya @ 3% foliar spray just after transplanting and at every 10 days interval up to 15 days before harvest (T_6), where as the later treatment resulted in the lowest values.

In conclusion, the investigation revealed that higher grain yield of finger millet as well as economic returns could be realized with 100% recommended dose of nutrients through fertilizers. Among the various organic sources of nutrients tried, 100% N through FYM + seedling treatment with beejamrutha + soil application of jeevamrutha @ 500 l ha^{-1} just after transplanting and at every 10 days interval up to 15 days before harvest (T_7) was proved to be the most promising integrated organic nutrient management practice for higher yield, economics of finger millet along with maintenance of soil biological activity as well as fertility for the sustenance of soil ecology in the present domain of study. Further, it can be inferred that payment of premium price for the organic produce after certification may make organic farming as lucrative as its conventional counterpart over the long haul towards sustainable agriculture.

AGRONOMY

Author	:	**VIJAYA BHASKAR REDDY, U.**
Title of the Thesis	:	**CROP RESIDUE AND NUTRIENT MANAGEMENTEFFECTS ON PRODUCTIVITY OF MAIZE-MAIZE CROPPING SEQUENCE**
Chairperson	:	**Dr. G. PRABHAKARA REDDY**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5501**

ABSTRACT

Present investigation entitled **"Crop residue and nutrient management effects on productivity of maize-maize cropping sequence"** was carried out for two consecutive *kharif* and *rabi* seasons of 2014 and 2015 at Agricultural College Farm, Mahanandi, Andhra Pradesh.

During *kharif* the field experiment was laid out in randomized block design with factorial concept while during *rabi* in split-plot replicated thrice during both the years.

The treatments consisted of three nitrogen levels (200, 250and 300 kg N ha^{-1}) and three phosphorus levels (40, 60and 80 kg $P_2O_5ha^{-1}$) during *kharif* season. While, during *rabi* season, nine main plot treatments consisting the combination of three nitrogen levels and three phosphorus levels of *kharif* season and four sub plot treatmentscomprising of fertilizer and crop residue management practices (F_1: Recommended dose of N and P_2O_5 (250 kg N and 80 kg P_2O_5 ha^{-1}), F_2: 125% of F_1, F_3: F_1+ *kharif*crop residue incorporation andF_4: F_2 + *Kharif* crop residue incorporation). The test cultivar of maize was P-3396 a single cross hybrid.

During *kharif*, the higher values of all the growth parameters like plant height, LAI and dry matter were recorded with the application of nitrogen at 300 kg ha^{-1} and phosphorus at 60 kg ha^{-1} during both the years. Interaction was not significant except on plant height at 90 DAS and on dry matter production at harvest in the first year.

During *rabi*, plant height of maize differed significantly due to residual nutrient effects (main plots), nutrient doses ± crop residues (sub plots) and their interaction during 2014 at 30 DAS only. There after variation in plant height was significant with respect to nutrient doses ± crop residues at 90 DAS and at harvest. Leaf area index differed significantly with respect to nutrient doses ± crop residues at 30 DAS in both the years, due to residual nutrient effects, nutrient doses ± crop residues at 60 DAS in the first year, at 90 DAS during both the years and at harvest due to residual nutrient effects during the second year. With respect to LAI, interaction was significant at 60 DAS only. There was significant influence of residual nutrient effects and nutrient doses ± crop residues on the dry matter production of maize at all the growth stages except by nutrient doses ± crop residues at 60 DAS where the difference was not significant. Interaction effect was significant at 90 DAS during both the years and at harvest stage during the first year of study.

During *kharif*, days to 50 per cent tasseling and silking differed significantly with nitrogen levels recording earlier flowering at 300 kg ha^{-1} but P levels did not result in any significant effect. The interaction was significant during both the years on days to 50 per cent tasseling with least number of days to tasseling in the plots received 300 kg N ha^{-1} and highest number of days with 200 kg N ha^{-1} at any level of phosphorus tried.

During *rabi*, early tasseling and silking occurred in N_3P_1(300 kg N+ 40 kg P_2O_5 ha^{-1}) main plots. With regard to sub plots, earlier tasseling and silking occurred in F_4 (F_2+ *Kharif* crop residue incorporation) and F_2 (125% of F_1). There was no significant interaction between main and sub plot treatments during both the years with respect to days to 50 per cent tasseling and silking.

During *kharif*, the higher values of yield attributes *viz.,* cob length, number of grains cob^{-1} and hundred grain weight were recorded with 300 kg Nand60 kg P_2O_5 ha^{-1} withno significant difference among other levels except on number of grains cob^{-1} by N levels. Significant interaction was observed on cob length among N and P levels with highest and lowest values by N_3P_2 and N_1P_3 respectively in the second year of study. During both the years, the highest and lowest grain and stover yields were recorded with N level of 300 kg ha^{-1} and 200 kg ha^{-1} and with P level of 60 kg ha^{-1} and 40 kg ha^{-1} respectively. Interaction was significant on grain yield during the first year recording higher values in a combination of 250 kg N and 60 kg P_2O_5 ha^{-1} while the lowest was in 200 kg N and 40 kg P_2O_5 ha^{-1}.

During *rabi*, the yield attributes *viz.,* number of cobs $plant^{-1}$, cob lengthand hundred grain weightof maize were not influenced significantly due to residual nutrient effects, nutrient doses ± crop residues and their interaction except number of grains cob^{-1}. Significantly higher grain yield of maize was recorded in N_2P_2 during the first year and in N_3P_3 during the second year. Maize sown in N_3P_2 (300 kg N + 60 kg P_2O_5 ha^{-1}) and N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded in higher stover yield during the first and second years

of study respectively. Significantly higher grain yield was recorded with F_2 (125% of F_1) which was however on par with F_4 (F_2+ *Kharif* crop residue incorporation) in both the years.

The uptake of Nitrogen, phosphorus and potassium was found to increase with each successive increase in nitrogen level from 200 to 300 kg ha^{-1} and phosphorus up to 60 kg ha^{-1} with increase in age of the crop with higher uptake of above nutrients with 300 kg N ha^{-1} and 60 kg P_2O_5 ha^{-1}.

Crop sown in N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) recorded significantly higher nitrogen and phosphorus uptake by grain, while N_2P_2 recorded significantly higher potassium uptake however it was on par with N_3P_3. Higher nutrient uptake was recorded in F_2 and F_4, while the sub plot F_1 and F_3 recorded lower nutrient uptake during both the years.

During *kharif*, significantly higher and lower gross and net returns were recorded with the application of nitrogen at 300 kg and 200 kg ha^{-1}, phosphorus at 60 kg and 40 kg ha^{-1} respectively. With regard to interaction significantly higher and lower net returns were realized with the application of 250 kg N + 60 kg P_2O_5 ha^{-1} (N_2P_2) and 250 kg N + 40 kg P_2O_5 ha^{-1} (N_2P_1) respectively.

Significantly higher B : C ratio was recorded with the application of 300 kg N ha^{-1} during both the years of study. Application of 60 kg P_2O_5 ha^{-1} duringboth the yearsrecorded higher values of B : C ratio. Significantly higher and lower B : C ratio was recorded with the application of 250 kg N + 60 kg P_2O_5 ha^{-1} (N_2P_2) and 200 kg N + 80 kg P_2O_5 ha^{-1} (N_1P_3) respectively during *kharif*.

Significantly higher gross and net returns of maize were realized when sown in N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}) during the first year and N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) main plots during the second year. Among the sub plot treatments F_2 (125% of F_1) recorded significantly higher gross and net returns which were however on par with F_1 (Recommended dose of N and P_2O_5) and F_4 (F_2+ *Kharif* crop residue incorporation) during the first year and with F_4 (F_2+ *Kharif* crop residue incorporation) during the second year.

Higher B : C ratio of maize was realized when sown in N_2P_2 (250 kg N + 60 kg P_2O_5 ha^{-1}) and N_3P_3 (300 kg N + 80 kg P_2O_5 ha^{-1}) main plots during the first and second years of study respectively. During both the years of experimentation, significantly higher B : C ratio was obtained in sub plot treatments of F_1 (Recommended dose of N and P_2O_5) and F_2 (125% of F_1) where there was no cost for incorporation of crop residues.

Incorporation of crop residues in F_3 and F_4 treatments resulted in 4.71 and 13.67 per cent increase in soil organic carbon content over without incorporation during first and second years of study respectively indicating the positive effect on carbon sequestration.

The investigations revealed that application of 250 kg N and 60 kg P_2O_5 ha^{-1}during *kharif* season and 125% recommended dose of N and P either with or without incorporation of residues of previous season during *rabi* along with recommended dose of potassium was found to be the optimum fertilizer schedule for maize-maize cropping sequence.

AGRONOMY (WATER MANAGEMENT)

Author	:	**VIJAYA LAKSHMI, KAVITI.**
Title of the Thesis	:	**ENHANCEMENT OF WATER PRODUCTIVITY IN BLACKGRAM (*Vigna mungo* L.) THROUGH FOLIAR NUTRITION**
Chairperson	:	**Dr. S. PRATHIBHA SREE**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5539**

ABSTRACT

The experiment was conducted on sandy loam soils of Agricultural Research Station, Jangamaheswarapuram during *rabi*, 2016-17 to study the "Enhancement of water productivity in blackgram (*Vigna mungo* L.) through foliar nutrition". The experiment was laid out in split plot design and replicated thrice with four irrigation levels *viz.,* I_1 - Control, I_2 -Irrigation at 0.3 IW/CPE, I_3 - Irrigation at 0.4 IW/CPE and I_4 - Irrigation at 0.5 IW/CPE ratios as main plots and four foliar spray treatments F_1 – 2 % urea, F_2 – 2 % DAP, F_3 – 1 % KNO_3 and F_4 – 2 % 19-19-19 applied twice at pre flowering and pod filling stages as sub plots.

The influence of irrigation and foliar treatments on plant height of blackgram was found to be non significant at all the stages of crop growth. A significant influence of irrigation levels and foliar treatments on number of branches plant^{-1} was found at all the stages of crop growth except at 30 DAS. The dry matter production at different crop growth stages was significantly influenced by irrigation levels and foliar treatments. At all the stages of crop growth the highest dry matter production was recorded at 0.5 IW/CPE which was significantly superior to all other irrigation levels. Among the foliar treatments, foliar application of 1 % KNO_3 recorded maximum dry matter production. At 75 DAS, foliar spray of 1 % KNO_3 was comparable with 2 % DAP and 2 % 19-19-19 sprayed twice at pre flowering and pod filling stages.

The data recorded on yield attributes indicated that the influence of irrigation and foliar nutrition treatments on number of clusters plant^{-1} and test weight was found to be significant. Though the significant difference in yield attributes such as number of pods cluster^{-1} and seeds pod^{-1} were not noticed. Anyhow, the maximum number of yield attributes was recorded in 0.5 IW/CPE (I_4) and minimum were recorded in non irrigated treatment. Among foliar treatments, 1 % KNO_3 (F_3) recorded maximum yield attributing parameters and minimum were recorded with 2 % urea spray. The interaction effect of irrigation and foliar nutrition on test weight of blackgram was found to be significant. Significantly the highest mean maximum test weight was recorded with I_4F_3 and was on a par with I_4F_2 and the lowest

mean maximum test weight was recorded with I_1F_1 treatment. The data recorded on seed yield and haulm yield and harvest index of blackgram revealed that the highest seed yield was recorded with 0.5 IW/CPE which was significantly superior to other irrigation levels. Among foliar treatments, 1 % KNO_3 recorded the highest seed yield which was on a par with 2 % DAP. The highest haulm yield was recorded at 0.5 IW/CPE which was on a par with 0.4 IW/CPE ratio. Maximum haulm yield was recorded with 1 % KNO_3 which was significantly higher over other foliar nutrition treatments. The influence of irrigation levels and foliar nutrition on harvest index of blackgram was found to be non significant.

Available macro nutrients in soil after harvest of blackgram were not influenced by irrigation and foliar nutrients. With respect to foliar treatments, maximum N, P and K uptake was recorded in 0.5 IW/CPE ratio. Nitrogen uptake was not influenced by foliar nutrition treatments, where as maximum P and K uptake were recorded in 2 % DAP and 1 % KNO_3 sprayed twice at pre flowering and pod filling stages, respectively.

The highest consumptive use of water and daily soil moisture use rate were recorded at 0.5 IW/CPE ratio. Maximum water productivity was recorded when the irrigation was not given. Foliar spray of 1 % KNO_3 recorded the highest water productivity which was significantly superior to other foliar treatments. Irrigation at 0.5 IW/CPE ratio and foliar spray of 1 % KNO_3 twice at pre flowering and pod filling stages registered higher gross returns, net returns and benefit cost ratio.

Overall, the study revealed that irrigation at 0.5 IW/CPE ratio and foliar spray of 1 % KNO_3 twice at pre flowering and pod filling stages was found to be better in increasing the growth, yield and water productivity of *rabi* blackgram.

AGRICULTURAL ECONOMICS

Author	:	**ALMASZABEEN, BADEKHAN.**
Title of the Thesis	:	**ECONOMIC AND ENVIRONMENTAL IMPACT ASSESSMENT OF PESTICIDE USAGE IN COTTON – A STUDY IN DHARWAD DISTRICT OF KARNATAKA**
Chairperson	:	**Dr. K. UMA DEVI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5401**

ABSTRACT

The pesticide that is heavily used in India is insecticide, whereas weedicides and fungicides application is correspondingly less. Cotton accounts for the maximum share of pesticide consumption followed by paddy and vegetables. Over the past decade, the perplexities in pest management intensified with more and more insect species developing resistance to insecticides. Cotton pest management was particularly affected due to insecticide resistance, which was a consequence of excessive use of insecticides on the crop. Insecticide resistance rendered insecticides ineffective, thus increasing the need for repeated applications, wastage of resources and consequent environmental pollution. Keeping this in view, the present study "Economic and environmental impact assessment of pesticide usage in cotton – A study in Dharwad district of Karnataka" has been taken up with the following objectives.

1. To estimate the cost and returns in cotton production with special reference to pesticide usage.
2. To study the pesticide usage pattern and its impact on cotton productivity.
3. To assess the perception of sample farmers on the effects of pesticide use.
4. To assess the environmental impact of pesticide usage in cotton.

Multistage sampling procedure was adopted to select the respondents. Out of five taluks of Dharwad district, three taluks viz., Navalgund, Hubli and Kundagol and from each taluk, two villages which were having maximum cotton area and cotton farmers were selected. A total of six villages viz., Annigeri, Morab, Shirguppi, Ingalahalli, Kundagol and Shunsi were selected. Twenty cotton farmers from each village were post stratified into small, medium and large farmers proportionately making a total sample of 120. A structured and pre-tested schedule was used to collect the data through survey method. The present study pertains to the agricultural year 2016-17.

Among the three different farm size groups, total costs as well as returns incurred were highest for large farmers as compared to medium and small farmers, but pesticides cost was more in case of small farmers followed by medium and large farmers. Imidachloropid was the most preferred insecticide and Mancozeb and Paraquat were preferred fungicide and weedicide respectively. Around 54 farmers (45%) spent Rs. 4500 to Rs. 5500 per ha for pesticide application.

In the results of Cobb Douglas function, the factors that showed significance were PPC (Plant Protection Chemicals) in kg, human labour cost, bullock labour cost and age for small farmers. While in case of medium farmers, PPC in kg, fertilizer cost, bullock labour cost, machine labour cost and area and for large farmers, PPC in kg, bullock labour cost, machine labour cost and age were influencing cotton yield. The optimum quantity of pesticide required for cotton for over all farmers was estimated to be 0.57 a.i. kg/ha which was double the actual use, and 0.58, 0.70 and 0.80 a.i.kg/ha in the case of small, medium and large farmers. The results of plant protection chemical expenditure function showed that total agricultural income, number of pesticide applications and human labour cost were significant factors for small, medium and large farmers.

Most of the farmers didn't know how to read literature on pesticide containers. It was astonishing to notice that 73.33 per cent of the farmers were not using protective masks/coverings during pesticide application and farmers were found careless in handling pesticides. Farmers got the information about pesticides from pesticide dealers and some from their own experience. Frequency of pesticide application by most of the farmers ranged from 4 to 5 times in one crop season. Headache was the major problem associated with exposure during pesticide application as reported by the sample farmers (especially small farmers) followed by eye irritation.

Majority respondents (90.83 %) felt that the pesticide use affects human health. About 45.83 per cent of respondents believed that pesticide usage increased levels of crop yield. Most of the respondents (64.16 %) were unaware of the long term effects of pesticide use, but most of them also disagreed to it and experienced short term illness (62.50 %).The relationship between the levels of perception and independent variables like age, income of farmer, type of farmer, education were found significant and showed positive relationship.

The pesticide with highest Field Use Environmental Impact Quotient (EIQ) value used by sample farmers was Profenophos (75.19) and lowest was Acetamiprid (0.19). Average Field Use EIQ was highest in case of small farmers (39.56) followed by large farmers with 38.23. Comparatively less Field Use EIQ was with medium farmers at 36.83. About 35.83 per cent of farmers were willing to pay 6 -10 per cent more price than that of chemical pesticides for eco-friendly pesticides followed by 24.16 per cent farmers who were ready to pay 1-5 per cent more price. Factors influencing Willingness To Pay (WTP) were education, family type, perception, income, age and total health effects.

AGRICULTURAL ECONOMICS

Author	:	**JHANSI, M.**
Title of the Thesis	:	**AN ECONOMIC ANALYSIS OF TOBACCO (FCV) PRODUCTION VIS-A-VIS ALTERNATE CROPS IN NORTHERN LIGHT SOILS OF ANDHRA PRADESH**
Chairperson	:	**Dr. G. RAGHUNADHA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5398**

ABSTRACT

The present research study entitled "An economic analysis of FCV tobacco (FCV) production vis-a-vis alternate crops in Northern Light Soils of Andhra Pradesh" was taken under with the following objectives.

1. To analyze the trends in area, production, productivity and prices of tobacco and its alternate crops.
2. To study the cost and returns structure of tobacco and its alternate crops.
3. To analyze the resource use efficiency in tobacco cultivation and its alternate crops.
4. To analyze the constraints in tobacco production.

A well structured schedule was used to collect the requisite information from sample respondents through interview method. From each auction platform four villages, cultivating FCV tobacco and alternate crops were selected randomly making a total of 20 villages. From each village 3 FCV growers were selected randomly to make a total of 60 respondents. The alternate crop respondents were also selected from same villages based on probability proportion of area under specific crop making a total of 90 respondents.

Trend analysis to find out area, production, productivity and average prices for FCV tobacco and alternate crops over a period of time, Cost concepts for estimating of cost of cultivation of FCV tobacco, Sugarcane, Blackgram-Maize system and Chilli, farm business analysis to estimate the profitability, Cobb-Doublas production function to estimate the resource use efficiencies and returns to scale were employed in the study. Garret ranking technique was employed to prioritize rank problems faced by FCV tobacco growers.

Trend analysis revealed that positive growth trend was observed in case of area, production, productivity and prices for FCV tobacco and alternate crops. The tabular analysis revealed that Cost A_1 (Rs. 197645/ha) was more in FCV Tobacco crop against three crops. This was mainly due to more utilization of man power in harvesting, curing and grading and also increased application of FYM & fertilizers, plant protection chemicals to obtain improved quality and higher yields. Cost B_1 (Rs. 198022/ha), Cost B_2 (Rs. 250832/ha), Cost

C_1 (Rs. 201337/ha), Cost C_2 (Rs. 254147/ha), Cost C_3 (Rs. 279561/ha) were also more in FCV tobacco crop which were mainly due to higher operational cost (Rs. 197645/ha), and rental charges (Rs. 52810/ha). In other words, the total cost of cultivation as per the cost concepts was highest in FCV tobacco (Rs. 279561/ha) followed by sugarcane (Rs. 190264/ha), chilli (Rs. 163150/ha) and blackgram-maize system (Rs. 144093/ha) respectively. Returns per rupee of investment ratio was high for sugarcane (0.31) followed by chilli (0.21), FCV tobacco (0.13) and blackgram-maize system (0.09) respectively.

Farm business analysis revealed that both the family labour income and farm investment income were more for FCV tobacco compared to its alternate crops. Even though the gross returns were more for FCV tobacco (Rs. 321937/ha) followed by sugarcane (Rs. 249366/ha), chilli (Rs.198261/ha) and blackgram-maize system (Rs. 157662/ha). The net returns were observed more with sugarcane (Rs. 59102/ha) production followed by FCV tobacco (Rs. 39103/ha), chilli (Rs. 35111/ha) and blackgram-maize system (Rs. 13569/ha) respectively.

The production function analysis of FCV tobacco revealed that seedlings and manures & fertilizers have got a significant influence and role to play in enhancing the FCV tobacco yields irrespective of farm size. Regarding plant protection chemicals and machine power these were excessively used on all farms, hence there was a need to curtail the expenditure on machine power and plant protection chemicals. The coefficients of farm size and fuel cost were found to be positive and non significant indicating these inputs have not reached to the level where these start influencing the production. The coefficients of hired human labour in curing were found to be negative and significant at 10 per cent level indicating that there would be decline in gross returns by increased use of resource.

Functional analysis of sugarcane showed that hired human labour, farm size, seedlings and manures & fertilizers were positive and significant which can increase gross returns. The machine power and cost of plant protection chemicals have not shown any significant changes in gross returns on their further usage. Functional analysis of maize revealed that seeds, cost of plant protection chemicals, machine power and manures & fertilizers significantly influenced more to the gross returns. The coefficient of seedling and machine power were negative and significant indicate the decrease in gross returns by increased use of these resources. The coefficient of hired human labour in cultivation and machine power were positive and significant which clearly indicates that 1 per cent increase in expenditure on these resources would raise the gross returns by 1.20 and 2.13 per cent respectively. The study revealed that FCV tobacco and sugarcane showed decreasing returns to scale, where as the maize showed incrasing returns to scale.

MVP to OC ratio of farm size (0.02), seedling (0.14), cost of plant protection chemicals (0.03), manures and fertilizers (0.05) and fuel cost (0.01) for FCV tobacco, hired human labour in cultivation (0.02) for maize and hired human labour in cultivation (0.01), farm size (0.09), seed (0.05), plant protection chemicals (0.18) and manures & fertilizers (0.05) for sugarcane were not at optimum level because the ratio was much less than the unity, indicating that use of these resources could increase production successfully. MVP to OC ratio of hired human labour in cultivation (-0.01), machine power (-0.01) and hired human labour in curing (-0.05) for FCV tobacco, farm size (-0.02), seed (-0.18), cost of plant protection chemicals (-0.80) and manures & fertilizers (-0.02) for maize and machine power (-0.01) for sugarcane, were negative hence, these input were excessive and indiscriminately used than required by the respondents. There is a need to reduce these inputs to achieve

higher productivity. MVP to OC ratio of machine power was more than unity for maize crop *i.e.* the utilization of inputs was optimal indicating that use of these inputs could be increased.

The Garrett ranking analysis revealed that shortage of labour power, frequent price fluctuations, high cost of cultivation, tobacco crop production time consuming, risk involvement, problem with grading officers, limit for construction of barns, health related problems, diseases of tobacco plant and others are the major problems faced by the farmers in study area. FCV tobacco production was restless enterprise to the farmer and consumes more human labour compared to alternate crops suggested. The agro based and rural cottage industries may be promoted to absorb the surplus labour thus saved by decline in area and production of FCV tobacco.

The study observed remunerative returns in cultivation of alternate crops. Even though the net returns obtained by sugarcane were more than FCV tobacco, the commendable returns were also realised by the other two i.e, chilli and blackgram-maize system. So in the light of present situation of declining worldwide demand for tobacco products, the said alternate crops can be recommended as potential and economically alternatives to FCV tobacco crop.

AGRICULTURAL ECONOMICS

Author	:	**JYOTHIRMAI, BALLA.**
Title of the Thesis	:	**ECONOMIC ANALYSIS OF ORGANIC FARMING IN RICE - A STUDY IN VISAKHAPATNAM DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. Y. RADHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5399**

ABSTRACT

The present study entitled “Economic analysis of organic farming in rice - A study in Visakhapatnam district of Andhra Pradesh” was undertaken with the objectives

i) To analyse the cost and returns in organic farming vis-a-vis conventional farming in rice

ii) To estimate the resource use pattern and technical efficiency of organic farming and conventional farming in rice

iii) To analyse the factors affecting technical efficiency in organic farming and conventional farming in rice and

iv) To identify the problems in practicing organic farming in rice.

Multi-stage sampling technique was employed for selection of final respondents. A sample of 90 farmers was selected from nine villages and three mandals of Visakhapatnam district of Andhra Pradesh. Tabular analysis was carried out to study the costs and returns of organic farming and conventional farming of rice in the study area. The cost concepts and income measures were also analysed through conventional analysis using various cost concepts and farm income measures. The resource pattern between the organic farming and conventional farming was analysed for comparison and tested through Z test. Stochastic Frontier Production Function was used to compute the technical efficiency, while multiple regression model was used to analyse the factors effecting technical efficiency in both organic farming and conventional farming of rice. Finally the problems in practicing organic farming were identified and analysed.

The average cost of cultivation per hectare of rice in organic farming was Rs. 33413 as against Rs. 42309 in conventional farming. The cost of chemical fertilizers and cost of plant protection chemicals were the differing factors in the cost of both types of farming in rice. Of the total cost, variable costs accounted for a major share of cultivation of rice in both types of farming. The proportion of variable cost accounted to 91.7 per cent and 93.4 per cent of the total cost of cultivation of rice in organic farming (Rs. 30658.39) and conventional farming (Rs. 39552) respectively. Among the different variable costs, human labour occupied the major share of total cost of cultivation with 71 per cent in organic farming, which might be due to various labour intensive operations like application of manures, bio fertilizers and bio pesticides.

The gross income per hectare was higher in conventional farming (Rs. 73128) with a difference of Rs. 8264 compared to that of organic farming (Rs. 64864). Whereas the net return in organic farming was Rs. 31451 per hectare, while it was only Rs. 30818 per hectare in conventional farming revealing that the net return was higher by Rs. 633 in organic farming compared to conventional farming. Though the yield levels were lower by 7.97 q/ha in organic farming (50.73q/ha.) compared to conventional farming (58.70 q/ha.), the net returns were higher in organic farming because of the lower cost of cultivation and slight premium price received for the produce. The net benefit - cost ratio was higher in organic farming (0.94) compared to conventional farming (0.72).

The analysis of per hectare resource use pattern revealed that organic farms used farm yard manure to a great extent (6.40 tonnes/ha.) as compared to conventional farms (3.32 tonnes/ha.). The quantities of vermicompost and green manure used by organic farms were higher as compared to conventional farms. Bio fertilizers and indigenous bio pesticides were used in the form of Jeevamrutha (57.65 l/ ha.) and neem seed kernel powder (2.93 kg/ ha.) by organic farms. Synthetic fertilizers and pesticides were used only by conventional farms (986.25 kg/ha and 6.4 l/ ha). Thus, study of resource utilization pattern of organic farming and conventional farming revealed that resource use intensity was higher in case of conventional farms (Rs. 21850.8/ha.) compared to organic farming (Rs.11948.43/ha).

The technical efficiency was found to be relatively higher in organic farming as compared to conventional farming, so we accept the hypothesis that the technical efficiency of organic rice production was more than that of conventional rice production. The mean technical efficiency of organic farms was estimated as 86 per cent, whereas for conventional farms it was estimated as 79 per cent. A comparison of Stochastic Frontier Production Function of organic farming and conventional farming revealed that the technical efficiency was found to be relatively higher in organic farming as compared to conventional farming.

The explanatory power of the model (R^2) was 85.4 per cent in organic rice, implying that all the explanatory variables together explained 85.4 per cent of variation in technical efficiency in organic rice. In case of conventional farms, the explanatory power of the model (R^2) was 77 per cent. In organic farming the education, experience, extension services offered to farmers and training programmes attended by farmers were positively significant at 1 per cent and market price was significant at 5 per cent level, indicating their positive influence on technical efficiency. Whereas age and distance to market were negatively significant at 1 per cent in organic farming. In conventional farming market price and education were positively significant at 5 per cent level and expenditure on seeds was negative but non- significant in both organic and conventional farming.

Relatively lower yield in initial years was the major problem expressed by most of the farmers (95%). The other problems were high weed intensity (77%), non - availability of required quantity of organic manures (75%), lack of technical guidance (75%) and distance to market (73%). According to 84 per cent of the respondents, lack of market information was the major constraint, and lack of organized marketing was a problem for over 80 per cent of the farmers. The other problems were lack of premium price (64%), lack of experience (55 %) and complex procedure for getting organic certification (53%).

Diversification of crops and staggered planting may be popularized in organic farming to reduce the demand for labour. As the technical efficiency was more in organic farming, the extension personnel of Department of Agriculture may encourage farmers to adopt organic farming through various training and other programmes organized on preparation of bio pesticides and bio fertilizers.

The price for organic produce may be enhanced by providing a premium price and making arrangements to certify the produce as organic and arranging for buy-back arrangements in the nearby markets, as the net benefit-cost ratio was found high in organic farming.

Research on reducing weed intensity in organic farming may be encouraged. Certification of organic produce, besides providing for buy-back arrangement may be taken up by the state Government to enhance organic farming in rice.

AGRICULTURAL ECONOMICS

Author	:	**LAKSHMI PRASANNA, TAMTUM.**
Title of the Thesis	:	**ANALYSIS OF VULNERABILITY INDICES IN VARIOUS AGRO-CLIMATIC ZONES OF ANDHRA PRADESH**
Chairperson	:	**Dr. S.RAJESWARI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V.AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5477**

ABSTRACT

The present study entitled "Analysis of vulnerabilit y indices in various agro-climatic zones of Andhra Pradesh" was undertaken mainly to study vulnerability of agriculture to climate change, source-wise share to the overall vulnerability to climate change during different periods and classification of the districts under different degrees of vulnerability. The study covered all the districts representing all agro-climatic zones of Andhra Pradesh. The time series data was collected for 30 years from 1985 to 2014 on all the demographic, climatic, agricultural and occupational indicators. Iyengar and Sudarshan method was employed for construction of vulnerability index. And to arrive at valid conclusions. Vulnerability index was calculated for three time periods viz., 1994, 2004 and 2014.

The results pertaining to overall vulnerability to climate change revealed that Anantapuram from Scarce rainfall zone continued to remain most vulnerable district during the three periods under study. S.P.S. Nellore district from Southern zone was the least vulnerable district in the year 1994 and this position was occupied by the East Godavari district during the periods 2004 and 2014.

Anantapuram district continued to remain most vulnerable district during the three periods under study. S.P.S. Nellore was the least vulnerable district in 1994, but East Godavari was found to be most stable with least vulnerability in the decades of 2004 and 2014.

Srikakulum district continued to remain most vulnerable during the three periods. Y.S.R. district was the least vulnerable during the period 1994 and S.P.S Nellore in 2004 and Chittoor in 2014 with reference to demographic vulnerability.

In terms of climatic vulnerability West Godavari in 1994, Chittoor in 2004 and Y.S.R. district in 2014 were the most vulnerable districts and Chittoor in 1994, Kurnool in 2004 and Visakhapatnam in 2014 were the least vulnerable district.

In terms of agricultural vulnerability Anantapuram district was the most vulnerable district. In the year 1994 and 2014 and in 2004 this position was occupied by the Visakhapatnam district. West Godavari in 1994, Guntur in 2004 and 2014 were the least vulnerable districts.

In terms of occupational vulnerability, Kurnool district was the most vulnerable district during the periods 1994 and 2014. In 2004 this position was occupied by the Anantapuram district. Visakhapatnam was the least vulnerable district throughout the study period.

Further classification of the districts under different degrees of vulnerability revealed that all the districts in an agro climatic zone does not fall under the same degree of vulnerability exemplifies the need for the state to prioritize research and development issues and effective decision making through location performance vulnerability based adaptation strategies viz., developing new crop varieties , early weather warning system, innovative farm resource management techniques, dynamic crop insurance and income stabilization programmes in order to overcome the adverse impacts of climate change on the quintessential sector of the state.

AGRICULTURAL ECONOMICS

Author	:	**LOHITH, N.**
Title of the Thesis	:	**AN ECONOMIC ANALYSIS OF PRICE BEHAVIOUR OF COTTON IN ANDHRA PRADESH**
Chairperson	:	**Dr. Y. RADHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5397**

ABSTRACT

The present study entitled "An Economic Analysis of Price Behaviour of Cotton in Andhra Pradesh" was conducted with the specific objectives (1) To analyse the temporal and spatial variations in prices and arrivals of cotton and their relationship in major markets of cotton in Andhra Pradesh. (2) To study the extent of market integration among major markets of cotton in Andhra Pradesh. (3) To forecast the future prices of cotton for major markets in Andhra Pradesh.

Analytical tools employed in the study were: Multiplicative model has been used to estimate the trend, seasonal, cyclical and irregular movements in market prices and arrivals and 12 months moving average method was used to construct the seasonal indices. Regression analysis was used to study the impact of arrivals on prices of cotton. Zero order correlation matrix was computed to ascertain the integration of selected market with respect to price of cotton. BoxJenkins model (ARIMA) was used to forecast the future prices.

The trends in arrivals and prices of cotton in the selected markets were fitted by linear trend equation model. The market arrivals of Adilabad markets were recorded as highest in the year 2011 with 2168688q, while the highest arrivals of 2312371q for Adoni, 1994360.52q for Guntur and Warangal 2643783q were recorded in the year 2014. The price were least during the year 2005 in all the four selected markets and were recorded highest during the year 2014 for Adilabad and Guntur markets, while the same had been recorded in the years 2013 and 2012 for Adoni and Guntur markets respectively.

The month wise seasonal arrivals revealed that the market arrivals was at their peak in the months of January, February, July and June in Adilabad, Adoni, Guntur and Warangal markets respectively, while the least market arrivals was recorded during the months of July for Adilabad, Guntur and Warangal markets and in the month of August for Adoni market. The prices were higher in the months of June, July, February and September in Adilabad, Adoni, Guntur and Warangal markets respectively and the prices were lower in the months of May, December, August and July in Adilabad, Adoni, Guntur and Warangal markets respectively. It is observed that the cyclical variation in market arrivals and prices of all the four selected markets under study showed clear cycles but in opposite direction thus the prices vary inversely with the supply of cotton in the markets under study. The irregular variation in market arrivals and prices were found almost similar for all the four selected markets under study. The fluctuations in irregular variation of market arrivals and prices were in the same

directions during the period of 2009 to 2011, while the fluctuations in opposite directions were noticed during the period of 2012 to 2015 in all the selected markets. The regression coefficient and correlation coefficient were found highly significant at 1 per cent level of significance in all the four selected markets. This indicates that the market arrivals of cotton were influencing the prices significantly leading to 62 per cent, 67 per cent, 77 per cent and 69 per cent variation in Adilabad, Adoni, Guntur and Warangal markets respectively.

The analysis of co-integration among markets revealed that that the prices in Adilabad market were influenced by the price in Warangal market to a very high degree as noted by 93 per cent of association. Guntur market price was influenced by the prices in Adilabad and Adoni markets almost to the same degree. Low degree of association was found between Adoni and Guntur markets with (59 per cent), which may be attributed to the imperfect association between these two markets. ARIMA model was used to forecast cotton prices in the four selected markets of Andhra Pradesh. The identified models (2, 1, 0), (1, 1, 0), (1, 1, 0) and (2, 1, 0) were found as the best models for Adilabad, Adoni, Guntur and Warangal markets respectively.

AGRICULTURAL ECONOMICS

Author	:	**MANJISHA, SINHA.**
Title of the Thesis	:	**ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF LAC IN RANCHI DISTRICT OF JHARKHAND STATE**
Chairperson	:	**Dr. N. VANI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V.AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5478**

ABSTRACT

The present study entitled **"Economic Analysis of Production and Marketing of Lac in Ranchi District of Jharkhand State"** was undertaken to study the input use patterns, cost and returns of production of lac, marketing channels for marketing of lac and processing aspects of lac and constraints in production as well as marketing of lac.

The study covered 3 blocks and 6 villages with 90 farmers culturing lac. Based on the number of lac host trees owned by the household, the data were categorized into small (0 – 33 trees), medium (34 – 46 trees), large (47– 59 trees) and very large (60 – 216 trees). The da ta pertained to agricultural year 2015-16 were collected through survey method with the help of pretested schedules. Conventional analysis was used to analyse the data and to arrive at valid conclusions.

The cost of cultivation of lac on small, medium, large, very large and pooled was estimated at ` 20807.36 for 14 host trees, ` 25185.37 for 20 trees, ` 29542.46 for 27 host trees ` 39676.24 for 50 host trees and 28323.03 for 26 host trees respectively and thus exhibiting direct relationship with the size of the farm.

The net income obtained from lac production varied from ` 9025.51 per 14 host trees in small farms, ` 25213.34 per 20 host trees in medium farms, ` 44370.86 per 27 host trees in large farms, to ` 103430.47 in very large farms with overall average of ` 41952.10 on pooled farms. Thus, net income has positive relationship with the size of the farms.

In the marketing of lac only one channel were identified. They were, producer village merchant (Paikar) town merchant (wholesaler) Processor. The analysis of marketing costs and margins revealed that the producer was getting a share of consumer's rupee of about 81.76 per cent.

The total cost incurred to produce one tonne of seedlac was 142339.79 consisting of variable cost amounting to ` 139010.90, fixed cost ` 287.73 and marketing cost of ` 3041.10 sharing about 97.66 per cent, 0.20 per cent and 2.14 per cent respectively.

The gross return obtained from the lac processing unit amounted to 146356.16 and the net return obtained from the lac processing unit were 4016.37.

AGRICULTURAL ECONOMICS

Author	:	**MEHARUNNISA BEGUM, SK.**
Title of the Thesis	:	**AN ECONOMIC ANALYSIS OF MILLETS CULTIVATION IN RAYALASEEMA REGION OF ANDHRA PRADESH**
Chairperson	:	**Dr. S. RAJESWARI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V.AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5480**

ABSTRACT

The present study entitled "An economic analysis of millets cultivation in rayalaseema region of Andhra Pradesh" was undertaken mainly to study costs and returns, resource use efficiency and constraints in production of millets. The study covered four mandals and eight villages and a sample of 120 farmers. The primary data for the year 2015-2016 were collected through a pretested schedule by survey method. Both conventional and functional analysis were used to analyse the data and to arrive at valid conclusions.

The total human labour was highest in ragi (66.40 mandays) followed by korra (32.49 mandays), jowar (29.46 mandays) and sama (17.66 mandays). The per hectare cost of cultivation of jowar, korra, ragi and sama was Rs.23,775.34, Rs.24,406.11, Rs.32,165.15 and Rs.14,533.67 respectively.

The gross income per hectare of jowar, korra, ragi and sama were Rs.30,000, Rs.23,000, Rs.36,947 and Rs.16,258 and net returns for the same crops were Rs.6,224.66, Rs.-1406.11, Rs.4,781.85 and Rs.1,724.33 respectively.

The functional analysis revealed that human labour and seed in jowar, machinery and seed in korra, human labour and seed in ragi and human labour machinery and seed in sama production were significantly contributed to increase the yields and the MVP to MFC ratio for the above was greater than unity indicating greater potentiality for further use.

AGRICULTURAL ECONOMICS

Author	:	**PRASANNA LAKSHMI, MUKKA.**
Title of the Thesis	:	**PRODUCTION AND MARKETING OF TURMERIC IN KADAPA DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. N. VANI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V.AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5479**

ABSTRACT

The present study entitled **"Production and Marketing of Turmeric in Kadapa District of Andhra Pradesh"** was intended to study the input use pattern, costs and returns, resource use efficiency, allocative efficiency, marketing aspects and constraints in the cultivation of turmeric. The study covered four mandals and eight villages with a sample size of eighty. The sample farmers were stratified into small (up to 2 hectares) and large (above 2 hectares). The data pertaining to agriculture year 2015-16 were collected through survey method with the help of pre-tested schedules. Conventional and functional analyses were used to analyse the data and arrive at valid conclusions.

On an average, the total human labour utilization was 236.87, 244.17 and 241.82 mandays per hectare on small, large and pooled farms respectively and thus indicated positive relationship between human labour use and farm size. The major labour absorbing operations were harvesting (30.33%), weeding (28.99%), irrigation (13.45%) and planting (8.58%) on the pooled farms. The same trend was observed on both the size groups.

The per hectare cost of cultivation of turmeric in the study area was estimated at ` 3,31,566.00, ` 3,48,441.60 and ` 3,40,507.93 on small, large and pooled farms respectively and thus exhibiting direct relationship with the size of the farm. The cost of producing a quintal of turmeric exhibited inverse relationship with the size of the holding as it was ` 3,766.94 on large farms and ` 3,900.78 on small farms. A quintal of dried turmeric yielded a net income of ` 3,099.22, ` 3,233.06 and ` 3,150.84 on small, large and pooled farms respectively indicating a direct relationship with the size of the farm. All the measures of income *viz.,* gross income, net income, farm business income, family labour income and farm investment income exhibited positive relationship with the size of the farm. For every rupee of expenditure in the cultivation of turmeric resulted in a net income of ` 0.79, ` 0.86 and ` 0.83 on small, large and pooled farms respectively.

The break-even analysis indicated that the break-even output per hectare in the cultivation of turmeric was 19.29, 19.44 and 19.31 quintals on small, large and pooled farms respectively.

The functional analysis revealed that human labour coupled with plant protection chemicals on small farms and plant protection chemicals on large farms and human labour, seeds and plant protection chemicals on pooled farms contributed to the increase in yields.

The producer share in consumer's rupee was higher in channel I (47.24%) than that of channel II (42.58%).

Inadequate curing facilities, high input prices and volatility of turmeric prices were the major problems faced by turmeric growers in the study area.

AGRICULTURAL ECONOMICS

Author	:	**SARATHBABU, BODDEPALLI.**
Title of the Thesis	:	**ECONOMIC EFFICIENCY OF CHILLI PRODUCTION IN GUNTUR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**DR. Y. RADHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5400**

ABSTRACT

Production of chillies plays an important role in improving the economic conditions of farmer's specially marginal and small farmers at one side and help to meet out the nutritional requirements of the people on the others side. The present study entitled "Economic efficiency of chilli production in Guntur district of Andhra Pradesh" was undertaken with the objectives

(i). to study the cost of cultivation of chilli in Guntur district of Andhra Pradesh;

(ii). to estimate the economic efficiency levels of chilli production;

(iii). to identify the factors affecting the technical efficiency levels of chill production, and

(iv). to analyse the constraints in chilli production

The multistage purposive and random sampling technique was adopted in designing sampling frame for the study. In the first stage Guntur district selected based on the highest area under chilli cultivation in Andhra Pradesh. In the second stage, four mandals *viz.*,

Veldurthi, Sattenapalle, Bollapalle, Medikonduru were selected based on the highest area under chilli. Similarly, in third stage, 3 villages were selected based on highest area under chilli, 10 farmers each from selected village of the mandal were selected at random, in view of spread of chilli growers in villages. Thus, the sample size constituted 120 farmers for the study. The primary data from sample farmers were collected by personal interview method by using pre-tested structured questionnaire. The primary data on cultivation of chilli from farmers pertained to 2015-16 agricultural year.

The value of total assets per hectare was highest on large farms followed by medium and small farms. The value of non-land assets related directly with farm size.

The human labour utilization was directly related with the farm size. Harvesting accounted for maximum share of total labour utilization. Family labour utilization was inversely related with the farm size.

Variable costs, fixed costs and total costs were varying in the three groups of farmers, the per cent contribution of variable costs and fixed costs to total costs remind same in all the three groups. The large farmers were incurring high cost of cultivation, followed by medium and small group of farmers, inferring that the total cost of cultivation was varying directly with the farm size. Variable costs contributed to the extent of 87.30 per cent of total cost of cultivation in sample as a whole and same was maximum in medium farmers when compared to small and large farmers.

There was a direct relationship between the farm size and productivity of chillies. Both the gross and net returns were positively correlated with farm size. All the income measures also showed direct relationship with farm size.

The results of economic efficiency of pooled sample indicated that, chilli farmer could decrease current input by 15.90 per cent to produce the same amount of output. The result for mean allocative efficiency also suggests that cost of production could be reduced by 24.80 per cent had farmers used the right inputs and low cost to input costs. On the other hand, it was observed that only about 10 per cent of farms, *i.e.* 12 farmers of the total 120 farmers under constant returns to scale performed with economic efficiency level equal to 0.90 or greater The mean efficiency score was 0.632. Based on this, it could be inferred that remaining 108 farmers, which did not operate at the maximum efficiency level, could reduce the input level by 36.80 per cent and maintain the same level of chilli production as achieved by 10 per cent of the farmers.

The results of regression equation fitted to identify the determinants of Technical efficiency indicated that among the significant variables, human labour and irrigation had a greater influence on technical efficiency of chilli in all farm sizes, followed by the cost of production.

The sample farmers prioritized the high cost of human labour during chilli production as the major constraint for the production of chilli with a score of 0.98 followed by high cost of irrigation (0.89) and pest and disease management (0.80).

AGRICULTURAL ECONOMICS

Author	:	**SATISH KUMAR, CH.**
Title of the Thesis	:	**ECONOMIC ANALYSIS OF COFFEE CULTIVATION AND IT'S IMPACT ON SOCIO-ECONOMIC CONDITIONS OF TRIBAL FARMERS IN VISAKHAPATNAM DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. K. S. R. PAUL**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5402**

ABSTRACT

Coffee is one of the important commercial plantation crops grown in India. It is the second largest traded commodity in the world after crude oil and is referred as 'Brown Gold'. It is estimated that more than 20 million people throughout the world earn their living from coffee.

The research study entitled "Economic Analysis of Coffee Cultivation and it's Impact on Socio-economic Conditions of Tribal Farmers in Visakhapatnam District of Andhra Pradesh" was taken up with the following objectives.

1. To study cost and returns of coffee cultivation in Visakhapatnam district
2. To analyse the impact of coffee cultivation on socio-economic conditions of tribal farmers in Visakhapatnam district
3. To examine and evaluate different methods of coffee processing and assess the factors that influence the choice of coffee processing method in Visakhapatnam district
4. To identify important marketing channels and analyse marketing costs for coffee in Visakhapatnam district
5. To identify the problems of coffee production and processing in Visakhapatnam district

A sample of 90 farmers were selected from eighteen villages in six mandals of Paderu division of Visakhapatnam district of Andhra Pradesh. The important analytical tools employed in the study were project evaluation techniques, livelihood framework analysis, multiple linear regression, binary logistic regression, Garret ranking technique, simple tabular analysis, *etc.*

The study revealed that the total human labour required for the establishment of coffee plantation (1st year) was 229 man days per hectare, of which digging of pits, bush clearance, application of manures, weeding and line marking and staking took the major share of 67 man

days (29.26 per cent), 55 man days (24.02 per cent), 37 man days (16.16 per cent), 20 man days (8.73 per cent) and 20 man days (8.73 per cent) respectively.

The total human labour required for cultivation of coffee was 207 man days per hectare of which harvesting, weeding, earthing up of soil, spreading of FYM and shade regulation were the major labour absorbing operations accounting for 97 man days (46.86 per cent), 52 man days (25.12 per cent), 17 man days (8.21 per cent), 7 man days (3.38 per cent), 7 man days (3.38 per cent), of total labour respectively.

The average total variable cost of coffee was Rs.27644 per ha, average gross returns per ha obtained by selling the fresh fruit berry was Rs.84550 average gross margin was Rs.56876.17 per ha and profitability index was 2.05 indicating that the farmer earned Rs.2.05 on each rupee invested. Farm investment techniques like net present value, BCR, IRR and payback period were computed and found to be Rs.243136, 2.03, 26.39 and 9 years respectively which pointed out that the investment on coffee plantation was feasible and economically viable.

Farm size and farming experience variables were positively significant, while farmer's age was negatively significant on coffee production. The average per ha annual net income obtained from coffee was three times higher than any other agricultural crops grown by the tribal farmers. Hence coffee cultivation was significantly contributing to the overall increase in the economic status of the farmers. Livelihood frame work analyses indicate that different capital assets were improved because of more income obtained from coffee plantation.

Majority of the farmers (65.55 per cent) adopted both the processing methods *viz.* Sundry + wet processing. The results of binary logistic regression indicate that only water source was significantly determining the choice of method processing.

Three marketing channels were identified and among which only one channel was considered in the present study. In channel –I the price spread was Rs.13, 269.97 and marketing efficiency was 14.23. Lack of irrigation, lack of skilled labour, lack of knowledge, lack of water source, shortage of central washing stations, low price of processed coffee were the major problems faced by farmers in production and processing of coffee.

AGRICULTURAL ECONOMICS

Author	:	**SHIREESHA, G.**
Title of the Thesis	:	**AN ECONOMIC ANALYSIS OF ACID LIME CULTIVATION IN NELLORE DISTRICT OF ANDHRA PRADESH WITH SPECIAL REFERENCE TO VARIETY BALAJI**
Chairperson	:	**Dr. B. APARNA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V.AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5481**

ABSTRACT

The present study entitled "An economic analysis of acid lime cultivation in Nellore district of Andhra Pradesh with special reference to variety balaji" was intended to examine the cost structure and economic viability in the cultivation of acid lime orchards. The study was carried out in Nellore district of Andhra Pradesh. Four mandals and eight villages having maximum area under balaji and local varieties were selected. All the acid lime orchardists of balaji and local varieties in the selected villages were listed out and 80 farmers were selected at random. 40 farmers from each balaji and local varieties of acid lime constituted the sample for the detailed study. The primary data were collected by survey method through well structured schedule for the agricultural year 2015-16. The data were analyzed by using conventional analysis and project evaluation techniques.

The total labour requirement during 15 years of acid lime orchard stood at 6171.19 mandays per hectare on balaji variety farms and 5380.38 mandays per hectare on local variety farms. The important labour absorbing operations were harvesting (1738 and 1172.5 mandays), irrigation (975 and 729 mandays), application of manures and fertilizers (728.6 and 838 mandays) and weeding (718 and 669 mandays) on balaji and local varieties of acid lime orchards.

The total cost for the 15 years of acid lime orchards worked out to 24,87,200.40 on balaji variety orchards as against ` 22,00,066.62 on local variety farms. Of the total cost, human labour was the highest item of the cost accounting for 44.98 per cent and 44.16 per cent of the total cost on the above said categories of farms respectively. Orchardists of balaji variety and local variety realized a net income of ` 12,82,797 and ` 7,81,047.40 per hectare respectively. The orchardists incurred ` 1,542.93 and ` 1,702.83 to produce a quintal of balaji and local varieties of acid lime respectively.

The NPV, B-C Ratio and IRR on balaji and local varieties worked out to ` 95,149.59 and ` 5,878.26, 1.25 and 1.01 at 24 per cent discount rate and 33.17 per cent and 24.6 per cent respectively. The project evaluation techniques revealed that acid lime production was economically viable in the case of both the varieties. However, the capital productive was higher on balaji variety orchards than on local variety farms.

AGRICULTURAL ENGINEERING
(AGRICULTURAL PROCESS AND FOOD ENGINEERING)

Author	:	**ANU BABU, TAGARAM.**
Title of the Thesis	:	**OPTIMIZATION OF PROCESS PARAMETERS FOR SPRAY DRYING OF PAPAYA LEAF JUICE**
Chairperson	:	**Dr. SIVALA KUMAR**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5461**

ABSTRACT

The present work was undertaken to optimize the process parameters for spray drying of papaya leaf juice. The effects of inlet air temperatures (130, 140 and 150 ^{o}C), maltodextrin concentrations (8%, 10%, 12%) and feed flow rates (350, 475 and 600 mL/h) on the powder yield and physico-chemical characteristics of papaya leaf powder (moisture content, water activity, L* values, a* values, b* values, pH values and total flavonoid content) obtained by spray drying were studied. Response Surface Methodology (RSM) was used to investigate the optimum process conditions for spray drying of papaya leaf juice and to analyze the effects of inlet air temperatures, maltodextrin concentrations & feed flow rates on spray drying of papaya leaf juice. Response surface plots of dependent variables against process variables were studied. The different regression equations describing the process variables on the yield and physico-chemical characteristics were developed. The predicted models were adequate based on the coefficient of determination obtained.

The papaya leaf juice for spray drying was prepared by adding different concentrations 8%, 10% and 12 % of maltodextrin as carrier agent to the concentrated papaya leaf juice. After adding maltodextrin, the papaya leaf juice was fed into the spray dryer under different feed flow rates such as 350, 475 and 600 mL/h and dried at different inlet air temperatures such as 130, 140 and 150 ^{o}C in a spray dryer. The storage period of papaya leaf powder was determined by measuring physico-chemical characteristics of spray dried powder for about 45 days.

Spray drying of papaya leaf juice at the optimized condition of inlet air temperature 130 ^{o}C, maltodextrin concentration 8% and feed flow rate 350 mL/h has given yield, moisture content, water activity, L* values, a* values, b* values, pH values and total flavonoid content of spray dried papaya leaf powders as 20.22 g, 4.65%, 0.32, 51.12, -0.29, -73.88, 37.29, 6.43, 63.13 mg/g of powder, respectively. Moisture content, water activity, color characteristics, total flavonoid content (TFC) were significantly affected by maltodextrin concentrations, feed flow rates and the inlet air temperatures. pH of spray dried papaya leaf powders was not affected by inlet air temperatures and feed flow rates. An increase in moisture content and water activity were observed during storage period of 0 to 45 days. Slightly decrease of pH

was observed with increase in storage period of 0 to 45 days. There was no loss of flavonoid content in papaya leaf powder during storage period of 0 to 45 days.

Keywords: *Papaya leaf powder, Physico-chemical characteristics, Shelf-life of papaya leaf powder, response surface methodology and optimization*

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**BIDYARANI CHANU, N.**
Title of the Thesis	:	**SIMULATION OF STREAM FLOW AND SOIL EROSION IN KRISHNA LOWER SUB BASIN**
Chairperson	:	**Dr. A. MANI**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5464**

ABSTRACT

Quantification of water resources in a catchment, particularly stream flow is necessary for a systematic analysis of water availability for long-term planning of water utilization. Stream flow is the spatial integration of runoff which is a major component of the catchment water balance.The lower Krishna basin is a deficit basin and it depends mainly on inflow from the upper basin and on upstream water uses. There is a declining trend of surface water inflow due to prevention of flow in the upper basin and lead to shrinkage of surface irrigation. Therefore, the project entitled 'Simulation of stream flow and soil erosion in Krishna lower sub basin'was proposedfor systematic analysis of water availability.

The different DEMs were downloaded from different sources to generate basin characteristics namely drainage area, elevation, slope steepness, slope length, and streams relief ratio.Among these DEMs, SRTM 90 m produced correct stream network. The IRS P_6, LISS III imagesfor 2014 and 2015 were downloaded from Bhuvan. The LULC maps were prepared for the study. Soil map developed by National Bureau of Soil Survey and Land Use Planning (NBSSLUP) was taken as reference map and clipped to the study area to identify the type of soils.

The study area consisted of mainly four types of soils. Majority of the area is under silt soils (46%) and clay soils (43%). Remaining 7 percent and 4 percent are under loam and water bodies. The average annual rainfall of study area for 23 years during 1990 to 2015 was 931.31 mm. The highest amount of rainfall was recorded in 2010 as 1620.71 mm and the lowest amount of rainfall was recorded in 2009 as 566.54 mm.About 91% of the area is nearly level and remaining 8% of the area occupied moderate slope to steep slope.

ArcGIS, ERDAS and HEC-HMS softwares were used and the SRTM DEM was used to derive parameters for the hydrological modelling. The results acquired using Geo-HMS were the catchment area of each sub-basin, slope of each sub-basin, flow lengthand time of concentration. After preparation of various input parameters, streamflow for a period of 23 years was simulatedusing SCS-CN technique. The time to peak and peak discharges for different storm events was also estimated.

Simulated runoff was more for the years with high rainfall. The annual runoff is highly correlated with annual rainfall with coefficient of 0.9. The simulated runoff depth was 1383.5 mm in the year 2010. It was only 261.97 mm in the year 2002. The average annual runoff depth during the period of 1993 to 2015 was 668.59 mm.Build up areas have produced more runoff followed by scrub land, current fallow, rabi crop, kharif crop, forest, plantation and double crop/triple crop areas.The simulated peak runoff rates were matched well with the inflow discharges that are available at Pulichintala project for different storm events and were in good agreement with R2=0.89. Hence, the model HEC- HMS can be used to predict runoff rate to plan flood mitigation measures.

RUSLE modelintegrated with GIS and RS techniques was used for estimation of annual average soil loss rate (t ha^{-1} yr^{-1}). The potential soil erosion in Krishna lower sub basin of Andhra Pradesh were mapped and quantified using RUSLE modelfrom 1993-2015. The maximum annual average soil loss occurred in the Krishna lower sub basin for the year 1993 to 2015 was 28.69t $ha^{-1}yr^{-1}$.Around 43.02% of catchment was prone to slight erosion. About 42.41% of area showed moderate soil erosion. Strong to severe erosion occurred in around 12.45% are in 1.3% area. Very severe erosion occurred in 0.8% which was very less compared to other classes.The study revealed that the average annual soil loss was sensitive to rainfall factor, R and the type of land use.

The very severe erosion was occured in 13.45% (262.66 km^2) of build up and 9.28% (21.65 km^2) of wasteland. Severe erosion occurred in 38.77% (768.561 km^2) percent of scrubland, in 18.62% (233.26 km^2) and 4.73% (43.93 km^2) of rabi crop area and waste land. Moderate erosion occurred in double/triple cropping area and slight erosion occurred in forest and Kharif crop.Percolation tank and check dams were suggested as conservation measures in severely eroded area.

Hence, the hydrological model HEC-HMS can be used for event based simulation of rainfall events in lower Krishna sub basin of Andhra Pradesh. RUSLE erosion model integrated with GIS and remote sensing can be used to map the soil loss in lower Krishna sub basin of Andhra Pradesh.

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**HARSHAVARDHAN REDDY, M.**
Title of the Thesis	:	**PERFORMANCE ASSESMENT OF THATIPUDI MEDIUM IRRIGATION PROJECT**
Chairperson	:	**Dr. M.V. RAMANA**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5465**

ABSTRACT

The World's population is increasing at an alarming rate resulting in increasing demand for food and fiber. On the other hand, per capita availabilityof land and water resources are decreasing. Water is a valuable natural resource, which is used for agriculture, recreation and industrial purpose. Due to industrialization, population growth and urbanization, demand for wateris being increased drastically, which resulted in stress on the water resources. The major portion of the water is used in agriculture sector for irrigation purpose to enhance the crop production. Due to growing demand for household and development purpose the share of the irrigation water needs to be diverted for industries, recreation and drinking purpose. Therefore, it is the need of the hour to effectively utilize the available water resources optimally and judiciously,Irrigation was given major importance in many countries of the world. However there is wide spread dissatisfaction with the performance of irrigation projects in developing countries. In India the performance of irrigation projects is reported to be very low, having an overall efficiency of 25-30 percent only due to lack of proper irrigation water management (Akhilesh *et al*., 2012). So the existing project and project command areas need to be evaluated for improving their System performance, agricultural production, financial aspects, irrigation efficienciesand water use efficiencies.

The present investigations is carried out in Thatipudi medium irrigation project in the district of Vizianagaram, Andhra Pradesh. It was constructed across Gostani River in 1963-68 and it serves 6218.29 ha of command area in Gantyada, Jami and S.kota mandals of Vizianagaram district. The average annual rainfall is 1183 mm.The study area received 64.32 per cent of annual rainfall during South West monsoon season and 23.52 per cent in North East monsoon season and remaining 12.16 per cent during winter and summer seasons. Crop water requirement and water use efficiency for Paddy, Pulses and Banana was estimated 1310.5 mm, 406.5 mm,1435.0 mm and 62.098%, 90.39%, 83.944% respectively. Overall irrigation efficiency for Thatipudi project was estimated as 29.67 %. Reservoir filling or storage efficiency was observed as 96.06 %, Conveyance efficiency was 65.778 % and the application efficiency was 45.581 %.

This project was analysed through performance indices which are given by the INCID (Indian National Committee on Irrigation and Drainage).System performance and Agricultural

production indices are found 'good' condition but the financial aspect indices are 'very poor' due to less revenue collection, low operation and maintenance funds and less persons involved for operating the project.Finally water budget was prepared by observing the current storage, average inflows to the reservoir the Gross water requirement for the crops (81.55 Mm^3), water supplying for the Greater Vishaka Municipal Corporation (GVMC) (15.17 Mm^3), leakage through head regulator (4.177 Mm^3), Water for Domestic and live stock purposes (2.98 Mm^3).

Key words: Medium irrigation project, Command area, Crop water requirement, Irrigation efficiencies, Performance indicators, Water budget.

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**INDRAJA, P.**
Title of the Thesis	:	**MODELLING THE IMPACT OF SALINE AND WATERLOGGED AREAS IN KRISHNA CENTRAL DELTA**
Chairperson	:	**Dr. H.V. HEMA KUMAR**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5467**

ABSTRACT

Land, a non-renewable resource, is central to all primary production system. It is estimated that some forms of land degradation constituting 75% of the earth's usable landmass affect 4 billion people in the world. About 15% of the world population is effected by land degradation which is likely to worsen unless adequate and immediate measures are taken to arrest the degradation processes. Mostly land is affected by wind and water erosion, which is about 80% of land degradation followed by salinization/alkalization and waterlogging. Krishna delta irrigates an ayacut of 5.14 lakh ha covering West Godavari, Krishna, Guntur and Prakasam districts of Andhra Pradesh. Eastern main canal's command area is about 2.948 lakh ha in Krishna and West Godavari Districts. Krishna Central Delta is a part of Krishna Eastern Delta that constitutes the command area of Bandar canal. During monsoon, these lands are affected by waterlogging and salinity problems.

Hence it is felt appropriate to study Krishna Central Delta with a special focus to identify the waterlogged and saline lands for reclamation by either drainage system or addition of amendments like gypsum etc. Under the aforesaid valid and farmers' felt research needs, the present post graduate research work entitled "**Modelling the impact of saline and waterlogged areas in Krishna Central Delta"** is proposed to i) to estimate the extent of land under waterlogging and salinity in Krishna Central Delta. ii) to simulate the effect of

waterlogging and salinity on crop yield using a model with various hypothetic scenarios. iii) to design location specific drainage parameters for combating waterlogging and salinity.

Krishna Central Delta which is a part of Krishna Eastern Delta constitutes the command area of Bandar canal which has an irrigated ayacut of 274834.09 acres (111223.83 ha) in Krishna district. In this study Landsat 8 images and Sentinel-2A images were used and analyzed using ERDAS IMAGINE 2014 and ArcGIS 10.1 software's. From the literature, different salinity indices were selected to find out the best suited index for the study area. Salinity indices used to find the salt affected soils using GIS. Details of ground water quality parameters which were analyzed from the water samples collected from the observation wells located in the Krishna Central Delta were collected from Ground water Department, Vijayawada.

Initially for the identified problematic patches, the input parameters some directly measured, some indirectly were assessed and fed into 'SALTMOD' model. Without the presence of any drainage systems, simulation for first, fourth, sixth and tenth year for depth of ground water table and root zone salinity was carried out and the output parameters were fed into AquaCrop model along with other crop, climate, irrigation requirement and other related parameters to predict the yields. WaSiM, Water balance Simulation Model is a physically based, distributed hydrologic model that runs on a regular grid and uses a modular system of sub-models to offer the possibility of creating a problem and scale adequate setup. Drain space, one of the modules of WaSim was used for sub surface drainage design.

Based on the research work carried out, the major conclusions drawn are i) Normalized Difference Vegetation Index (NDVI) was found to range from 0.72 to -0.92 in Krishna Central Delta (KCD) region. In KCD region, Normalized Difference Salinity Index (NDSI) was found the best suitable and it ranged from -0.714 to 0.185 and best correlated with ground truth values. Soil salinity was characterized into five classes and it was found that highest area was under moderately saline with an area of 68754.01 ha followed by strongly saline, slightly saline, non saline and very strongly saline. ii) Spatial analysis of water table data revealed that most critically waterlogged zone was found in post monsoon covering an area of 597.65 km^2 which was about 26.27% of the total study area. It was found that critically waterlogged area increased from 620.12 km^2 (27.25%) in pre monsoon period to 1074.02 km^2 (47.2%) in post monsoon period. The area under less critically waterlogged was found to be decreased from 704.49 km^2 (30.95%) in pre monsoon to 163.06 km^2 (7.16%) in post monsoon period. iii) Soil salinity was predicted for future ten years using SALTMOD and corresponding yield were predicted using Aquacrop. With increase of soil salinity from 0.5 dS m^{-1} to 6.5 dS m^{-1} there was about 42.28% reduction in the crop yield and 36.69% reduction in biomass yield. iv) Using 'Drain Space', a module of WaSim software, by using the Hooghoudts equation under steady state condition, the drain spacing for shallow drain depth placement of 0.6 m, 0.7 m and 0.8 m the spacing was arrived as 9.5, 16.6, 22.36 m. For deeper drain depth placements of 0.95, 1.0 and 1.15 m, the drain spacing was arrived as 30, 32.4 and 38.81 m respectively for a constant desired depth of water table as 0.5 m to make the root zone free from waterlogging.

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**KISHAN, K.**
Title of the Thesis	:	**OPTIMUM ALLOCATION OF SURFACE AND GROUND WATER RESOURCES OF APPAPURAM CHANNEL COMMAND IN KRISHNA WESTERN DELT**
Chairperson	:	**Dr. H.V. HEMA KUMAR**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5472**

ABSTRACT

The sustainability of water resources is a critical issue against the backdrop of rising water demand for agricultural, industrial and domestic uses as the world needs about 60% more food (FAO, 2013) to feed the 9.5 billion people in 2050 (United Nations, 2012). The issue has become more challenging in the light of shrinking water resources due to urbanization, contamination, and climate change impacts.

The Central Ground Water Board strongly emphasized and recommended conjunctive use of surface water and ground water should be followed not only to meet the requirements of tail-end areas but also to reduce the water logging and salinity problems. Appapuram channel (commands about 10,000 ha and is of 43.186 km length) is a Commamuru canal in Krishna Western Delta (KWD), flowing through agricultural fields of Chebrolu, Vatticherukuru and Kakumanu mandals of Guntur district is found to be appropriate as per its representative scope for conjunctive use planning. Hence this research study, titled "Optimum Allocation of Surface and Ground Water Resources of Appapuram Channel in Krishna Western Delta" is proposed on a pilot scale to fulfill the following objectives. i) To assess the surface water quality and quantity available in Appapuram channel command. ii) To estimate the ground water resources quality and quantity available in the channel command. iii) To estimate the irrigation water requirements of existing and other high value crops in the channel command using Aqua Crop model. iv) To optimize the use of surface and ground water resources using LINGO and other models to maximize the profit in the channel command. v) To study the institutional management and capacity building aspects for the successful implementation of identified conjunctive use planning.

The command area of Appapuram channel, which branches form Commamuru branch canal (Krishna Western main canal) near Sangam Jagarlamudi lock is selected as the study area. It spreads over 10000 ha and is on an average 6 m above the mean sea level. Interaction meetings and interviews with the farmers, WUA members were conducted to collect the information regarding the cropping pattern, canal supplies, demand and short falls. Field visits were made to study the actual cropping pattern existing in the command.

Though the crops like paddy, cotton, maize, chillies, black gram, and green gram and sugarcane are commonly grown in the area, for the past three years, farmers were growing paddy, in kharif and maize, blackgram in rabi seasons respectively. The model CROPWAT was run to calculate the effective rainfall which is an important parameter for calculating crop irrigation requirement. The canal water release data for 10 years (2005-2015) were collected from Water Resources Department at Bapatla in AP and analyzed for further investigation. The details of crops grown in the command, climate, soil data etc. collected are used to assess the net irrigation requirement in the distributary using Aqua Crop 4.0 Model. 'LINGO' model is chosen for the study for optimized allocation of to maximize the net profit. To summaries the results, For branche no.1,2,8 & 9, there is no feasibility of conjunctive use planning at present in view of saline ground water. For branch no. 3, 4, 5, 6,7 & 8 the profit could be increased when 40% and 50% additional ground water is pumped from the commands. Though different crops tried, the model allocated more area for chillies followed by rice and cotton in view of their high value and profit contribution. For branch No.1 of Appapuram canal, if 100% and 90% of surface water alone is utilized, a profit of Rs. 59.35lakh and Rs.53.41 lakh respectively could be obtained. For branch No. 2 of the canal, if 100% surface water alone is used, a maximum profit of Rs. 175.54 lakh rupees could be obtained. For branch No.3 if 100% surface water, 100% surface water+ 20% Ground Water, 100% surface water+ 30% Ground water, 100% surface water+ 40% 100% surface water+ 50% are utilized, a profit of Rs. 125.87 Rs.169.46, 191.25 and 213.05 lakh could be obtained respectively. For branch No.4, if 100% surface water, 100% surface water+ 20% Ground Water, 100% surface water+ 30% Ground water, 100% surface water+ 40% 100% surface water+ 50% are utilized a profit of Rs. 37.37, 50.02, 56.77, 63.23 and 69.71 lakh could be obtained respectively.

For branch No.5, if 100% surface water, 100% surface water+ 20% Ground Water, 100% surface water+ 30% Ground water, 100% surface water+ 40% 100% surface water+ 50% are utilized a profit of Rs. 106.37, 143.20, 161.60, 180.02, and 198.43 lakh respectively could be obtained respectively. For branch No.6, if 100% surface water, 100% surface water+ 20% Ground Water, 100% surface water+ 30% Ground water, 100% surface water+ 40% 100% surface water+ 50% are utilized a profit of Rs. 130.45, 175.64, 198.22, 220.79, and 243.38lakh respectively could be obtained respectively.

For branch No.7, if 100% surface water, 100% surface water+ 20% Ground Water, 100% surface water+ 30% Ground water, 100% surface water+ 40% 100% surface water+ 50% are utilized a profit of Rs. 18.925, 34.32, 48.577 and 62.17 lakh respectively could be obtained respectively. For branch No.8 if 100% of surface water alone is utilized, a profit of Rs. 35.355lakh respectively could be obtained. For branch No.9, if 100% of surface water alone is utilized, a profit of Rs. 29.47 lakh respectively could be obtained.

As per the survey conducted in the entire command, it lacks the involvement of institutes particularly in conjunctive use of surface and ground water resources. There is lot of gap and capacity building is highly essential for the line departments and farmers in formulating and for the successful implementation of the conjunctive use plans. From the above study, it could be concluded that an additional benefit of Rs. 5000-8000/-/per ha could be foreseen if conjunctive use plans of surface and ground water are implemented in the command.

AGRICULTURAL ENGINEERING
(AGRICULTURAL PROCESS AND FOOD ENGINEERING)

Author	:	**LAVANYA, P.**
Title of the Thesis	:	**CHARACTERIZATION OF FUEL BRIQUETTES FROM MAIZE COBS AND COTTON STALKS**
Chairperson	:	**Dr. D. BHASKARA RAO**
Degree	:	**M.Tech.**
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Accession Number	:	**D5462**

ABSTRACT

Agriculture waste management during processing is one of the most serious rural-urban environmental problems in India. The disposal of this agriculture waste in the fields is being done mostly by burning, thereby causing health hazards and air pollution. Adequate means of disposing these wastes are lacking. Hence, converting them to other useful products such as briquettes for fuel is highly essential. In Andhra Pradesh, large quantities of maize cobs and cotton stalks are produced annually and are the two most commonly available agricultural residues that can be utilized for the production of briquettes.

In this study, briquettes were produced from these two raw materials using high pressure briquetting machine operated at 118 MPa. Briquettes were produced with the maize cobs and cotton stalks in the ratio of 100M:0C, 50M:50C, 75M:25C, 25M:75C and 0M:100C combinations with and without binders. Briquettes with these combinations were prepared by adding banana peel and molasses as binders at 10% and 15% level (w/w basis). Proximate analysis of briquettes was done in terms of moisture content and per cent ash. The effects of raw material combination, binder type and its proportion on physical properties like compressed density, relaxed density, relaxation ratio, moisture content, diametral expansion, longitudinal expansion, shatter resistance, water absorption and compressive strength were evaluated. Calorific values of the briquettes were also found out to test the suitability of briquettes as fuel.

Briquettes with binders had more positive attributes than briquettes without binders. The compressed density and relaxed density of briquettes produced from different treatments ranged from 688.62-1631.48 kg m^{-3} and 595.04-1495.81 kg m^{-3} respectively. Relaxation ratio of briquettes produced from these treatments ranged from 0.82 and 1.57. The moisture content of briquettes ranged from 2.69% to 19.23% (w.b.). Shatter resistance of briquettes produced from different treatments ranged from 29.44% to 100%. Compressive strength and water absorption of briquettes ranged from 644.87-3965.31 kPa and 32.96% to 190.57% respectively. The ash content and calorific value of different combinations were 2.1% to 4.42% and 1749.89-3606.09 kcal kg^{-1} respectively. Among all treatments in terms of all the properties, briquettes prepared from 100% cotton stalks and 75C:25M were rated as best. Briquettes prepared from 75M:25C ranked last. Cotton stalks briquettes had good strength

properties compared to maize cobs briquettes. Net cost of production for maize cobs and cotton stalks were Rs.3840 tonne^{-1} and Rs. 3340 tonne^{-1}, respectively.

Key words: Binder, banana peel, molasses, ash, calorific value, compressed density, compressive strength, shatter resistance and cost economics.

AGRICULTURAL ENGINEERING
(FARM MACHINERY AND POWER ENGINEERING)

Author	:	**LEELA VEERA VARA PRASAD, MORLA.**
Title of the Thesis	:	**DEVELOPMENT AND EVALUATION OF MINI-TRACTOR DRAWN RIDGE PLANTER FOR MAIZE CROP**
Chairperson	:	**Dr. S. JOSEPH REDDY**
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Accession Number	:	**D5463**

ABSTRACT

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as "Queen of cereals" because it has the highest genetic yield potential among the cereals and also staple food for human being and quality feed for animals. In developed countries, maize is consumed mainly as second cycle produce, in the form of meat, eggs and dairy products. In developing countries, it is consumed directly and serves as staple diet for some 200 million people. Among the cereal crops in India, Maize with annual production of around 22.5 million tonnes from 8.67 million hectares ranks third in production and contributes to 2.4% of world production with almost 5% share in world harvested area (Gracy *et al*., 2013). In India maize consumption has increased at a CAGR of 3.6% over the last five years and poultry feed accounts for 50% of maize consumption. According to advance estimate its production is 15.5 million tonnes (2015-16) mainly during *Kharif* season which covers 80% area. Maize in India, contributes nearly 9% in the national food basket and more than Rs. 100 billion to the agricultural GDP at current prices. Recent trends (2004-05 to 2014-15) in growth rate of area (2.5%), production (5.5%) and productivity (2.9%) of maize in India has been of high order and experienced highest growth rate among the food crops.

World population is increasing day by day which is a serious threat to food security. This can be overcome by enhancing production of major crops like maize, rice, wheat, etc. So the demand for maize is increasing day by day in the world as well as India. But the maize yield varied greatly in different countries. The factors affecting maize yield are conventional method of cultivation and also lack of precision planting technologies. In recent decades, with the improvement of seed quality, germination percentage and emergence rate of maize seed

have been guaranteed. As a result precision planting has become the main direction for seeding maize. The method of planting also plays a vital role for better establishment of crop under a set of growing situation. Different sowing methods followed for maize are Raised bed (ridge) planting, Zero-till planting, Conventional till flat planting, Furrow planting and Transplanting. Among all these sowing methods the raised bed planting is considered as best planting method for maize during monsoon and winter seasons both under excess moisture as well as limited water availability/rainfed conditions. Presently, large farmers alone are using tractor operated machinery and implements because of high initial cost involved in the purchase of present tractors. The medium horse power tractors ranging from 31-40 hp are most popular and are fastest growing segment. The cost of these tractors is as high as 5.0-6.75 lakhs, which is beyond the purchasing capacity of small and marginal farmers. In India, approximately 65-70% of total land holding contributes small and marginal farmers.

The present study was conducted on the "Development and evaluation of mini-tractor drawn ridge planter for maize crop" which was carried out at Regional Agricultural Research Station, Nandyal. An attempt was made to develop ridge planter with three ridge bottoms and evaluated for its performance with ground wheel drive in terms of seed rate, seed damage, field efficiency, fuel consumption, seed to seed spacing, depth of sowing etc. Working width of developed ridge planter is 1.2 m, spacing between two furrow openers is 60 cm and no. of furrow openers are two. Good recommended seed rate was obtained through inclined plate metering mechanism compared to vertical plate metering mechanism at 2, 2.5 and 3 km h^{-1} speed of operations i.e. 22.78, 20.83 and 18.67 kg ha^{-1}, respectively. Effective field capacities of the developed ridge planter at 2, 2.5 and 3 km h^{-1} speed of operations were 0.16, 0.212 and 0.251 ha h^{-1}, respectively. Ground wheel slip of the developed ridge planter at 2, 2.5 and 3 km h^{-1} speed of operations was 2.45, 1.04, and 0.90%, respectively. The fuel consumption of tractor for planting of maize at 2, 2.5 and 3 km h^{-1} speed of operations were 2.07, 2.43 and 2.72 l h^{-1}, respectively. Seed miss index was less at 2.5 km h^{-1} speed of operation with both the inclined plate and vertical plate metering mechanisms. The spacing between seed to seed for planter with vertical plate metering mechanism was 18.76, 20.60 and 22.10 cm and with inclined plate metering mechanism was 19.23, 20.02 and 22.40 cm at 2, 2.5 and 3 km h^{-1} speed of operations, respectively. The average depth of planting for ridge planter with vertical plate and inclined plate metering mechanism was 42.34 and 41.67 mm, respectively. Germination of seeds was 84.33%. Plant population in one square meter for planter with vertical plate metering mechanism was 13, 10 and 9 and with inclined plate metering mechanism was 12, 10 and 8 at 2, 2.5 and 3 km h^{-1} speed of operations, respectively. Cost of operation for developed ridge planter and traditional method was Rs. 1785/- and Rs. 2900/- per hectare, respectively.

Keywords: Inclined plate metering mechanism, Vertical plate metering mechanism, Seed to seed spacing, Field efficiency.

AGRICULTURAL ENGINEERING
(FARM MACHINERY AND POWER ENGINEERING)

Author	:	**MADHAVA, M.**
Title of the Thesis	:	**DESIGN AND DEVELOPMENT OF HYBRID SOLAR PHOTOVOLTAIC GREENHOUSE DRYER**
Chairperson	:	**Dr. SIVALA KUMAR**
Degree	:	**M.Tech.**
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Accession Number	:	**D5469**

ABSTRACT

India is the second largest producer of rice (*Oryza sativa* L.) in the world next to China with production of 104.8 MT during the year 2014-15. Andhra Pradesh is the third largest producer of rice in India, about 9 per cent of paddy is lost due to use of old and outdated methods of post harvest practices. Solar drying of agricultural products in enclosed structures by forced convection is an attractive way of reducing post-harvest losses. Study has been conducted to design and develop a hybrid solar photovoltaic greenhouse dryer for drying of paddy.

A greenhouse dryer with 4467 mm length, 2134 mm width and 2591 mm height at the centre was designed and fabricated with 50.8×25.4 mm mild steel (MS) pipe, 19×30.2 mm MS angles. Transparent twin wall polycarbonate sheet of 6 mm thickness was used as a covering material. Forced ventilation was provided with 9-inch diameter exhaust fan which runs at 1200 rpm with rated power of 40 Watt. Two 150 W power capacity solar photovoltaic panels with 18.5 V rated voltage and 8.10 A rated current were used to drive the exhaust fans.

Study on assessment of ten years solar radiation data of Andhra Pradesh state revealed that, an average global solar insolation in the state was 5.21 kWh m-2. Average air temperature of 27.28 °C, 63.75% relative humidity and 3.4 ms-1 wind speed was observed. Performance evaluation was conducted under no load condition. It was observed that the average dryer air temperature was 7.6-13.4 °C and 6.3-13.2 °C (22-43%) higher than the ambient temperature during *Rabi* and *Kharif* seasons, respectively. Ambient air temperature varied between 29-38 °C and 25-36 °C during *Rabi* and *Kharif* seasons, respectively. Average relative humidity of the green house dryer was 26-47% and 23-40% less as compared to ambient relative humidity during *Rabi* and *Kharif* seasons, respectively, where as ambient relative humidity varied between 34-64% and 44-68% during *Rabi* and *Kharif* seasons, respectively. Forced ventilation was achieved by DC exhaust fans, which was powered with photovoltaic panels. Exhaust air flow rate varied in the range of 38.93-81.95 m3 min-1, and 28-63 m3 min-1 during *Rabi* and *Kharif* seasons respectively.

Performance evaluation of solar greenhouse dryer under full load condition for *kharif* and Rabi paddy was conducted with three different bed thicknesses (5, 10 and 15 cm). *Kharif*

paddy was dried from 26.5% to 12.15%, 25.3% to 10.87% and 26.15% to 11.13% moisture content (w.b.) within 25, 25 and 16 h of drying for 15, 10 and 5 cm bed thickness, respectively. Highest drying rate observed during the first day of drying was 2.02 %(d.b) h-1 for 5 cm, whereas 1.62 and 1.27%(d.b) h-1 drying rates were observed for 10 cm and 15 cm, respectively. Rabi paddy was dried from 22.3% to 12.57%, 22.8% to 11.57% and 22.4% to 10% (w.b) in 21, 21 and 17 h of drying for 15, 10 and 5 cm, respectively. Highest drying rate observed during the first day of drying was 2.0, 1.29 and 1.27%(d.b) h-1 for 5, 10 and 15 cm, respectively.

Milling quality analysis showed that there was no significant effect of season, replication and interaction of season and depth on brown rice yield (BRY), milling recovery (MR) and head rice yield (HRY), however, grain bed thickness had significant effect at 5% significant level. Highest HRY of 66.4% achieved was for 10 cm bed thickness, as compared to 62.9% and 65.4% for 5 and 15 cm beds thick, respectively. Broken rice obtained was 3.66% during *Kharif* season which was significantly lower than that the broken rice (5.11%) obtained during *Rabi* season. Head rice yield in the greenhouse dryer was much higher than mechanical drying (63.5%) and open sun drying (62.91%). Highest germination percentage (90%) was achieved during *Kharif* paddy drying and there was no significant difference in germination among greenhouse and open sun drying at 5% significant level.

Drying data were fitted to the eleven thin layer drying models. Among them, logarithmic model was found to be the most suitable model for describing the drying characteristics of thin layer drying of *Rabi* paddy. Logarithmic model gave R2 = 0.9891, $\chi 2$ = 0.00689, RMSE = 0.024477 and MBE = 4.02×10-8. Midilli model was found to be the best to describe the drying behaviour of thin layer drying of *Kharif* paddy. Midilli model gave R2 = 0.9953, $\chi 2$ = 0.0000408, RMSE = 0.019042 and MBE = -1.3×10-5. Payback period of the solar greenhouse dryer was 1.84 years and gave 49.34% rate of return. Cost of drying was `0.2 per kg of paddy. Cost-benefit ratio was 4.13.

Keywords: PV potential, forced ventilation, greenhouse drying, open sun drying, paddy drying, economic evaluation, mathematical modelling

AGRICULTURAL ENGINEERING
(AGRICULTURAL PROCESS AND FOOD ENGINEERING)

Author	:	**NAGAMANI, K.**
Title of the Thesis	:	**DEVELOPMENT OF PROCESS TECHNOLOGY FOR CLARIFICATION AND PRESERVATION OF SUGARCANE JUICE**
Chairperson	:	**Dr. P.V.K. JAGANNADHA RAO**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5466**

ABSTRACT

Sugarcane (*Saccharum officinarum* L.) belonging to the family Graminae, is a commercial cash crop widely grown in the world. India is the largest consumer and second the largest producer of sugar in the world next to Brazil. Sugarcane cultivation in Andhra Pradesh spreads over an area of 1.23 lakh ha in 2015-16, which is roughly 2.46% of cane acreage in our country. In India, sugarcane is grown mainly for producing sweeteners like sugar, jaggery and khandasari. Sugarcane juice is very popular delicious drink and it is rarely available in commercial packaged form. In general, sugarcane juice is spoiled quickly soon after extraction due to presence of simple sugars, and also juice gets very dark color by oxidation of its components (Chlorophyll and Poly phenols). Biodegradation is mainly caused by microorganisms mainly *Leuconostoc* sp. (L. *mesenteroides* and L. *dextranium*). Many studies have been carried out on sugarcane juice process to increase its shelf life. Formation of sediments at the bottom of storage container is a major problem to transfer the technology to the entrepreneurs. The information on use of stabilizing gums and mechanical filtration to control the sediments during storage is practically non-existent.

In view of this, the present study was conducted on the "Development of process technology for clarification and preservation of sugarcane juice" to explore the use of stabilizing gums (tannin, gelatin and polysorbate) and mechanical filtration techniques to control the sediments during storage for the production of good quality bottled pasteurized sugarcane juice. Pasteurized sugarcane juice was packed in three different bottles (glass, PET and PP). Fresh sugarcane juice contains more number of impurities. By using stabilizing gum (gelatin) and filtration equipment maximum (99%) number of impurities present in juice was removed (3.56 g per L). Also, study the characteristics of juice in terms of TSS, pH, RS, TS, TA, color, yeast, mould and total plate count, *etc*. Untreated juice (control) stored at room temperature was spoiled within few hours of extraction (3-4 h), and low temperature storage was spoiled in 10 h. Also juice stored in PET bottles was readily spoiled than juice stored in glass and PP bottles at room temperature (4 days). Also, juice stored in PET bottles with gelatin was spoiled readily than PP and glass bottles at refrigeration temperature. Among all the treatments, based on sensory attributes, juice without gelatin (pasteurized at 80 ^{o}C for 10 min + preservative) was found to be the best treatment. Among three bottles, juice packed in glass and PP bottles was found to be good. PET proved to be the least effective in maintaining the quality of the juice. Viable bacterial, yeast and mould count was increased during storage at room and low temperatures, but the increase was less at low temperature. Packaging materials was found to have no effect on sensory properties of juice. But, addition of gelatin had some effect on sensory properties of sugarcane juice. The color of the juice was better in gelatin treated juice as compared to other treatments. It can be concluded that membrane processing of sugarcane juice is one of the alternate methods in combination with thermal processing for producing quality juice.

Keywords: Homogenization, Physico-chemical, Gelatin, Pasteurization, Packaging material

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**RAMA RAO, A.**
Title of the Thesis	:	**DESIGN, DEVELOPMENT AND PERFORMANCE EVALUATION OF POLYMER CASTED CENTRIFUGAL PUMP**
Chairperson	:	**Dr. G. RAVI BABU**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5470**

ABSTRACT

In India, agriculture plays a major role in economy and livelihood. Majority of the population of India depends on agriculture hence more water resources (about 80% of total water) and energy resources are required for the irrigation in dry seasons. Since resources are limited and have to be conserved for future use, any effort for their proper utilization and conservation cannot be neglected. The present research problem, "Design, Development and Performance Evaluation of Polymer Casted Centrifugal Pump" was taken up for the benefit of farming community and other sections like domestic and industries in the way of financial feasibility and technical possibility. In our country many of the centrifugal pumps are made up with cast iron. In the present study a cast iron pulley operated centrifugal pump was selected which has 11 components namely casing, impeller, shaft, pulley, bearing stand, bearing cover, top flange, bottom flange, gland, counter weight and base. It was found that the present existing centrifugal pumps have many technical disadvantage related to its cost, weight, corrosion and wear and tear.

During the study it was found that these technical disadvantages can be overcome by replacing the metallic parts of pumps with the engineering plastic materials. There are polymeric materials like Poly Phenylene Oxide (PPO) or Noryl, Delrin, Vespel, Zytel, Cast Nylon, Ultra High Molecular Weight Polyethylene (UHMWPE) and Poly Ether Ether Ketone (PEEK) are commercially available in the market.

The following polymers are recommended as alternative materials for making the centrifugal pump.

S.No.	Name of the pump Component	Existing metallic material	Alternative Polymer
1	Casing	Cast Iron	UHMWPE
2	Impeller	Cast Iron	Cast nylon

3	Shaft	Cast Iron	Delrin
4	Bearing stand	Cast Iron	Cast nylon
5	Bearing cover	Cast Iron	Delrin
6	Top flange	Cast Iron	UHMWPE
7	Bottom flange	Cast Iron	UHMWPE
8	Gland	Cast Iron	Cast nylon
9	Counter weight	Cast Iron	Delrin
10	Pulley	Cast Iron	Delrin
11	Base	Cast Iron	Cast nylon

The 3-D models of all 11 pump components were developed and designed by Co-ordinates Measuring Machine (CMM) and the models were loaded in Computational Fluid Dynamics (CFD) ANSYS 16.0 software for simulating the results. All the 11 pump components were taken 16 hours time in CMM for development and design of 3-D models. Based on the optimization and selection of polymers to replace the metal pump components the fabrication of polymer pump components were done by Computer Numerical Control (CNC) lathes and milling machines. Among the 7 polymer materials identified 3 were selected and used for machining of 10 pump components except shaft of the pump. The shaft was initially made with Delrin polymer material later on for avoiding the frequent breakage of shaft by packing rope and oil seal, it was finalized to machine with stainless steel only. The study concluded with rest of the 10 individual pump components were machined based on their properties, characteristics and technicalities with 3 polymer materials viz. Cast Nylon, UHMWPE and Delrin. After machining, all the pump components were assembled with the nut, bolts, washer and packing ropes as same as metal pump. The polymer pump was connected to 0.5 hp low speed single phase motor and v-belt and was set for experiments in field irrigation laboratory at College of Agricultural Engineering, Bapatla. After completion of all experiments of head, discharge, pressure and power consumption with polymer pump, the metal pump was also operated with the same motor and conditions for comparison.

The discharge of both metal and polymer pumps at 1m, 2 m, 3 m, 4 m, 4.5 m and 5 m suction heads were same as 1.2 l/s, 1.1 l/s, 1.0 l/s, 0.9 l/s, 0.9 l/s and 0.8 l/s respectively. The pressure of both metal and polymer Pumps at 1 m, 2 m, 3 m, 4 m, 4.5 m and 5 m suction heads were same as 0.5 kg/cm^2, 0.5 kg/cm^2, 0.4 kg/cm^2, 0.3 kg/cm^2 and 0.3 kg/cm^2 respectively. The time taken for one unit (1 kW) power consumption of both metal and polymer pumps at different heads taken same as 1.5 h in all cases. The rpm of motor and polymer pump at 1m, 2 m, 3 m, 4 m, 4.5 m and 5 m suction heads were 1392 and 2491, 1382 and 2486, 1378 and 2485, 1368 and 2471, 1366 and 2466 and 1362 and 2465 respectively. The rpm of motor and metal pump at 1 m, 2 m, 3 m, 4 m, 4.5 m and 5 m suction heads were 1408 and 2647, 1406 and 2639, 1398 and 2635, 1396 and 2632, 1394 and 2631 and 1387 and 2624 respectively. The polymer pump was operated for 310 h till date and found no wear and tear. It was noticed that the total weight of the metal pump was 5.7 kg and polymer pump was only 1.7 kg. By replacing the metal components of centrifugal pump with the polymers the weight of the pump was reduced by 70 per cent and become very light in weight.

Based on CIPET estimation on mold cost and component cost, the production cost of one lakh polymer pumps were projected and the difference of both metal and polymer pumps was calculated. The mold cost of one polymer pump was 24.5 lakh and production cost one

polymer pump was Rs.485 when compared to metal pump market price of Rs. 1200. The projected cost of 1 lakh polymer pumps was Rs. 4.85 cr. and 1 lakh metal pumps market price was Rs. 12 cr. and the difference of cost was Rs. 7.15 cr. The projected cost of 5 lakh polymer pumps was Rs. 24.25 cr. and 5 lakh metal pumps market price was Rs. 60 cr. and the difference of cost was Rs. 35.75 cr. By replacing the metal pump with the polymer pump the cost of the pump was reduced by 59.6 per cent, making it very cheap.

AGRICULTURAL ENGINEERING
(FARM MACHINERY AND POWER ENGINEERING)

Author	:	**RAMI REDDY, K.V.S.**
Title of the Thesis	:	**STUDIES ON DESIGN, DEVELOPMENT AND PERFORMANCE EVALUATION OF TRACTOR DRAWN ROTARY SPIDER WEEDER FOR ROW CROPS**
Chairperson	:	**Dr. AUM SARMA**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5471**

ABSTRACT

Tractor operated weeding implements can save about 75 per cent time and 20 per cent cost as compared to conventional methods. Usually tractor mounted cultivators are used for weeding and inter-culturing operations in farm but these are not effective for soil pulverization. The rotary type weeder stirs the soil more accurately, disturb the weed root and remove them from the soil and pulverize the soil effectively. However, the major handicap in the adoption of the technology was the non-availability of suitable weeding equipment. Hence, suitable equipment has to be developed for adoption of weeding operation under field conditions especially for the wide row spaced crops like cotton, maize and chillies, where the tractor can be run. Keeping this in view, a study was undertaken on "studies on design, development and performance evaluation of tractor drawn rotary spider weeder for row crops" at College of Agricultural Engineering, Bapatla. A tractor drawn rotary spider weeder suitable for crops was designed, developed and fabricated at workshop, Department of Farm Machinery and Power Engineering, College of Agricultural Engineering (CAE), Bapatla. Performance evaluation of developed weeder was conducted by varying different forward speeds of 0.56, 1.11, 1.67 and 2.22 ms^{-1} at M_1 (10 ± 0.5%), M_2 (15 ± 0.5%) and M_3 (20 ± 0.5%) soil moisture levels in cotton, maize and chilli crops.

The results summarized that the mean bulk density decreased from 1.289×10^3 to 1.201×10^3 kg m^{-3} when soil moisture increased from M_1 to M_3 moisture level. Soil resistance is an indication of soil hardness measured by cone penotrometer and is expressed as force per square centimeter required for a cone to penetrate into soil. Soil resistance decreased from 27×10^4 to 23×10^4 N m^{-2} when soil moisture content increased from M_1 to M_3 moisture level.

Lower weeding efficiencies of 39%, 40% and 43% were observed at forward speed of 0.56 ms^{-1} at M_1, M_2 and M_3 moisture levels respectively in cotton crop at 30 and 45 DAS. Higher rate of increase in weeding efficiency was observed from 1.11 ms^{-1}forward operating speed onwards at all soil moisture levels and in all crops. It was observed that the weeding efficiency was almost constant for further increase of forward speed from 1.11 to 2.22 ms^{-1} in all the crops and, also, at all soil moisture levels. It was observed that there was no significant difference in the weeding efficiencies when forward speed increased from 1.11 to 2.22 ms^{-1} at all the soil moisture levels.

There was significantly higher plant damage per cent was recorded at 2.2 ms^{-1} forward speed of operation at all moisture levels and at 30 and 45 DAS in all the crops. There was no significant difference in plant damage when forward speed increased from 1.11 to 2.22 ms^{-1} in all the crops at all soil moisture levels and also at 30 and 45 DAS. Lowest plant damage percent was observed at forward speed of 0.56 ms^{-1} at all soil moisture levels and stages of weeding.

It was observed that the field capacity increased with the increase of forward speed at all levels of soil moisture content in all the crops and stages of weeding. Lowest field capacities were obtained at all soil moisture levels at forward speed of 0.56 ms^{-1}. It was observed that the draft increased with the increase of forward speed from 0.56 to 2.22 ms^{-1} at all levels of soil moisture content.

Highest performance index were recorded at 2.2 ms^{-1} forward speed of operation in all the crops at 30 and 45 DAS in all the crops. Lowest performance index were recorded at 0.56 m s^{-1} forward speed of operation at different stages of weeding in all the crops. Field machine index of the unit was computed as 0.83 and 0.78 at 30 and 45 DAS, respectively. Highest energy demand was recorded at 30 DAS compared to 45 DAS. Cost of operation of the weeder was ₹ 1491 ha^{-1} whereas the same with the traditional method of weeding was ₹ 3211 ha^{-1}. There was a saving of ₹ 1720 ha^{-1} over traditional method of weeding.

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**RUPAVATHI, K.**
Title of the Thesis	:	**DEIGN AND FIELD EVALUATION OF LOWCOST WIRELSS SOIL MOISTURE SENSOR FOR AUTOMATION OF DRIP IRRIGATION SYSTEM**
Chairperson	:	**Dr. G. RAVI BABU**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5468**

ABSTRACT

In our country, the irrigated area is about 36 per cent of the net sown area. Presently, the agricultural sector accounts for about 83 percent of all water uses. The remaining uses include 5, 3, 6 and 3 per cent respectively for domestic, industrial and energy sectors and other consumers. Increasing competition with the other water users in the future would limit the water availability for expanding irrigated area.

At the present era, the farmers have been using irrigation technique in rural areas through the manual control in which the farmers irrigate the land at the regular intervals, and also some rural areas are severely affected by droughts or floods. New technologies are coming for the assured supply of water but they are too expensive for the common farmer. One major reason of not adopting new technologies is unnecessary wastage of water in agriculture field due to unawareness of farmers about sufficient supply of water.

Farmers usually control the electric motors observing the soil, crop and weather conditions by visiting the sites. These manually controlled irrigation systems cannot ensure a proper level of water in the site. Another reason is due to the lack of electricity and mismanagement in the manually controlling systems, sometimes their fields become dry and sometimes flooded with excess water. Automatic drip irrigation system allows farmers to apply the right amount of water at the right time, by turning the valves on and off.

The GSM based wireless soil moisture sensor is designed using keil µvision 3 software into microcontroller for maximum of three sensors present in each field 466.4 sq m of tomato and 406 sq m of cluster bean and controls the water supply in the field to be irrigated using solenoid valve. The sensor present in each field stops the pump automatically through microcontroller when the field reaches to its field capacity and the motor will be switched on automatically when soil moisture reaches 70% of field capacity.

The experimental fields with an area of 466.4 m^2 for tomato crop and 406 m^2 for cluster bean crops were selected at field irrigation laboratory, Department of Soil and Water Engineering, College of Agricultural Engineering, Bapatla. The field was divided into 3 sub plots for tomato and cluster bean crops respectively to conduct experiments on drip irrigation with low cost wireless soil moisture sensor. The crop duration for tomato crop and cluster bean was 120 days (Dec 20th 2016 to March 3rd, 2017) and 90 days (March 24th to June 21st, 2017) respectively. The water was applied as per the crop water requirement calculated by CROPWAT in flood irrigation method, whereas water application was done based on operation of automatic wireless soil moisture sensor in both single row and paired row drip irrigation systems. The inline drip laterals were arranged with each dripper flow rate of 2 lph and spacing between drippers is 0.4 m. Field data was collected regularly to evaluate the performance of low cost soil moisture sensor based GSM and benefit cost ratio was found for different irrigation systems used for both tomato and cluster bean crops.

The results revealed that the yield response was observed to be the best in wireless soil moisture sensor based irrigation with each row lateral spacing in tomato crop as 2.902 t ha^{-1}. The yield in tomato crop was very less as compared to normal yields. This is due to the reason that crop was affected by blight and tomato spotted wilt virus and final harvest was done about one month before the actual harvest date (April 8th). Water applied in drip irrigation system using soil moisture sensor was found to be 410 mm instead of 490 mm in flood method for tomato and 16.39 % water saving was observed. In cluster bean, the yield was best in single row drip method as 7.5 t ha^{-1}. Water applied in drip irrigation system using wireless soil moisture sensor was found to be 410 mm instead of 507 mm in flood method and 19.13 %

water saving was observed. Less water saving was observed because of crops are grown in sandy soils. The total cost of the GSM based low cost wireless soil moisture sensor was Rs 3424/- .

Water use efficiency for tomato crop is highest in single row drip method with 7.15 kg/ha-mm followed by paired row drip and flood method as 6.25 and 2.24 kg/ha-mm respectively. Whereas in cluster bean, the water use efficiency was highest in single row drip method as 18.29 kg/ha-mm followed by paired row drip and flood method as 14.55 and 8.71 kg/ha-mm respectively.

For tomato crop cultivation the total annual cost for the drip system was Rs.24000. The benefit cost ratio of 0.81 was recorded for single row followed by 0.79 for paired row and the least value of benefit cost ratio was recorded in flood as 0.53. For cluster bean crop cultivation the total annual cost for the drip system was Rs.20000. The benefit cost ratio of 2.12 was recorded for single row followed by 2.14 for paired row and the least value of benefit cost ratio was recorded in flood as 2.06.

Keywords: GSM, wireless soil moisture sensor, microcontroller, keil µvision3, automatic drip irrigation.

AGRICULTURAL ENGINEERING
(SOIL AND WATER ENGINEERING)

Author	:	**SUNITHA, D.V.**
Title of the Thesis	:	**MODELING OF SURFACE IRRIGATION SYSTEMS USING 'SURDEV' IN COASTAL AREAS OF GUNTUR DISTRICT**
Chairperson	:	**Dr. H. V. HEMA KUMAR**
Degree	:	**M.Tech.**
College	:	**COLLEGE OF AGRICULTURAL ENGINEERING, BAPATLA**
Accession Number	:	**D5460**

ABSTRACT

Water is the most vital input in agriculture and its availability is necessary in providing stability to food grain production and self-sufficiency. About 80% of total water resources are being utilized for agriculture. Surface irrigation is widely practiced throughout the world i.e., more than 95 % of world's irrigated area is under surface irrigation (Anonymous, 2003). India has the highest irrigated area with almost one fifth of the irrigated area in the world. According to statistical year book India 2016, irrigated land in India is about 64.7 M ha of which 55 M ha is irrigated by surface methods of irrigation. The irrigated land in Andhra Pradesh is about 4.2 M ha of which 3.68 M ha is under surface methods of irrigation.

All along the coast, Guntur district is predominantly with sandy soils, where deep percolation losses are more thereby having lot of scope to improve irrigation efficiency. In the

coastal agriculture, small to medium farmers are dominant group cultivating rice, groundnut and vegetables following check basin and furrow irrigation systems. Under the aforesaid valid and farmers' felt research needs, the present post graduate research work entitled "**Modeling of surface irrigation systems using 'SURDEV' in coastal areas of Guntur district**" is proposed to fulfil the following major objectives. i) To survey different farmers' fields for the existing field design of surface irrigation systems in coastal areas of Guntur district. ii) To estimate the overall irrigation efficiency of surface irrigation systems using SURDEV model. iii) To model the design parameters for the improvement of overall irrigation efficiency using SURDEV.

A total number of 120 coastal farmers' fields (60 fields under check basin irrigation system and 60 fields under furrow irrigation system) were surveyed. The major crops grown in the study area are rice, groundnut, pulses in basins; maize and vegetables in furrows. The dominant soil type is sandy. In the present study, software model SURDEV developed by M. Jurriens, was used to determine the existing field efficiencies and to improve the efficiencies of the irrigation systems. The required data for inputting into the model was collected from field survey.

With this data from existing basin and furrow irrigation systems were used as input for BASDEV and FURDEV modules respectively for obtaining the application, storage, and distribution efficiencies (%), minimum, maximum and average infiltrated depths (mm), advance and recession times (min), and under-irrigation, over-irrigation lengths and depths. The performance of surface irrigation system proved to be unsatisfactory and so suggestions for improvement were evaluated with BASDEV and FURDEV modules in SURDEV. Also for some fields, cutback and tail water reuse options in FURDEV were used by giving suitable values of cutback ratio and tail water reuse ratio to further increase the efficiencies. To know whether the improvement is statistically significant or not, on theoretical basis, simple statistical analyses were performed. i) Student 't-test' amongst existing and improved efficiencies ii) standard error of mean within a particular group of efficiencies and finally iii) correlation matrix with various input parameters which were changed on hit and miss trials basis were chosen.

For rice under basin irrigation system, the overall efficiency was increased from 38.14% to 71.55% using BASDEV module in SURDEV. Similarly, for groundnut and pulses the overall efficiency was increased from 32.48% to 65.15% and 38.49% to 69.15% respectively. For maize under furrow irrigation system, the overall efficiency was increased from 40.8% to 58.32% using FURDEV module in SURDEV. Similarly, for cucumber and for watermelon the overall efficiency was increased from 35.63% to 51.84% and 53.68% to 62.83% respectively. With cutback option in FURDEV module further increase in efficiency was obtained as 9.14% for 20 cucumber fields, 11.85% for 3 maize fields and 12% for 2 watermelon fields under furrow irrigation system. Similarly, with tail water reuse further increase in efficiency was found to be 3% for 6 cucumber fields, 4.8% for 6 maize fields and 2.4% for 1 watermelon field.

From the t-test, it was observed that the application and overall efficiencies for all the crops of study area for basin irrigation system and furrow irrigation system showed significant variation in the design exercise at 5% level of significance. It was observed from the standard error calculations that storage efficiency for all crops except groundnut and distribution, overall efficiencies for maize and watermelon crop showed less standard error which means that they are more or less following certain governing pattern and the rest showed standard error equal to and greater than 1 indicating that the efficiencies varied tremendously.

From the correlation matrix prepared for the various input parameters (independent variables) and various efficiencies tested in study fields separately for different soils and

different irrigation systems, the correlation has not given any uniform pattern for any of soils. In some cases, basin width, cut off time and basin length has shown high correlation and for certain soils like clay loam, sandy loam, loam and silty clay, the sample sizes were very meagre and hence the statistical results outcome could not be worked out. If measures are taken to improve at least 10% in the efficiency by recommending flow rate, cut off time, field dimensions, there will be a saving of water in the tune of 6.129 BCM because of the fact that as per AP water vision, the irrigation water consumption is 61.317 BCM at present.

AGRICULTURAL EXTENSION

Author	:	**DIVYA, KASU.**
Title of the Thesis	:	**A STUDY ON IMPACT OF NATIONAL FOOD SECURITY MISSION (NFSM –RICE) PROGRAMME ON RICE FARMERS IN GUNTUR DISTRICT OF ANDHRAPRADESH**
Chairperson	:	**Dr. P. RAMBABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5404**

ABSTRACT

Research study entitled "Impact of National Food Security Mission (NFSM-Rice) Programme on Rice Farmers in Guntur district of Andhra Pradesh" was under taken to study the profile of beneficiaries, knowledge level, impact in terms of direct and indirect changes, and their relation with profile characteristics, constraints and suggestions faced by beneficiaries. An ex-post facto research design was followed to study the impact of NFSM-Rice programme in Guntur district of Andhra Pradesh. The study was conducted in Andhra Pradesh state during 2016-17. Guntur district of Andhra Pradesh was purposively selected based on maximum number of NFSM-Rice activities. Out of 57 mandals, three mandals and four villages from each mandal were selected for the study. Beneficiaries were selected from each village by following proportionate random sampling procedure thus making 120 beneficiaries constituted the sample of the study.

Data was collected with pre-tested interview schedule followed by personal interview method by selecting the independent variables *viz.*, age, education, land holding, farming experience, training received, socio-politico participation, extension contact, mass media exposure, decision making, achievement motivation, risk orientation, market orientation, scientific orientation, innovativeness and dependent variables knowledge and impact in terms of direct changes and indirect changes *viz.,* yield, net income, net sown area under HYV's, cropping pattern, adoption under direct changes and Change in use of High Yielding Varieties(HYV's), pesticides (IPM), fertilizers (INM), nutritional educational and health habits , decision making , self-confidence, communication behaviour, economic status , socio-political participation, reduction in cost of cultivation under indirect changes.

For the purpose of statistical analysis of the coded data variousstatistical tools were used *viz.,* Arithmetic Mean, Standard Deviation, Frequency & Percentage, Correlation coefficient, Multiple Linear Regression (MLR).

The detailed analysis of profile of the beneficiaries indicated that majority of the beneficiaries were middle aged (61.66%), primary school education (31.66%), marginal land holding(36.66%) , 21 to 30 years of farming experience (35.83%), 1 to 2 trainings received (40.83%), medium socio-politico participation (85.84%), medium extension contact (51.66%),

medium mass media exposure (52.50%), medium decision making (41.67%), medium achievement motivation (50.83%), low risk orientation (52.50%), medium market orientation (41.66%), medium scientific orientation (54.17%), medium innovativeness (47.50%).

The detailed analysis of dependent variables indicated that majority of the beneficiaries had medium level of knowledge (58.34%) followed by low (24.16%) and high knowledge (17.50%) categories.

Majority (70.00%) of NFSM-Rice beneficiaries experienced medium direct changes followed by high (15.84%) and low (14.16%) direct changes. Direct changes occurred due to implementation of NFSM-Rice were increased yield, net income and net sown area under HYVs of beneficiaries.

Majority (51.66%) of NFSM-Rice beneficiaries experienced medium indirect changes followed by low (31.67%) and high (16.67%) indirect changes. Indirect changes occurred due to implementation of NFSM-Rice were change in use of HYVs, fertilizers, pesticides, change in self-confidence, decision making, communication behaviour and change in food habits of beneficiaries.

Out of fourteen selected independent variables age, education, training received, socio-politico participation, extension contact, mass media exposure, decision making, achievement motivation, risk orientation, market orientation, scientific orientation and innovativeness showed significant relation with extent of knowledge of NFSM-Rice beneficiaries. Remaining variables like land holding and farming experience did not show any significant relationship with extent of knowledge. The Multiple Linear Regression (MLR) analysis indicated that all the fourteen variables put together explained 86.80 per cent of variance in the extent of knowledge of NFSM-Rice beneficiaries, remaining 13.20 per cent due to the extraneous factors.

Out of fourteen selected independent variables age, education, training received, socio-politico participation, extension contact, mass media exposure, decision making, achievement motivation, risk orientation, market orientation, scientific orientation and innovativeness showed significant relation with direct changes of NFSM-Rice beneficiaries. Remaining variables like land holding and farming experience did not show any significant relationship with direct changes experienced by the beneficiaries.The Multiple Linear Regression (MLR) analysis indicated that all the fourteen variables put together explained 88.50 per cent of variance in the direct changes experienced by NFSM-Rice beneficiaries, remaining 11.50 per cent due to the extraneous factors.

Out of fourteen selected independent variables education, training received, extension contact, mass media exposure, decision making, achievement motivation, risk orientation, market orientation, scientific orientation and innovativeness showed significant relation with indirect changes of NFSM-Rice beneficiaries. Remaining variables like age, land holding, farming experience and socio-politico participation did not show any significant relationship with indirect changes experienced by the beneficiaries.The Multiple Linear Regression (MLR) analysis indicated that all the fourteen variables put together explained 88.60 per cent of variance in the indirect changes experienced by NFSM-Rice beneficiaries, remaining 11.40 per cent due to the extraneous factors.

The constraints perceived by the selected NFSM-Rice beneficiaries were non availability of inputs at right time, non availability of quality seed, non availability of low cost machines, non availability of recommended weedicides, non availability of bio fertilizers, lack

of providing improved varieties, not providing sufficient quantity of inputs, not giving latest and efficient weedicides, providing impure seeds, not providing latest and efficientpesticides , lack of guidance from department officials, lack of proper trainings, lack of method demonstrations on new practices, lack of conducting field days, and lack of proper management.

The suggestions given by the selected NFSM-Rice beneficiaries to overcome the constraints perceived by them were availability of inputs at right time, availability of improved varietal seeds, have to provide latest and efficient weedicides, availability of bio fertilizers, availability of weedicides, availability of latest and efficient pesticides, frequent availability of low cost machines, availability of quality seeds, trainings on new technologies, availability of pure seeds, method demonstrations on new practices, organizing field days, consultation of department people with beneficiaries and proper implementation of programme.

AGRICULTURAL EXTENSION

Author	:	**HAREESH, A.**
Title of the Thesis	:	**A STUDY ON THE IMPACT OF AGRICULTURAL PROGRAMMES OF ITDA ON TRIBAL FARMERS IN VIZIANAGARAM DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. T. GOPI KRISHNA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5406**

ABSTRACT

Andhra Pradesh is the traditional home of nearly 33 tribal groups with a population of 6.59 percent of its total population. In Andhra Pradesh, the scheduled area comprises of 29,683 square kilometers, which forms 10.70 per cent of the total geographical area of the state and 11.00 per cent of the total scheduled area of the country.

With the advent of ITDAs (Integrated Tribal Developmental Agencies), developmental efforts of various departments (Agriculture, Horticulture, Veterinary and Rural works departments) have been channeled through a single window system. Agriculture being the main thrust area, ITDAs is focusing on improving the productivity of the crops by provisioning inputs such as seeds of improved varieties, and chemicals to make the farmers economically better off.

A study on the impact of Agricultural programmes of ITDA on tribal farmers in Vizianagaram district of Andhra Pradesh was carried out during 2015. From each district three mandals had been selected by purposive sampling. From the selected mandals four villages had been selected by random sampling method. From each village, tribal farmers were selected by proportionate random sampling, thus making a total of 120 tribal farmers.

Considering opinions, direct and indirect as dependent variables. Scale was developed for opinions by using summated rating technique. The opinions scale was comprised of 53 statements. A well structured interview schedule was also prepared for direct and indirect changes. The study was conducted by following an *ex-post-facto* Research Design. Data was collected by pre-testing followed by personal interview method.

For the purpose of statistical analysis of the coded data, various statistical tools were used *viz.,* were used such as frequency and percentage analysis, mean and standard deviation, z test, correlation analysis, multiple regression analysis, ranking and exclusive class interval.

The analysis of profile characteristics of tribal farmers indicated that nearly half (48.33%) of tribal farmers were middle aged, illiterate (52.50%) belonged to marginal (65.83%), annual income level (45.00%), medium farming experience (62.50%), occupation as Agriculture + wage work + Animal Husbandry (45.83%), medium extension contact (55.83%), social participation (59.16%), medium mass media exposure (60.00%), economic orientation (63.33%), risk orientation (54.17%), scientific orientation (56.67%), innovativeness (45.83%), achievement motivation (56.66%) and market orientation (63.33%).

Tribal farmers of ITDA were medium from the points of their opinions towards agricultural activities (48.33%), direct changes (63.33%) and indirect changes (55.84%).

Profile characteristics of tribal farmers of ITDA such as age, education, farming experience, extension contact, social participation, mass media exposure, economic orientation and scientific orientation, innovativeness, achievement motivation, market orientation found to be positive and significant in their relationship with their opinions, direct and indirect changes undergone at 1% level of significance where as risk orientation had negative and significant relationship at 1% level of significance.

The multiple linear regression analysis (MLR) indicated that all the fifteen profile characteristics of tribal farmers of ITDA put together explained about variation in the opinions (80.00), direct changes (82.20) and indirect changes (80.10).

The most important constraints of tribal farmers of ITDA for effective implementation of agricultural activities were categorized into Personal Constraints- Less outside contacts (90.00%), Socio-Economic Constraints- High wage rate of labours (90.83), Technical Constraints-Non-availability of skilled labours (85.83) and Organizational Constraints-Inadequate conduct of periodical training programmes (87.50).

The most important suggestion of tribal farmers of ITDA for effective implementation of agricultural activities were; Organizaing skill training programmes (90.00%), Establishing coordination with government departments (87.50%), Subsidized supply of fertilizers (85.00%), Improving extension contact (64.17%) and Increased staffing arrangements (62.50%).

AGRICULTURAL EXTENSION

Author	:	**MADHURI, K.**
Title of the Thesis	:	**SWOC ANALYSIS OF TOMATO CULTIVATION IN CHITTOOR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. V. SAILAJA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5482**

ABSTRACT

The tomato is a major vegetable crop that has achieved tremendous popularity over the last century. In India tomato is grown in 767.3 M ha area with 16385.0 Mt production and 21.4 Mt/ha productivity. Andhra Pradesh is producing about 36% of tomato in the country and is the leading producer of tomato involving a production of 1473.5 thousand metric tones from an area of 54.2 thousand hectares with productivity of 27.2 Mt/ha.

SWOC as an acronym stand for Strength, Weakness, Opportunity and Challenge of an organization, a programme and a project. These four attributes are also called SWOC parameters.In management science, SWOC analysis plays a paramount role in understanding the management problems. It has an application for strategic decision in personal lives, organizational environments and even in politics. Practically, no literature was available on SWOC analysis concerned with agricultural research and development till the year 1994. However, a maiden attempt has been made by Paroda (1995) on its application in agricultural research and development while formulating the perspective plan for the entire Indian Council of Agricultural Research (ICAR) setup. The tool was extensively used by Venkateswarulu and Jagadeesh (1996) in various projects of national Agricultural Research System like National Agricultural Research Project (NARP).

The SWOC analysis facilitates to get a comprehensive understanding of any selected subject. Even though the scenario of tomato cultivation is quite encouraging, the farmers are encountering frequent failures both in terms of production and marketing. Hence, there is every need to thoroughly understand the tomato production in Chittoor district of Andhra Pradesh state. Hence the present study entitled as “SWOC analysis of tomato cultivation in Chittoor district of Andhra Pradesh” was undertaken.

Ex-post-facto research design was followed in the present investigation. The Chittoor district was purposively selected as tomato is extensively grown in the district. The three mandals Viz., Kurabalakota, Molakalacheruvu and Gurram konda of chittoor district were purposively selected for the study since it is having highest area under tomato cultivation. Four villages from each mandal were selected by following simple random sampling procedure, thus making a total of twelve villages for the study. From each of the twelve selected villages, 10 respondents were selected by following simple random sampling procedure, thus making a total of 120 respondents. A pre tested interview schedule with measurement devices of all the

variables was used for the collection of raw data. The data were collected by personal interview method through a structured interview schedule and analyzed by employing suitable statistical methods.

The analysis of profile characteristics of the farmers indicates that majority of the farmers engaged in tomato cultivation are middle aged, with primary school education, small farmers with medium farming experience, annual income, extension contact, mass media exposure, scientific orientation, risk orientation, management orientation, innovativeness and achievement motivation.

Majority of the farmers had medium level of knowledge with regard to recommended package of practices of tomato cultivation.

Majority of the farmers had medium extent of adoption of recommended package of practices of tomato cultivation.

Correlation analysis revealed that there was a positive and significant relationship between education, farm size, annual income, extension contact, mass media exposure, scientific orientation, risk orientation, management orientation, innovativeness and achievement motivation with the level of knowledge of tomato growers. However marketing facilities and credit orientation had non significant relationship with the knowledge level of tomato farmers. All the selected 14 independent variables put together explained about 66.50 per cent variation in the knowledge level of tomato growers.

Correlation analysis revealed that there was a positive and significant relationship between education, farm size, extension contact, mass media exposure, scientific orientation, risk orientation, management orientation, innovativeness and achievement motivation with the extent of adoption of the recommended cultivation practices by tomato growers. However marketing facilities and annual income had non-significant relationship with the extent of adoption of tomato farmers. All the selected 14 independent variables put together explained about 69.30 per cent variation in the extent of adoption of the recommended cultivation practices by tomato growers.

The first ten strengths as perceived by the tomato growers were higher net income; requires less number of irrigations; significant yield increase; staking provides support to the growing plant; better price in the market; availability of HYV and disease resistant varieties; easy accessibility to market; demand during off season; cost of cultivation is low; high demand for the value added tomato products in the market .

The first ten weaknesses as perceived by the tomato farmers were price instability; whole salers and retailers role in price fixation; higher hiring charges of the transport vehicles; non-availability of labour; high cost of plant protection chemicals; less bargaining power of farmers; lack of planning about tomato production; lack of direct farmer access to retailers and super markets; lack of market information resources; micro nutrient deficiencies.

The first ten opportunities as perceived by the tomato farmers were creation of facilities for strengthing of public and private partnership in agriculture; provision of storage facilities; opportunities to set up processing industries; build the capacities of the farmers on post harvest techniques i.e, grading, sorting, packaging etc; developing organized tomato marketing systems in the main production centres; provision of government support for market integration and agro-enterprise development; raise in export prices to achieve higher margins in current and future export markets by enhancing quality; favourable climate; requires no skilled labour; contact farming initiatives which needs to be encouraged through supportive policies

The first ten challenges as perceived by the tomato farmers were non availability of seed in time; weak management information system in tomato production; labour migration to nearby cities/towns; farmers do not have their own transport to deliver the product to the market; high cost of chemical fertilizers; frequent price slashes due to changes in export policies or unregulated domestic markets; lack of co-ordination between ministry of agriculture and other departments; lack of extension and advisory services in tomato marketing; cash payments not received in time; malpractices of merchants in the mandies such as deduction of unauthorized market charges, unfair weighment of the produce

A suitable strategy has been developed keeping in view of the results obtained in the study and discussions held with the stakeholders of the study.

AGRICULTURAL EXTENSION

Author	:	**MUBEENA, MD.**
Title of the Thesis	:	**ASTUDYONENTREPRENEURIAL BEHAVIOUR OF MEMBERS OF PODUPU LAXMI IKYA SANGAM IN KURNOOL DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. T.LAKSHMI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5483**

ABSTRACT

In 21st Century, the transformation of social fabric of the Indian society, in terms of increased educational status of women and varied aspirations for better living, necessitated a change in the life style of Indian women. Woman constitutes the family, which leads to society and nation. Social and economic development of women is necessary for overall economic development of any society or a country. Entrepreneurship is the state of mind which many women have in her but has not been capitalized in India in way in which it should be. Due to change in environment, now people are more comfortable to accept leading role of women in our society, though there are some expections. She has completed with man and successfully stood up with him in every walk of life and business. They managed to survive and succeed in this cut throat competition with their hard work, diligence and perseverance. Developing and developed nations have realized that developing women entrepreneurship is indispensable to flourish, as economically dominant nations in the modern high –tech world.

Therefore, creation of platforms and networks for entrepreneurial culture are prominent issues globally. Ex-post- facto research design was followed in the present investigation.

The present study was conducted with broad objective of studying the entrepreneurial behaviour of members of Podupu Laxmi Ikya Sangam (PLIS) in Kurnool district of Andhra Pradesh. The study was framed in such a manner to explore the selected profile characteristics

of members of Podupu Laxmi Ikya Sangam and to identify the relative importance of different components of entrepreneurial behaviour of its members.To know the direct and indirect changes of Podupu Laxmi Ikya Sangam members.The problems faced by PLIS members and their suggestions for effective functioning of PLIS for better entrepreneurship was also elicited.

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

Kallur, Orvakal and Nandikotkur mandals of Kurnool district of Andhra Pradesh were purposively selected for investigation on the basis of presence of variety of PLIS micro enterprises. Two villages were selected from each mandal thus constituting a total of six villages. A total of 120 members, 20 from each group of five PLIS from each village were selected randomly. Thirteen independent variables and the entrepreneurial behaviour as the dependant variable were identified for the study.

Majority of the PLIS members were middle aged, illiterate with medium level of income, social participation, self confidence , management orientation and market facilities, material possession, mass media exposure, training received, extension contact, majority of respondents belonged to middle caste and most of the respondents had high creativity.

Regarding direct changes of PLIS members the income and employment generated after joining PLIS was found to be significantly high and whereas with respect to indirect changes the perceived impacts in psychological, sociological and economic dimension are very much felt by the PLIS members. But in case of political dimensions was not upto the level of other dimensions.

Correlation analysis revealed that age had negatively significant relationship, social participation negatively non significant, caste non significant whereas education, income, material possession, mass media exposure, training received, extension contact, creativity, self confidence, management orientation and market facilities had positive and significant relationship with the entrepreneurial behaviour of PLIS members.

Regression analysis revealed that out of the 13 selected independent variables, education, income, material possession, mass media exposure, training received, extension contact, creativity, self confidence, management orientation and market facilities are positively and significantly contributed to the most of the variation with the entrepreneurial behaviour of PLIS members.

Problems related to marketing of the produce is the major constraint which is ranked first by the PLIS group under which lack of own retail shop for selling is major restraint followed by lack of local general store for selling, lack of nearby town for selling, lack of local sale, mobile vans .Then comes the technical constraints ranked second, in which lack of awareness, lack of direction and encouragement, lack of knowledge about loan procedure, lack of technical person for supervision, lack of training and lack of infrastructure facilities and lack of regular meetings are the leading constraints. It is followed by economic constraints which is ranked third in which lack of finance, high cost of credit, lack of marketing facilities, delay in repayment, lack of availability of inputs and raw materials, high transaction cost, poor fund rotation were the major constraints. The constraint which is ranked fourth is social constraint under which lack of education, lack of support from family, lack of motivation, lack of mutual understanding among members, poor attendance in the meeting are opined as the major constraints.

Majority of the members had given suggestions related to the marketing of the produce i.e. providing facilities like retail shops of their own to selling of their produce followed by mobile vans, local sale should be provided to attend near markets. It is followed by

suggestions related to the technical constraints under which to meet the customer demands, more improved machineries are needed which should be provided followed by advertisements and guidance to bring awareness about loan procedure, more skill oriented trainings to do the works more efficiently. It is followed by suggestions related to economic constraints under which repayment of money for the products purchased should be made regular basis but on installments, in time availability of finance and proper marketing facilities such as melas, exhibitions etc. Finally suggestions related to social constraints under which educating and encouraging the respondents, more credit facilities with lower interest rates through cooperative societies, attendance in the meetings should be made compulsory were the suggestions.

AGRICULTURAL EXTENSION

Author	:	**MUBEENA.H.SOFEGHAR**
Title of the Thesis	:	**A STUDY ON ENTREPRENEURIAL BEHAVIOUR OF GRAPE GROWERS IN BAGALKOTE DISTRICT OF KARNATAKA**
Chairperson	:	**Dr. S.V. PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5484**

ABSTRACT

A study on Entrepreneurial behaviour of grape growers in Bagalkote district of Karnataka was carried out during 2017. *Ex-post facto* research design was adopted in the present investigation. Ten respondents from each of the selected twelve villages of the district were selected by using simple random sampling procedure, thus making a total of 120 respondents and data were collected by personal interview method. The detailed analysis of profile of grape growers indicated that majority of the respondents were middle aged, having high school education, medium level of income, medium in social participation, medium extension contact; mass media exposure, management orientation, credit orientation, training received, and market facilities.

The study revealed that majority of the grape growers had medium entrepreneurial behaviour. Among components of the entrepreneurial behaviour, it was found that majority of the respondents had medium innovativeness; decision making ability, achievement motivation, economic motivation, information seeking, leadership ability, risk orientation, managerial assistance, knowledge of the enterprise, and cosmopoliteness.

The correlation analysis revealed that education, income, social participation, extension contact, mass media exposure, credit orientation, training received and marketing facilities had positively and significant relation and age had negatively significant relationship with entrepreneurial behaviour of grape growers. The Multiple Linear Regression analysis indicated

that, all the independent variables put together explained 66.30 per cent of the total variance with entrepreneurial behaviour**.**

The most important components in order of their importance were, decision making ability, achievement motivation, innovativeness, leadership ability, economic motivation, information seeking, risk orientation, knowledge of the enterprise, managerial assistance, and cosmopoliteness.
Main constraints faced by the grape growers include, downy mildew, difficult to identify disease free planting material, non-availability of labour for harvesting, high cost of plant protection chemicals and fertilizers, lack of knowledge about value added products of grape, requirement of more investment, low rate of subsidy, lack of training, inadequate transport facilities and inadequate marketing facilities.

Important suggestions were, supply of disease free planting material by the Horticulture Department or by Horticultural University, reduction in the costs of the fertilizers and plant protection chemicals. Trainings should be given by State Department of Horticulture and Horticulture University regarding all aspects of package of practices and post-harvest handling of the produce, processing unit (plant) should be started in the area, marketing and transport facilities should be improved, and under MGNREGA, employment should be provided to MGNREGA beneficiaries, only during off-season.

AGRICULTURAL EXTENSION

Author	:	**NAVEEN, BUSI.**
Title of the Thesis	:	**A STUDY ON THE FUNCTIONING OF REVISED RAWE PROGRAMME IN ANGRAU, ANDHRA PRADESH**
Chairperson	:	**Dr. T. GOPI KRISHNA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5407**

ABSTRACT

Agricultural Sciences attempt to provide a systematic understanding of the agricultural phenomena in order to make the cultivation of plants and rearing of animals more profitable. A properly trained agricultural graduate will, therefore, have knowledge of the fundamental principles of Genetics, Pathology, Physiology, Entomology, Soils, Agronomy, etc., in relation to the production environments of plants and animals and such other discipline that have direct or indirect bearing on the understanding of the plant-animal complex, including Social Sciences. Planning of agricultural curricula in any system should, therefore, attempt to develop the interaction between the various fundamental disciplines. In the curriculum for undergraduate degree programmes, all the courses have practical content which include laboratory exercises, field practicals, visits to villages, etc.

Realizing this need, the ANGRAU introduced, for the first time in the country, an innovative concept of Rural Agricultural Work Experience Programme (RAWEP) in its undergraduate curriculum in the academic year, 1979-1980.

In this programme; the final year students are deputed in the seventh semester to stay in villages along with farmers for one full semester, where they will interact with the farmers of the village, work with them, understand their problems, apply the latest knowledge, acquire necessary skills and gain self-confidence. Accordingly, Randhawa Committee (1992) in India recommended the Rural Agriculture Work Experience (RAWE) Programme for imparting quality, practical and productive oriented education for the agriculture degree programme. The utility of this unique programme has been appreciated by the Indian Council of Agricultural Research (ICAR) and recommended this programme to other State Agricultural Universities in India, to adopt it.

Considering opinion and extent of participation as dependent variables, one scale was developed by using Likert method of summated rating technique viz., opinion of students and functionaries towards RAWEP and extent of participation of RAWEP students. The opinion scale was comprised of 90 statements and structured questionnaire on extent of participation had 50 statements. Data was collected through a well structured questionnaire which was developed keeping in view of the objectives of the study.

Descriptive research design was used in the present study. ANGRAU in Andhra Pradesh was selected purposively. Among the existing five colleges in ANGRAU, three colleges representing three regions namely Agricultural College, Naira from North Coastal Region, Agricultural College, Bapatla (1945) from Southern Coastal Region, S.V. Agricultural College, Tirupati (1961) from Rayalseema Region purposively selected for the study. A total of 120 students registered for RAWEP during the academic year 2015-16 were selected by proportionate random sampling and all the teachers, scientists associated with the implementation of RAWEP during 2015-16 such as Associate Deans, Associate Directors of Research (ADR), Head of the Departments of Agricultural Extension, Associate Deans Representatives, Co-ordinators of concerned DAATTCs, Programme Co-ordinators of KVKs, Scientist (TOT), connected with will be selected to constitute the sample.

The detailed analysis of profile of students indicated that majority of the students were female, farmer being small farmers, students belonged to rural background, their parents as occupation agriculture farming and low income, high academic excellence, medium extent of supervision and guidance, high agriculture exposure, medium achievement motivation, medium satisfaction with course curriculum, high communication skills, medium facilities available in village, medium decision making skills and medium organizing skills. Regarding extent of participation, students partially participation and had medium favourable opinion towards RAWEP. The functionaries had medium favourable opinion towards RAWEP.

The computed correlation coefficient (r) values of farm size of host farmer, parental occupation, parental income, academic excellence, extent of supervision and guidance, achievement motivation, satisfaction with curriculum, facilities available in village and decision making skills were positively significant at 0.01per cent level of probability and agriculture exposure and rural-urban back ground, also positively significant at 0.05 per cent level of probability with opinion of RAWEP students. Communication skills and organizing skills were positive and non-significant with opinion of RAWEP students.

The computed correlation coefficient (r) values of farm size of host farmer, rural-urban back ground, parental occupation, parental income, academic excellence, extent of supervision and guidance, achievement motivation, satisfaction with curriculum, facilities available in

village, decision making skills and organizing skills were positively significant at 0.01per cent level of probability and communication skills was also positively significant at 0.05 per cent level of probability with opinion of RAWEP students. Agriculture exposure was positive and non-significant with extent of participation of RAWEP students.

Most important constraints of the RAWEP students in the percentage rank order of their importance as: Non- disbursement of stipend in time, Remote opportunity to prepare for competitive examinations, Inadequate transport facilities etc.

Suggestions expressed by the RAWEP students in the percentage rank order of their importance as: Release the stipend in time, Enhancement of stipend, Provision of facilities like TV, Video etc to teach farmer though telefilms/documentaries etc.

Constraints expressed by the RAWEP functionaries in the percentage rank order of their importance are: Non- coincidence of RAWEP with crop season, Difficulty in girl students accommodation, Tending nature of external evaluation etc.

Suggestions expressed by the RAWEP functionaries be placed in the percentage rank order of their importance are: Timely payment of RAWEP stipend, Coinciding RAWEP with crop season, Adequate staffing arrangement at DAATTC/KVKs etc.

AGRICULTURAL EXTENSION

Author	:	**PRASANTHA KUMAR, THELLA.**
Title of the Thesis	:	**ORGANIZATIONAL EFFECTIVENESS AND JOB PERFORMANCE OF RESEARCH AND EXTENSION SCIENTISTS IN ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY**
Chairperson	:	**Dr.B.VIJAYABHINANDANA**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5405**

ABSTRACT

Different approaches to organizational effectiveness indicate that the achievement of organizational objectives efficiently is the outcome of organizational effectiveness. But it depends on the contribution of the individual employees, groups and the total organization.

The System of State Agricultural Universities (SAUs) in India is one of the largest national agricultural research systems of the world. It has shouldered the responsibilities of research, education and extension in different fields of agriculture and allied discipline over decades. Approximately six thousands of scientists are employed under the ICAR and about twenty five thousands of scientists are working under the SAUs.

Agricultural Research and Extension have a common objective of helping farmers. They are service agencies designed by the Government to help the farmers by generating appropriate technologies and transferring them into production recommendations – messages, so that the farmer adopt them in their farming to improve upon the production, income and living standards.

The main objective of the study was to find out the perceived organizational effectiveness and job performance of research and extension scientists working in Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad. An *Ex-post-Facto* research design was adopted for the present study. ANGRAU has been bifurcated into PJTSAU and ANGRAU on 2nd June, 2014. Being a native of A.P., the study was purposively conducted in ANGRAU, which is also situated in Guntur, A.P.

Considering the objectives, organizational effectiveness and job performance were taken as dependent variables. The selected independent variables were educational qualification, professional experience, trainings received, attitude towards organization, organizational stress, organizational climate, achievement motivation, job involvement, job satisfaction and promotional avenues.

Proportionate random sampling was followed by selecting as sample of 120 research scientists. Since the sample size of extension scientists (60 nos.) by following proportionate random sampling method was not getting, a complete enumeration of 60 extension scientists working in different extension units of university were taken in entire nine agro-climatic zones thus making a total of 180 respondents for this study who were having minimum five years of continuous experience in research and extension units spread over nine agro climatic zones of the state of Andhra Pradesh.

A well structured questionnaire was constructed to meet the objectives of the present study. Before the instruments were used with the respondents the questionnaire was pre-tested with non-respondent research and extension scientists in Andhra Pradesh.

The data collected through questionnaire were coded, categorized and filled into tables to facilitate interpretation of findings. The master table formed the basics for subsequent analysis. After subjecting the data to statistical analysis, the findings emerged out of the data were suitably interpreted objectively and necessary conclusions and inferences were drawn accordingly.

It was found that half of the research and extension scientists belong to middle aged group (36-45 years) and had Ph.D degree (78.89%). The experience in the present position has upto 5 years (60.56%), 35 per cent of them had 6 to 10 years of overall experience. The study revealed there is a greater need for training in three major areas *i.e.,* research, research project management and extension education. Majority of the scientists (46.67%) had undergone medium number of trainings in their entire service and very few of them had attended abroad trainings. Majority of the research and extension scientists were received 21 days training as it is mandatory for CAS promotion in the University. Majority of the selected scientists (45%) had the favourable attitude towards organization. Majority of them (54%) perceived high level of stress. About half of the scientists (52%) perceived the organization (ANGRAU) had good organizational effectiveness for the benefit of farmers.

Regardingthe organizational climate 41 per cent of the selected scientists agreed about their job clarity in terms of their job roles and responsibilities in the University. 45 per cent of them agreed that there is lot of scope in ANGRAU to work as teams. About 40 per cent agreed that the leadership of senior scientists in the University promote good superior-subordinate

relationships and healthy climate among the scientists in the execution of tasks. 38 per cent of the scientists agreed that the University has a clear cut and transparent promotional policy and rewards in the University are based on individual performance and contribution. About 37 per cent of the scientists agreed that the scientists get demotivated due to lack of decision makingability. In case of communication, 40 per cent of the selected scientists disagree that there is inadequate communication in the University between the top management and scientists at all levels.

The scientists of ANGRAU had high level of job involvement (44%). 79.00 per cent of them had high level of job satisfaction. 55.00 per cent of the scientists derived full satisfaction on their career advancement scheme (CAS) and direct selection.52.00per cent perceived the organization (ANGRAU) had good organizational effectiveness for the benefit of farmers.95.00 per cent of the farmers perceived Acharya N.G. Ranga Agricultural University was ready to receive innovative ideas, technologies and welcome positive changes and accept new ideas.

Regarding job performance of the scientists performed their job during the last five years was total number of research papers published in the international journals by the selected scientists was 735 (average 4), in national level journals was 1281 (average 7) and in state/regional level journals was 449 (average 2),62 nos. of books were published as a first author and 81 books have been published as co-author and 23 nos. as co-editor.The selected scientists published 129 nos. of book chapters as first author, 75 nos. as co-author, 13 nos. of book chapters as co-editor.In case of edited volume, 11 nos. were published as first author, the same no. *i.e.,* 11 as co-author and 20 nos. of the edited volumes published as co-editor. With regard to seminar proceedings 395 nos. as first author, 239 nos. as co-author and 49 nos. of seminar proceedings as co-editor.Number of technical bulletins published were 6008 and the popular articles were 3771 and that of conferences / seminar papers presented were 1118.Number of new crop varieties developed were 279,new farm implements were 36, number of new production technologies developed were221, new protection technologies were 161, innovative extension methodologies were 119, new statistical models developed were 7 and that of patents obtained were 4.Number of externally funded projects completed were 210, number of research projects funded by the universitywere 887, internationally funded projects completed were 84, new projects developed were 120, paid up trials completed were 272 and money spent on projects was 284.9 lakhs.Revolving fund generated by the scientists was 264.2 lakhs, number of germplasm collected and conservedwere 199, annual reports prepared were 595, number of university publications prepared were 227 and amount of service provided with related to production of seed was 294.2 tonnes.

There were 252 students guided by the selected scientists during the last 5 years at M.Sc. (Ag). Level and the number of students guided at Ph.D level were 94.Number of training programmes conducted as course director were 128, as resource person were 5699, number of training manuals were 302, villages adopted were 600, farmers' associations established were 957, extension leaflets printed were 8299, extension booklets were 2765, seed material distributed were 665 tonnes, on farm trials conducted 1917, front line demonstrations conducted were 2922, mini kits conducted were 3279, radio programmes given were2513, TV programmes given were3118, diagnostic surveys conducted were9257, regional agriculturalfairs organized/associated were 704, ICT models developed or practiced were 130, RAWEP batches organized were437, group discussions conducted were4321, exhibitions conducted were852, kisan melas conducted were515, field days conducted were 1564, campaigns conducted were613 and the new formats designed for monitoring extension activities were51.The international awards received by the scientists were 23, ICAR or other national awards were 57, state or university level awards were 92, district level awards were

114 and the awards by scientific professional societies were 58.Regarding professional recognition almost 95.00 per cent of the scientists (171 numbers) indicated that they were not occupied the honorary post of Chief Editor of any research journals; only 5.00 per cent of the scientists (9 numbers) had the post of the Chief Editor of the research journals. 87.78 per cent (158 numbers) of the selected scientists indicated that they were not editorial members of any research journal and it was found that 12.22 per cent (22 numbers) hadeditorial membership of research journals. 87.20 per cent (157 numbers) had no executive position and 12.78 per cent (23 numbers) had executive position with the professional societies.

Regarding correlation analysis of independent variables with dependent variable, the variables namely attitude towards organization, organizational climate and organizational stress had positive and significant relationship with organizational effectiveness, while education, overall experience, trainings received and training needs of scientists, achievement motivation and job involvement showed non significant relationship with the organizational effectiveness.

With regard to multiple linear regression analysis of independent variables with dependent variable (OE) organizational climate and job satisfaction were most important determinant of organizational effectiveness. It was most visible and tangible aspect that made variation in the organizational effectiveness as 1 per cent level of significance. The variable such as attitude towards organization, organizational climate, achievement motivation, job involvement, job satisfaction and perceived opinion of promotional avenues were most important determinant of job performance since it was most visible and tangible aspect that made variation in job performance as 1 per cent level of significance.

The major constraints perceived by the scientists in the organization were lack of adequate supporting staff, followed by lack of avenues for higher training in abroad to improve skills. The main suggestion was felt in case of provision for a three months foundation course for newly recruited scientists as in the case of ICAR scientists. The other suggestion given by the scientists was formulation and implementation of transfer policy doing justification for all employees irrespective of recommendations/various pressures.

AGRICULTURAL EXTENSION

Author	:	**RESHMA.J.MURUGAN**
Title of the Thesis	:	**TRAINING NEEDS OF BANANA GROWERS IN PALAKKAD DISTRICT OF KERALA**
Chairperson	:	**Dr. B. MUKUNDA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5403**

ABSTRACT

Banana (*Musa* species) the “queen of tropical fruits” is considered to be one of the oldest fruits known to mankind. Banana is considered as the most important energy providing

food and is a good source of mineral, salts and vitamins. Banana produces a more balanced diet than many fruits.

In India, banana is largely grown in Tamil Nadu, Kerala, Maharashtra, Andhra Pradesh and Bihar. It is the second most important fruit crop in India next to mango. Production alone constitutes 32 per cent of the fruit production in India. The contribution of banana to GDP of agriculture in India is 2.80 per cent.

The productivity of banana in Kerala was 13.8 tha^{-1} (Source: Directorate of Economics & Statistics, Kerala) in 2014 where as, it was 46.1 tha^{-1} in Tamil Nadu (Source: National Horticultural Board). This productivity difference is due to lack of information and skills among farmers about the cultivation strategies of banana. Hence, it is required to strengthen human capital through an effective system of extension training and education.

Keeping the above in view, a research study was designed to study the training needs of banana growers in Palakkad district of Kerala. An ex-post facto research design was followed to conduct the study with a total of 120 banana growers selected from three blocks. The data was collected through pre-tested interview schedule, which was subjected for statistical analysis and interpreted.

Findings of the study indicated that majority of the banana growers were middle aged with high school education, marginal land holding, occupation of agriculture + labour as their occupation, 11- 15 years of farming experience, medium annual income, medium level of social participation, extension contact, urban contact, mass media exposure, risk orientation, scientific orientation, market orientation, innovativeness and achivement motivation.

The findings of the study revealed that the plant protection (2.66), organic practices (2.01), nutrient management (1.82), suckers and planting (1.58), post harvest management (1.53), water management (1.49), land preparation (1.34), intercultural practices (1.26), harvesting (1.24) and agro climatic requirements for growing of banana (1.19) were the main areas of training needs in knowledge in their mean rank order of importance.

The study indicated that the nutrient management (2.71), organic practices (2.15), water management (2.02), plant protection (1.96), suckers and planting (1.96), post harvest management (1.62), intercultural practices (1.59) and land preparation (1.56) were the main areas of training needs in skills in their mean rank order of importance.

The findings of the study revealed that majority of the banana growers preferred non institutional training of 10 to 20 members group, one day training, about plant protection management and preferred demonstration and field trip method.

The findings of the study revealed that majority (59.17%) of the banana growers were observed under medium adoption category followed by the remaining under low (22.50%) and high (18.33%) adoption categories in relation to recommended practices of banana.

The correlation analysis indicated that out of 15 selected profile characteristics, 10 of them such as education, occupation, social participation, urban contact, mass media exposure, scientific orientation, risk orientation, market orientation, innovativeness and achievement motivation were found to be positive and significant in their relationship with the training needs at 0.01 level of probability, while age and extension contact were found to be negative at 0.01 and 0.05 level of probability, respectively. However land holding, farming experience and annual income were found to be non - significant.

The Multiple Linear Regression Analysis revealed that the selected profile characteristics put together contributed 82.81 per cent of the total variation in the training needs of the banana growers. Extension contact, social participation and scientific orientation

of the banana growers had contributed significantly at 0.01 level of probability towards the variation. Remaining 17.19 per cent may be due to extraneous characteristics.

The correlation analysis indicated that out of 15 selected profile characteristics, 10 of them such as education, occupation, social participation, urban contact, mass media exposure, scientific orientation, risk orientation, market orientation, innovativeness and achievement motivation were found to be positive and significant in their relationship with the adoption levels of banana growers at 0.01 level of probability , while age was found to be negative at 0.01 level of probability. However land holding, farming experience, annual income and extension contact were found to be non - significant.

The Multiple Linear Regression Analysis revealed that the selected profile characteristics put together contributed 87.14 per cent of the total variation in the adoption levels of the banana growers. Social participation and scientific orientation of the respondents had contributed significantly at 0.05 and 0.01 level of probability respectively, towards the variation. Remaining 12.86 per cent may be due to extraneous characteristics.

The important constraints under bio physical constraints reported by the banana growers in order of their importance were problematic soils, wild boars, natural calamities, inadequate drainage facilities, poor quality of irrigation water and poor water retention capacity of soil. Incidence of insect / pest attack like banana weevil, susceptibility of plant to disease like panama wilt, non availability of suitable high yielding variety and unfavourable weather conditions during fruit formation were the constraints faced by the growers in technological constraints. Constraints like lack of proper knowledge about banana production technology, inadequate contact with extension workers and poor economic conditions of the banana growers were faced by the respondents under socio personal constraints. The important constraints under economic constraints in order of their importance were low profit due to high cost of cultivation, high labour cost, lack of premium price for organic produce, high cost of plant protection chemicals and high cost of manure and fertilizers. Inadequate training facilities, insufficient technical staff, inadequate supply of agricultural inputs from cooperative societies, improper crop insurance schemes, non- availability of adequate credit, non-availability of fertilizers and plant protection chemicals in time were the administrative constraints faced by the banana growers. Constraints like lack of remunerative price, insufficient collection centres at local levels, inadequate knowledge about market intelligence and inadequate transport facilities were marketing constraints faced by the banana growers.

Majority of the banana growers suggested to provide appropriate control measures of diseases and pests (1st rank) followed by timely technical guidance (2nd rank), frequent monitoring of technical staff (3rd rank), establishing soil testing labs in nearby locality (4th rank), provision of fertilizers on subsidy rates (5th rank), establishment of collection centers at the nearest point (6th rank), providing crop insurance (7th rank), conduct training programmes (8th rank), market outlets for organic produce (9th rank), supply of planting materials at a subsidised rate bythe Department of Agriculture (10th rank) and maintaining demonstration plots (11th rank).

AGRICULTURAL EXTENSION

Author	:	**SRI CHANDANA, T.**
Title of the Thesis	:	**EXTENT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) UTILIZATION BY THE AGRICULTURAL OFFICERS IN ANDHRA PRADESH**
Chairperson	:	**Dr. P.V. SATYAGOPAL**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5485**

ABSTRACT

The present study was conducted to analyze the personal characteristics of Agricultural Officers and their attitude towards ICT utilization and the extent of ICT utilization. The relationship between personal characteristics of Agricultural Officers with their attitude towards ICT utilization and the extent of ICT utilization was elicited. The problems and suggestions as perceived by the Agricultural Officers towards ICT utilization were elicited and a strategy was designed for enhancing extent of ICT utilization by the Agricultural Officers.

Ex post facto research design was followed in the present investigation. The Andhra Pradesh state was chosen as the locale of the study, since the researcher belongs to the state and was familiar with the local conditions as well as organizational set up in the State Department of Agriculture. All the three regions in the newly formed state of Andhra Pradesh viz., Rayalaseema, Coastal Andhra and North Coastal region were included for the present study. One district from each region was selected by following lottery method of simple random sampling procedure. The names of the selected districts were Ananthapur from Rayalaseema region, Nellore from Coastal region and Srikakulam from North Coastal region. From each of the selected district, forty Agricultural Officers were selected as respondents by following simple random sampling procedure. The sample constituted to a total of 120 respondents. Twelve independent variables and two dependent variables viz., attitude towards ICT utilization and extent of ICT utilization were selected for the study. The data was collected through a structured questionnaire and analyzed by employing suitable statistical methods.

The results of the study shown that majority of the respondents were middle aged (36-45 years), majority were males, had M.Sc. (Ag.) academic qualification, 6-10 years of work experience and possessed medium level of communication gadgets. The psychological variables like Perceived workload, organizational climate, job autonomy, personal importance and social status attached to the job were found to be medium level with moderate convenience of posting and job satisfaction.

Nearly one third of the Agricultural Officers had neutral attitude towards ICT utilization followed by one-fifth of them had moderately unfavourable attitude, one- fifth and nearly one-fifth of them had shown moderately unfavourable and favourable attitude towards

ICT utilization respectively. On the other side highly favourable and unfavourable attitude towards ICT utilization was noticed among more than one-tenth of the Agricultural Officers.

Nearly half of the Agricultural Officers had moderate extent of ICT utilization followed by one-third of Agricultural Officers had low and one-fifth of Agricultural Officers had high extent of ICT utilization.

Correlation analysis revealed that job autonomy, convenience of posting, possession of communication gadgets, organizational climate and job satisfactions were positively significant related. Age and perceived workload were negatively significant related where as Gender, Academic qualification, personal importance, social status attached to the job and work experience showed non significant relationship with attitude towards ICT utilization.

In case of extent of ICT utilization the correlation analysis revealed that organizational climate, job autonomy, possession of communication gadgets and job satisfaction were positively significant related. Age, work experience and perceived workload were negatively significant related where as Gender, Academic qualification, personal importance and social status attached to the job showed non significant relationship with Extent of ICT utilization.

The regression analysis revealed that, Age, Possession of communication gadgets, Perceived workload, Organizational climate and job satisfaction were the major variables to explain attitude of towards ICT utilization up to 51.24 per cent.

In case of extent of ICT utilization the regression analysis revealed that Possession of communication gadgets, Perceived workload, Organizational climate, Convenience of posting and Job satisfaction were the major variables to explain extent of ICT utilization up to 49.38 per cent.

Among the problems in ICT Utilization as perceived by the Agricultural Officers, ‘Lack of expertise and skills in using ICT’, ‘Poor/ limited internet speed’, ‘High cost of ICT equipment’, ‘Limited budget for purchase of ICT equipment’, ‘lack of ICT facility at office’, ‘lack of personal ICT equipment/ tools’, ‘lack of technicians and professionals in the vicinity’, ‘poor annual maintenance of the ICT equipment’, ‘overburdened allied activities’ and ‘limited power supply’ were in the order of their gravity. On the other side, ‘Periodical training programmes on application of ICT’, ‘Creating awareness on importance of different ICT tools and programmes’, ‘Uninterrupted high speed internet with high quality broad band facility’, ‘Establishing WIFI in all the agricultural offices’, ‘Engaging an ICT professional / technician on permanent basis’, ‘Proper mechanism for annual maintenance of ICTs’, ‘Uninterrupted power supply in the agricultural offices’, ‘Hands- on training through coaching and counselling’, ‘Allocation of enough budget to buy latest ICT tools and programmes’, ‘Regular updating of recent advances in ICT’ and ‘Special budget for capacity building for the agricultural officers’ were the suggestions given by the Agricultural Officers for enhancing the extent of ICT utilization.

The strategy has been developed keeping in view of the results obtained in the study and discussion held with the stakeholders of the study.

AGRICULTURAL MICROBIOLOGY

Author	:	**ESWARA RAGHAVA KUMARI, M**
Title of the Thesis	:	**ISOLATION AND CHARACTERIZATION OF STRESS TOLERANT PLANT GROWTH PROMOTING RHIZOBACTERIA AND THEIR INFLUENCE ON BLACKGRAM (*Vigna mungo* L.)**
Chairperson	:	**Dr. A.VIJAYA GOPAL**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5541**

ABSTRACT

Stress tolerant Plant Growth Promoting Rhizobacteria (PGPR) are the rhizosphere bacteria that can enhance plant growth under stress condition by production of ACC deaminase enzymes. In the present study 32 stress tolerant PGPR were isolated from rhizospheric soils of drought prone areas and were tested for different plant growth promoting activities. Out of 32 bacterial strains (8 *Rhizobium* isolates, 8 *pseudomonas* isolates, 8 potassium releasing bacterial isolates and 8 zinc solubilizing bacterial isolates) isolated from blackgram soils, four efficient PGPR strains, one each of *Rhizobium* (KUR1), *pseudomonas* (KCP1), potassium releasing bacterial (KGK1) isolate and zinc solubilizing bacterial (STZ1) isolate were selected for further studies. These four isolates contain higher ACC deaminase activity KUR1 (+++), KCP1 (+++), KGK1 (+++), STZ1 (+++) and produce higher exopolysaccharide KUR1 (34.6 mg ml^{-1}), KCP1 (30.6 mg ml^{-1}), KGK1 (20.3 mg ml^{-1}), STZ1 (24.6 mg ml^{-1}). All isolates were positive for siderophore production, IAA production and also phosphate solubilization efficiency.

All the isolates were further screened *in vitro* for antagonistic activity against the fungal pathogen *Rhizoctonia solani* and found that all these isolates inhibited the fungal pathogen and highest inhibition was found with the isolates KUR1 (37.6%), KCP1 (39.53%), KGK1 (36.47%), STZ1 (36.07%).

The selected strains were tested in soil to assess their effectiveness against stress tolerance by improving growth of blackgram under water stress conditions. Pot culture experiment was conducted with blackgram crop at different water holding capacity (80%, 60%, 40% and 20%).

The results revealed that reduced soil moisture levels significantly decreased the growth of blackgram. However inoculation of blackgram with stress tolerant rhizobacteria containing ACC deaminase, isolated from the soils collected from drought prone areas significantly increased the drought tolerance in blackgram and increases the growth and yields.

These stress tolerant PGPR improved the growth parameters like plant height (13.3 cm, 31.6 cm and 39.0 cm at 30 DAS, 60 DAS and75 DAS respectively), Number of branches $plant^{-1}$ (4.73, 9.60, 11.60 at 30 DAS, 60 DAS and75 DAS respectively) and number of leaves $plant^{-1}$

(13.3, 31.6, 39.0 at 30 DAS, 60 DAS and75 DAS respectively) increases. Number of pods plant^{-1} (32.3), number of seeds pod^{-1} (5.0), seed yield (2815.0 kg ha^{-1}), 100 seed weight (4.98 gm) also increases.

Other physico chemical properties of soil like pH (7.97), EC (0.98 dSm^{-1}), Organic carbon (0.75%), N (283.40 kg ha^{-1}), P (98.99 kg ha^{-1}), K (324.73 kg ha^{-1}) and enzymes like dehydrogenase (233.4 µg TPF formed g^{-1} d^{-1}), phosphatase (Acidic 130.00 µg pNP g^{-1} h^{-1}, Alkaline 148.00 µg pNP g^{-1} h^{-1}), urease (121.62 ug urea g^{-1} h^{-1}) also improved at flowering stage of blackgram. Proline content of plant was increases under stress condition. *i.e.,* at 20% WHC, it was recorded as 64.33 µ moles g^{-1}. N (0.55%), P (0.32%), K (2.21%) content of plant samples also increases. These results revealed that combined inoculation of stress tolerant PGPR significantly increased growth and yield of blackgram 42 percent more compared to control under moisture stress conditions.

AGRICULTURAL MICROBIOLOGY

Author	:	**LASYA MOHANA REKHA, DASARA.**
Title of the Thesis	:	**INFLUENCE OF BIOFERTILIZER CONSORTIA ON GROWTH AND YIELD OF PEARL MILLET (*Pennisetum glaucum* L.)**
Chairperson	:	**Dr. R. LAKSHMIPATHY**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5542**

ABSTRACT

A pot experiment was carried out to study the effect of biofertilizer consortia in combinations with recommended dose of FYM and different doses of inorganic fertilizers on growth and yield of pearl millet with an objective of enhancing growth, yield and nutrient uptake in pearl millet and to improve soil health. The significantly more plant height at 50DAS, 75DAS and at the time crop harvesting was recorded in the treatment MC1 + 75% RDF + with recommended dose of FYM and least in case of treatment applied with the consortium MC1 alone. There were no significant differences in number of leaves per plant between different treatments was noticed up to 50DAS however, the highest number of leaves after 75 days of sowing was recorded in treatments T_3 (MC1 + FYM) and T_{11} (MC1 +75% RDF + FYM). The root length (28.833 cm), root weight (3.294 g) and yield parameters like earhead length (20.733 cm), earhead weight (9.987 g), the number of seeds per earhead (1440.00), test weight (0.894 g), seed yield (4807.948 kg ha^{-1}) and straw yield (5977.00 kg ha^{-1}) were significantly more in treatment having biofertilizer consortium MC1 with recommended dose of FYM and 75 per cent chemical fertilizers.

The maximum soil pH at flowering was recorded in treatment applied with biofertilizer consortium MC2 with 50 per cent RDF, MC2 + 75%RDF, 100% RDF and at harvesting, it was observed to be maximum in treatment having inorganic fertilizers alone whereas, higher

electrical conductivity and organic carbon at flowering and harvesting were recorded in the treatment having biofertilizer consortium MC1 with recommended dose of FYM. The highest soil available N, P and K at flowering and harvesting was recorded in the treatment having biofertilizer consortium MC1 with recommended dose of FYM and 75% chemical fertilizers.

The highest dehydrogenase activity at flowering and harvesting was recorded in the treatment having microbial consortium MC1 with recommended dose of FYM. Acid and alkaline phosphatase activity were observed to be maximum in the treatment having microbial consortium MC1 with recommended dose of FYM at flowering and acid phosphatase activity was observed to be maximum in the treatment having biofertilizer consortium MC1 with recommended dose of FYM and 50% chemical fertilizers, alkaline phosphatase activity significantly more in the treatment having biofertilizer consortium MC1 with recommended dose of FYM and 75% chemical fertilizers at the time of crop harvest.

NPK uptake by the plants was significantly more in the treatment with MC1 + 75% RDF + FYM. The highest microbial population (Bacteria, Fungi, Actinomycetes, *Azospirillum*, *Azotobacter* and PSB) was recorded at flowering compared to other growth stages. Microbial population at flowering and harvesting was more in the treatments having bifertilizer consortium with recommended dose of FYM and chemical fertilizers as compared to application of 100 per cent RDF alone. Among the different stages of crop growth the maximum AM fungal spore count and percent root colonization were at harvesting compared to other stages. Further, the maximum AM fungal spore count and percent root colonization were recorded in the treatment which is inoculated with biofertilizer consortium MC1 along FYM and chemical fertilizers than treatment applied with chemical fertilizers at harvesting. The results of this study clearly shows that pearl millet growth and yield can be enhanced by inoculating soil with biofertilizer consortium MC1 along with recommended dose of FYM and 75 per cent RDF over only with 100 per cent RDF. Further, from this study it is also concluded that, soil fertility and health can be improved with the inoculation of soil with biofertilizer consortium along with recommended dose of FYM.

AGRICULTURAL MICROBIOLOGY

Author	:	**SAISREE, CHALLA.**
Title of the Thesis	:	**EFFECT OF PHOSPHATE SOLUBILIZING BACTERIA ON GROWTH AND YIELD OF FINGER MILLET**
Chairperson	:	**Dr. A. VIJAYA GOPAL**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5543**

ABSTRACT

Phosphate solubilizing bacteria (PSB) plays an important role in dissolving both of fertilizer phosphorus (P) and bound P in the soil that is environmental friendly and sustainable. Phosphate solubilization is mainly through the reaction between organic acids excreted with phosphate binders such as Al, Fe, and Ca, or Mg to form stable organic chelates to free the bound phosphate ion. Phosphorus deficiency is widespread and phosphorus fertilizers are required to maintain crop production. Reductions in the supply of P fertilizers could severely diminish crop yields. One solution for mitigating the threat of this diminishing resource is to develop sustainable technologies to improve P use efficiently for plant uptake. Since chemical fertilizers are frequently used with finger millet crop, use of PSB, as biofertilizers would help in improving better crop stand and crop yields.

Sixteen PSB isolates were isolated from finger millet rhizospheric soils of twelve villages in Andhra Pradesh. All the 16 PSB isolates were able to solubilize phosphate qualitatively and quantitatively. The PSI for 16 PSB isolates were in the range of 6.61 to 2.62 qualitatively and all 16 PSB isolates were able to solubilize phosphate quantitatively in Pikovskaya's broth containing TCP in the range of 189.5 to 41.3 mg l^{-1}. The isolates were purified and they were culturally, morphologically and biochemically characterized. Biochemical characterization revealed that 9 isolates were positive for Voges Proskauer's test and motility test, 10 isolates were positive for nitrate reduction and catalase test, 11 isolates were positive for citrate utilization and oxidase test, 8 isolates were positive for starch hydrolysis and methyl red test, 6 isolates were positive for gas and acid production and 13 PSB isolates were positive for indole production. These isolates were screened *in vitro* for plant growth promoting attributes like phosphate solubilization, siderophore, IAA, ammonia and HCN production. Results revealed that all 16 isolates solubilized phosphorous and 87.5% isolates produced ammonia, 75% isolates produced HCN, 56% isolates produced siderophores and 81% isolates produced IAA.

All the isolates were further screened *in vitro* for antagonistic activity against the fungal pathogen *Rhizoctonia solani* and found that all isolates inhibited the fungal pathogen and highest inhibition was found with the isolate BKP2 (51.49%). The best 3 efficient PSB strains i.e., PSB1, PSB2 and PSB3 were selected by estimating the phosphorus solubilizing ability of isolates qualitatively as well as quantitatively and by determining the morphological, biochemical and plant growth promoting rhizobacterial properties of isolates. Therefore, the best 3 PSB strains were identified as *Pseudomonas* sp. (isolate name, BKP2) *Bacillus* sp. (isolate name, SSP1) and *Enterobacter* sp. (isolate name, SBP1).

Pot culture experiment was conducted for evaluating the effect of PSB on growth and yield of finger millet. Results revealed that the highest microbial population (Bacteria, PSB, Fungi and Actinobacteria) was recorded at flowering stage compared to other growth stages while microbial population at flowering stage was more in the treatment (T_5) with 75% RDP+PSB1+PSB2+PSB3. Root length (23.1 cm), no. of fingers plant^{-1} (10.0), phosphorus content in plant sample (0.183%), total dry matter (39.4 g plant^{-1}) and yield parameters like grain yield (4031.9 kg ha^{-1}) and straw yield (4691.5 kg ha^{-1}) were recorded highest in the treatment (T_5) with 75% RDP+PSB1+PSB2+PSB. The enzyme activities (acid phosphatase, alkaline phosphatase, dehydrogenase and urease) and soil physico-chemical properties (pH, EC, available N, P, K and Organic carbon) recorded highest at various stages of crop growth in the treatment (T_5) with 75% RDP+PSB1+PSB2+PSB3. The results of this study clearly shows that finger millet growth and yield can be enhanced by inoculating soil with PSB biofertilizer along with recommended dose of FYM and by varying RDF in different treatments. Further,

from this study it is also concluded that, soil fertility and soil health can be improved with the inoculation of soil with PSB biofertilizer.

AGRICULTURAL STATISTICS AND MATHEMATICS

Author	:	**AKHISHA, P. A.**
Title of the Thesis	:	**DISTRIBUTION AND FUTURE TRENDS OF MONTHLY RAINFALL IN THE DISTRICTS OF KERALA – A STATISTICAL APPROACH**
Chairperson	:	**Dr. V SRINIVASA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5458**

ABSTRACT

An attempt was made to study the district wise monthly rainfall pattern of Kerala State. Data pertaining to monthly rainfall of the fourteen administrative districts of the state starting from 2004 to 2016 (156 months) was collected from Regional Meteorological Centre, Thiruvananthapuram for the study. Components of time series viz., secular trend, seasonality, cyclical variation and irregularity were studied along with the descriptive statistics like Arithmetic Mean (AM), Standard Deviation (SD) and Coefficient of Variation (CV%). To determine regional rainfall pattern, a non hierarchical cluster analysis, i.e., K means Clustering Algorithm, was applied on autocorrelation coefficients at different lags and four rainfall groups were found based on the time series models. The results of the time series modeling showed a high variation of temporal pattern of the monthly rainfall over Kerala. Auto Regressive Integrated Moving Average (ARIMA) models, Seasonal Dummy models and Seasonal Exponential Smoothing were fitted to the data and best model was chosen based on values of AIC, SBC, R square and MAPE. Better forecasts were obtained by Seasonal Dummy and Seasonal Exponential Smoothing.

Trend analysis showed that the mean monthly rainfall of Kerala State exhibited a slightly decreasing trend over the period of study and seasonal indices were found highest in June and least in January.Clustering of districts showed that Kasargod and Kannur districts were listed under cluster 1 while Thiruvananthapuram was listed under Cluster 2 alone. Kottayam, Alappuzha, Pathanamthitta and Kollam were listed under Cluster 3 while Kozhikkode, Wayanad, Malappuram, Palakkad, Thrissur, Ernakulam and Idukki were listed under Cluster 4.

The results of descriptive statistics indicated that the state received consistent rainfall in the month of June and inconsistent rainfall in February month. It also revealed that the state received maximum rainfall in 2007 and least rainfall in 2016 during the study period.

AGRICULTURAL STATISTICS AND MATHEMATICS

Author	:	**AMARNADH, V.**
Title of the Thesis	:	**FOREWARNING MODELS FOR PESTS AND DISEASES OF GROUNDNUT**
Chairperson	:	**Dr. B. RAVINDRA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5486**

ABSTRACT

The present study "Forewarning models for pests and diseases of groundnut" was mainly aimed at to study the behaviour of climate factors on major pests and diseases of groundnut, to establish association between climatic factors and pests and diseases of various groundnut varieties in different years in groundnut growing seasons, to generate forewarning statistical models for prediction of major pests and diseases based on climatic factors and also to study the influence of pests and diseases on various groundnut varieties with respect to climate factors. The selection of location (Regional Agricultural Research Station (RARS), Tirupati) for data collection was done on the basis of major groundnut grown area and also compatibility. The secondary data on major pests (%) and disease (%) incidence of various groundnut varieties along with climate factors were collected for the period from 2007 to 2016 (10 years) during crop seasons.

The correlation studies were under taken to study the relationship between various pests and disease incidence subject to the climate factors. The Multiple Linear Regression (MLR) models were used for predication of groundnut pest and disease incidence. The logistic models were also used for prediction of the probabilities of occurrence /non-occurrence of pests and disease of groundnut in standard weeks of groundnut growing seasons. The descriptive statistics were used to know the behaviour of climate factors along with pests and disease incidence over years during the crop seasons. Analysis of Variance (ANOVA) techniques applied to test the significance between standard weeks/varieties/years with respect to pest and diseases of groundnut. Finally, markov chain models were used to identifying the presence/absence of pest in consequent days effectively.

The results revealed that climatic factors from 2007 to 2016 in groundnut growing seasons the rainfall distribution varied greatly within groundnut growing seasons over years (13.61 mm – 36.06 mm). The average minimum temperatures (21.52°C – 22.03°C), maximum temperatures 31.80°C – 34.75°C), morning relative humidity (73.11 - 83.58%) and evening relative humidity (43.81 - 58.36%) were observed.

The results revealed that the days with RH > 78 per cent, temperature (13°C - 42°C) and weekly rainfall are most critical factors in the development of leafhopper incidence, the days with RH > 78 per cent, temperature (15°C - 42°C) are the most critical factors in the development of groundnut leaf miner incidence, the days with RH > 77 per cent, temperature (19°C - 37°C) are the most critical factors in the development of thrips incidence and the days with RH > 77 per cent, temperature (15°C - 43°C) are the most critical factors in the

development of root grub incidence. The days with RH > 81 per cent, temperature (16°C - 35°C) and weekly rainfall are the most critical factors in the development of late leaf spot incidence and the days with RH > 82 per cent, temperature (21.2°C - 35°C) and weekly rainfall are the most critical factors in the development of rust incidence.

Correlation coefficients were computed to ascertain the pattern of relationship between major pests/diseases and climate factors over years (2007-2016) and within year (groundnut growing seasons) under different groundnut varieties. Overall for the years 2007 to 2016 the results of correlation studies revealed that, there was a positive relationship between the leafhopper incidence and climate factors viz., rainfall, evening relative humidity and sunshine hours. There exist positive relationship between the groundnut leaf miner incidence and maximum temperature, minimum temperature, rainfall and evening relative humidity and negative relationship with morning relative humidity and sunshine hours. For thrips there exist positive relationship with temperatures and wind velocity and negative relationship with morning relative humidity, evening relative humidity, rainfall and sunshine hours. In case of root grub there exist positive relationship with temperatures, rainfall, evening relative humidity, wind velocity and negative relationship with morning relative humidity and sunshine hours.

The results on late leaf spot revealed that the positive relationship with temperatures, sunshine hours and the negative relationship with morning relative humidity, evening relative humidity and wind velocity.

For rust, among the climate factors evening relative humidity, wind velocity and rainfall exhibited negative association and rest of the climate factors were positively associated.

AGRICULTURAL STATISTICS AND MATHEMATICS

Author	:	**BHAVYA, NAMALA.**
Title of the Thesis	:	**AN ANALYSIS OF GROWTH AND INSTABILITY OF CHICKPEA (GRAM) PRODUCTION IN PRAKASAM DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. V. SRINIVASA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5457**

ABSTRACT

The present study entitled "**An analysis of growth and instability of Chickpea (gram) production in Prakasam district of Andhra Pradesh**" has been undertaken to estimate the growth rates of Chickpea crop and to fit the adequate trend equations for the

future projections by 2020 AD. The reference period of study was from 1976 to 2014 (39 years) and the study was carried for Prakasam district of Andhra Pradesh.

Linear and Compound growth rates were calculated to examine the trends in area, production and productivity of Chickpea crop. Ten linear and non linear growth models viz., linear, logarithmic, inverse, quadratic, cubic, compound, power, s-curve, growth and exponential were fitted to the area, production and productivity of Chickpea crop and the best fitted model for future projection was chosen based upon least RMSE, MAE, MAPE and highest significant R^2. Instability in area, production and productivity of Chickpea crop has been identified by using coefficient of variation and coppock's instability index. Decomposition analysis has been used to work out the level of stability in growth along with the percentage contribution of area, productivity and their interaction towards the production of chickpea in Prakasam District of Andhra Pradesh.

The study revealed that area, production and productivity of Chickpea marked a significant increasing trend during the study period (1976-2014). The projections were done by using 2 year moving average for area, production and productivity which showed stable growth by 2020 AD. Higher instability was shown in Chickpea production when compared with area and productivity of Chickpea. Interaction effect was showing dominating influence on production.

AGRICULTURAL STATISTICS AND MATHEMATICS

Author	:	**KHADARBASHA, DUDEKULA.**
Title of the Thesis	:	**AN ANALYSIS OF FARMER'S PREFERENCE INTHE SELECTION OF FARM MACHINERY**
Chairperson	:	**Dr. SHAIK NAFEEZ UMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5459**

ABSTRACT

An attempt was made to study about the factors that influence the farmer in selection of farm machinery in Guntur, Krishna and Prakasam districts of Andhra Pradesh by collecting data from six villages, i.e., in each district one wet land and one dry land village covering 15 farmers in each village making a sample size of 90 farmers. The data was analysed using statistical tools like Spearman's Rank correlation, factor analysis, Ward's Minimum Variance Cluster analysis and non-parametric tests like Chi-Square test, Garret Ranking Techniques and Z-test.

This study showed that the variables mechanics reputation, engine, loan availability to the farmer and media influence were showing significant difference in between dry land and wet land farmers whereas the variables brand reputation, easy reparability, cost of the

machine, appearance, performance, resale value and subsidy does not show any significant difference in between dry land and wet land farmers.

Factor analysis is a data reduction technique, which was used to identify a small set of variables, which accounts for a large proportion of the total variance in the original variables. The first five factors constitute about 63.60% of the total variance in the total 13 variables included in the analysis. The results indicated that multivariate approaches based on cluster analysis and factor analysis effectively summarized the source of variability in farmer's preference in the selection of farm machinery and precisely identifies different clusters of farmers based on their similarities existing among them.

Correlation studies showed that farmers prefer branded machinery which can have best engine capacity and its performance to agricultural operations was very good. It was also revealed that the farmers were buying the farm machinery based on the media influence. Hence, when the farmer was looking for a branded farm machinery, he was not considering spare parts availability, cost of machine, appearance of the machine, offers from the dealers, resale value and subsidy from the Government because the branded machinery generally have all these characteristics automatically.

Chi-square test showed that there was significant difference between the independent variables like age, education, farm size, family size, farming experience and crops grown with the preference in the selection of farm machinery.

Cluster analysis revealed that there were 4 different clusters of farmers existing among the selected villages based on the similarities existing in between them among the various variables that influence a farmer in selecting farm machinery. Among them, cluster IV was the largest with 30 farmers contributing about 33.33% of the total farmers. The cluster I was the second largest cluster with 28 farmers contributing about 31.11% followed by cluster II with 21 farmers with 23% of the total farmers. The smallest cluster was cluster III with 11 farmers contributing about 12% of the total farmers.

The various constraints that the farmers were facing during usage of farm machinery were analysed using Henry Garret Ranking technique and concluded that lack of credit facilities majorly influence the farmer's for buying farm machinery. The other constraints were small land holding, scattered farm holdings, high cost of farm machinery and maintenance of farm machinery. Farmers were least influenced by constraints like negative attitude of farmers towards improved machinery and belief of few farmers that the machinery was not suitable for varied types of lands and crops.

This study helps to identify the factors that were positively and negatively affecting the farmers in selecting the farm machinery. This helps to analyze the various constraints involved in selecting the farm machinery and suitable measures can to be taken to overcome these constraints. This will lead to increase the usage of farm machinery in the modern mechanized era to a greater extent.

AGRI BUSINESS MANAGEMENT

Author	:	**ANEESH, AKKINENI.**
Title of the Thesis	:	**SUPPLY CHAIN MANAGEMENT OF MANGO – A CASE OF GALLA FOODS LIMITED**
Chairperson	:	**Smt. Y. PRABHAVATHI**
Degree	:	**M.Sc (MABM)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5473**

ABSTRACT

The present study "Supply Chain Management of Mango - A Case of Galla Foods Limited" mainly aimed to study the supply chain of mango in study area, supply chain of mango of Galla Foods Ltd, cost estimation of mango processing and issues and challenges of supply chain of mango in the study area. For the present study, purposive cum simple random sampling technique was adopted. The study was undertaken in Chittoor district of Andhra Pradesh. Five mandals in the district were selected based on the criterion of highest area under mango cultivation. Two villages from each mandal were selected based on the above criterion and thus the total number of villages chosen stood at ten. From each village twelve mango growing farmers were selected randomly and thus the total sample size stood at 120. A pre structured schedule was prepared and required information was collected from sample farmers, traders, processors and other government departments to analyse the supply chain of mango in the study area, cost estimation and issues and challenges in supply chain of mango of Galla Foods Ltd by using a set of statistical tools.

The study revealed that greater percentage of sample farmers were in the age group of 36-45 years, were illiterate, had family size of 4-6 members and were large farmers. Mango growers in the study area supply produce mainly to traders followed by processors. Processors procure produce from farmers, bulk buyers and village traders. As totapuri variety of mango was mainly used for processing. They majorly export pulp to other countries and marginally supply to local manufactures for further value addition. Consumers mainly receive value added products from local retailers, importers and other national markets.

Galla Foods Ltd, a processing mango firm majorly procure produce from farmers (85 per cent) followed by traders (15 per cent) and process into pulp. Around 95 per cent of the pulp processed was marketed to exporters and local markets and only 5 per cent was value added to juice. The total cost incurred for processing one tonne of mango accounted to ` 40051.89 (100.00 per cent) of which fixed costs was ` 1902.5 (4.75 per cent) and variable costs was ` 38149.39 (70.01 per cent). Farmers supplying produce to Galla Foods were mainly satisfied with price and payment period and highly dissatisfied with waiting time for unloading of the produce. The major issues and challenges of supply chain of mango being faced by the company were lack of cold storage, high cost of packing material, ineffective transportation, contract farming and long payback period.

AGRI BUSINESS MANAGEMENT

Author	:	**KALAIVANI, A.**
Title of the Thesis	:	**EXPLORING THE FACTORS IMPACTING THE PURCHASE INTENTION OF CONSUMERS FOR ORGANIC FOODS**
Chairperson	:	**Smt. Y. PRABHAVATHI**
Degree	:	**M.Sc (MABM)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5474**

ABSTRACT

The present study "Exploring the factors impacting the purchase intention of consumers for organic foods" was mainly aimed to study the most preferred category of products of organic origin, to identify the factors influencing the purchase intention of organic foods and to find the relationship between demographic factors and factors influencing the purchase intention in the study area. For the present study, purposive cum simple random sampling technique was adopted. The study was undertaken in Coimbatore district of Tamil Nadu. Major five retailers in the district were randomly chosen for the study. Thirty consumers visiting each retail shop were identified and randomly selected and thus the total sample size was 150. A pre structured schedule was prepared and consumers identified above were surveyed to explore various factors influencing them to purchase organic products. The data collected was analyzed to attain the stated objectives by using percentage analysis, Garret ranking technique, cross tabulation, Likert scaling technique and factor analysis.

The study revealed that, vegetables followed by milk and dairy products were the most preferred category of products of organic origin. Food safety factor followed by supportive factor were the major factors considered by sample respondents while purchasing of organic foods and influential and motivational factors were least preferred by respondents while purchasing organic foods. Majority of sample respondents fall in the age group of 25-35 years and were majorly considering food safety factor, environmental factor, influential factor, cooking quality factor, keeping quality factor and reliability factor while purchasing organic foods. Majority of sample respondents fall in the occupation group of private employees and were majorly considering influential factor, food safety factor and hygiene factor while purchasing organic foods. The major constraint in purchasing organic foods by sample respondents was high price followed by poor promotional activities by the marketers and least constraint was non availability of the products regularly.

AGRI BUSINESS MANAGEMENT

Author	:	**PRIYANKA .T**
Title of the Thesis	:	**ONSUMER PREFERENCE FOR BASMATI RICE IN CHITTOOR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. B. APARNA**
Degree	:	**M.Sc (MABM)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5475**

ABSTRACT

India accounts for 75 per cent of total basmati rice produced globally. The remaining 25 per cent is contributed by Pakistan. The demand for basmati rice has grown at a CAGR of 20 per cent in the past seven years. Around 45 per cent of the basmati rice demand emanates from exports and the balance from domestic consumption. Domestic consumption of basmati rice is growing at a healthy CAGR of 15 per cent over the medium term, buoyed by the increasing spending power of the middle-income sections of the society. The proliferation of the modern retailing format has helped the consumption of a higher quantum of branded products, as Indian consumers are fast embracing the mall culture and organized retail, triggering a shift from unbranded to branded rice and from economy to premium brands.

The present study "Consumer preference for basmati rice in Chittoor district of Andhra Pradesh" was mainly aimed at studying the most preferred attributes of basmati rice, to identify the factors influencing the purchase intention of basmati rice and to find the impact of basmati rice on purchase intention of consumers in the study area. Purposive-cum-simple random sampling technique was adopted. Major retailers in the district were identified and five retailers were randomly chosen for the study. Thirty consumers visiting each retail shop were identified and randomly selected thus the total sample size is 150. Through pre structured schedule consumer preferences for basmati rice was identified. The data collected was analyzed to attain the stated objectives by using percentage analysis, Garret ranking technique, Kendall's co-efficient of concordance. Likert scaling technique, factor analysis and cross tabulation.

The study revealed that gender, age, literacy status, income, occupation and family size of sample respondents are the main demographic variables that significantly influenced the purchase pattern of basmati rice in the study area. The findings show that colour was the most preferred attribute of basmati rice among sample consumers. The study identified the factors influencing the buying decision using factor analysis. Seasoning factor followed by colour factor were the major factors considered by sample respondents while purchasing the basmati rice. Physical and influential factor and keeping quality factors were least preferred by respondents while purchasing basmati rice.

Majority of sample respondents fall in the age group of 23-35 years and were majorly considering cooking factor while purchasing basmati rice. Majority of sample respondents fall in the occupation group of self-employed and were majorly considering colour factor and

physical and influential factor while purchasing basmati rice. The results of cross tabulation indicates that gender has significant impact on quantity of purchasing and brand preference and income of sample respondents shows significant impact on place of purchase, quantity of purchasing and brand preference. The major constraint in purchasing basmati rice by sample respondents was lack of quality followed by adulteration and high price of basmati rice and the least constraint was limited choices to access points for purchasing of basmati rice.

AGRI BUSINESS MANAGEMENT

Author	:	**RESHMA CHANDAN SHAIK**
Title of the Thesis	:	**ECONOMICSOFSERICULTURE AND PROCESSING OF COCOONS IN KURNOOL DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. N. VANI**
Degree	:	**M.Sc (MABM)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5476**

ABSTRACT

The present study entitled **"Economics of Sericulture and Processing of Cocoons in Kurnool District of Andhra Pradesh"** was undertaken to study the cost of cultivation of mulberry leaf production and cocoon production, study marketing aspects and processing of cocoons, problems encountered by the sericulture industry and price behavior of cocoons.

The study covered 2 mandals and 4 villages with 60 farmers growing mulberry. The sample farmers were stratified into marginal (up to 1 hectare) and small (up to 2.5 hectares). The data pertained to agricultural year 2014-15 were collected through survey method with the help of pretested schedules. Conventional method was used to analyse the data and to arrive at valid conclusions.

The per hectare cost of establishment of mulberry garden on marginal, small and pooled farms were worked out to Rs. 77,734.85, Rs. 76,900.63 and Rs.77,112.12 respectively and thus exhibiting inversed relationship with the size of the farm.

The per hectare cost of maintenance of mulberry garden on marginal small and pooled farms were worked out to Rs. 1,08,885.2, Rs. 1,05,747.18 and Rs 1,07,015.5 respectively and thus exhibiting relationship with the size of the farm.

The cost of production per kg of mulberry was Rs. 1.50, Rs. 1.49 and Rs. 1.50 on marginal, small and pooled farms the gross and net income was Rs.1,22,097.30 and Rs. 13,212.10 on marginal farms, Rs. 1,18,828.79 and Rs. 13,081.61 on small, Rs. 1,20,233,.99 and Rs. 13,219.45 on pooled farms.

The total cost of cocoon production was Rs. 3,54,444.8, Rs.3,38,517.66 and Rs. 3,46,225.58 on marginal, small and pooled farms. The gross income from cocoon production

was higher on marginal farms (Rs. 7,65,866.12) than small and pooled farms (Rs.7,59,424.68 and Rs 7,62,646.64).

In the marketing of cocoons, single channel was identified. That is farmer → market → reeler → twister → weaver → dyer → weaver → consumer. The cost of production of yarn per kg per year worked out to Rs. 89,54,984.42. The analysis of marketing costs and margins revealed that the weaver was getting higher share of consumer's rupee .

The raw silk obtained was 4,596.58 kg along with the 1,544.4 kg of jute and 2,246.4 kg of water jelly as byproducts per unit per year. The total gross income was Rs. 1,81,61,548 and net income was Rs. 92,06,563.58 per unit per year. The gross ratio and B-C ratio was 2.02 and 1.02 respectively. Total 26,450 silk cocoons was reeled to produce 4,396.58 kgs of yarn, renditta to produce 1 kg of yarn was 6.66.

The results revealed that there was an increasing trend in the prices of cocoon in the selected market. Seasonal variations in prices were observed in the selected market and the highest seasonal index was found in the month of may (92.25). The results of cyclical variations of cocoon prices in the Dharmavaram market indicated that no price cycles. Irregular variation did not exhibit any definite periodicity in their occurrence in prices of cocoon in the selected market.

CROP PHYSIOLOGY

Author	:	**AKHILA ANIL .I**
Title of the Thesis	:	**EFFECT OF PHOTOPERIOD AND TEMPERATURE ON GROWTH, DRYMATTER PARTITIONING AND YIELD IN GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. P.SUDHAKAR**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5502**

ABSTRACT

The experiment on **"Effect of photoperiod and temperature on growth, drymatter partitioning and yield in groundnut (*Arachis hypogaea* L.)"** was conducted at Tirupati located at 13.65^{0}N & 79.42 ^{0}E of Southern Agroclimatic zone of Andhra Pradesh. The experiment was conducted during *kharif* season of 2016 in a split plot design with three replications. The treatments included four varieties (Narayani, Dharani, K-6 and TMV-2) of groundnut sown at three dates of sowing (June 21st, July 14th and July 30th).

The data on crop weather interactions interms of temperature (GDD-Growing degree days), day length (Photothermal unit), sun shine hours (Heliothermal unit) and Heat use efficiency (HUE) were calculated for the three varieties sown at three different dates of sowing. The data reveals that Dharani (V2) recorded higher accumulation of GDD (2277°day), PTU (27691°C day hr), HTU (14164.81 ^{o}C day hr), and HUE (0.88 Kg ha $^{-1}$ ^{o}C day^{-1}) from sowing to physiological maturity compared to Narayani, K-6 and TMV-2. Dharani variety also recorded higher physiological efficiency interms of Leaf area index (LAI), drymatter accumulation and pod yield and its attributes compared to other three varieties.

Among the three dates of sowing, photothermal units i.e., GDD, HTU and PTU were varied across the different growth stages. June 21st sowing had favourable agro-climatic conditions particularly temperature and rainfall at vegetative phase and more accumulated temperature, day length and sun shine hours in terms of higher accumulated GDD, HTU and PTU from sowing to physiological maturity compared to other dates of sowing. Hence, June 21st sowing showed higher LAI, drymatter accumulation and yield and its attributes compared to other two dates of sowing. This early sown crop resulted in higher pod yields also because of higher heat use efficiency of 0.93 kg ha^{-1} ^{o}C day^{-1}. LAI and total drymatter also showed significantly positive correlation with yield at different growth intervals.

Validation of PNUTGRO model of groundnut varieties at three dates of sowing also showed good to moderate results. Model estimation was very close to that of observed values for emergence day, anthesis day, days to seed initiation, days to pod initiation and days to harvest maturity. Model underestimated pod yield, haulm yield, stock yield due to the supply of irrigation in higher temperature. The overall performance of the model was good which indicated that model works well in this Southern Agroclimatic region of A.P.

It is concluded that Dharani variety sowing during June 21st (June II fortnight) sowing is effective interms of better accumulation of temperature, photoperiod and sun shine hours especially at pod filling stage thereby higher drymatter, yield and HI. Heat use efficiency is a good index for identifying better variety and dates of sowing.

CROP PHYSIOLOGY

Author	:	**DURGA MOUNIKA, PATHAKOTA.**
Title of the Thesis	:	**EFFECT OF SALICYLIC ACID ON GROWTH, PHYSIOLOGICAL PARAMETERS, ANTIOXIDANT DEFENSE SYSTEM AND YIELD IN CHICKPEA (*Cicer arietinum* L.) UNDER WATER STRESS**
Chairperson	:	**Dr. K. JAYALALITHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5409**

ABSTRACT

The present investigation entitled "effect of salicylic acid on growth, physiological parameters, antioxidant defense system and yield in chickpea (*Cicer arietinum* L.) under water stress" was undertaken at Agricultural College Farm, Bapatla during *rabi*, 2016-17.The experiment was laid out in split plot design with three main treatments viz., no stress (M_0), stress from flowering stage (M_1) and stress from pod formation stage (M_2) and four sub treatments viz., no SA spray (S_0), SA spray @ 0.01 mM (S_1), SA spray @ 0.1 mM (S_2) and SA spray @ 1.0 mM (S_3) in three replications.

The results revealed that, significant differences were observed between main and sub treatments and their interactions. Among the morphological parameters, plant height and number of branches plant^{-1} significantly decreased under water stress condition, and the decrease was 18.2 and 10.0 per cent with the plants that were subjected to water stress from flowering and pod formation stages, respectively, with regards to plant height, and 11.9 per cent with the plants that were exposed to water stress from flowering stage, over control plants. Foliar application of SA @ 0.1 mM at 35 DAS increased the plant height and number of branches by 20.2 and 25.9 per cent, respectively, over the control plants (no spray).

Leaf area was reduced by 19.8 per cent and total dry matter was decreased by 33.1 per cent by the plants that were stressed from flowering stage when compared to unstressed plants. Plants sprayed with SA @ 0.1 mM at 35 DAS recorded 18.9 and 20.4 per cent increase in leaf area and total dry matter, respectively, over unsprayed plants. Foliar application of SA @ 0.1 mM at 35 DAS to the plants that were stressed from pod formation stage (M_2S_2) increased the total dry matter by 14.5 percent when compared to the stressed plants from pod formation

stage which were not sprayed with SA (M_2S_0), and it was at par with the unstressed plants sprayed with SA @ 0.1 mM (M_0S_2).

The plants that were exposed to water stress from flowering stage reduced the total chlorophyll and carotenoid contents by 18.7 and 10.6 per cent and increased the proline content by 29.8 per cent, SOD and catalase activity by 50.3 and 29.6 per cent, respectively, over unstressed plants. Exogenous application of SA @ 0.1 mM at 35 DAS recorded 10.5 and 19.7 per cent increase in total chlorophyll and carotenoid contents and 25.4, 25.3 and 11.9 per cent increase in proline content, SOD and catalase activity, respectively, over control plants (i.e. no spray). Application of SA @ 0.1mM at 35 DAS to the plants that were stressed from pod formation stage (M_2S_2) increased the total chlorophyll and carotenoid contents by 8.2 and 17.5 per cent; proline accumulation by 30.0 per cent; SOD and catalase activity by 34.5 and 11.8 per cent, respectively, over the plants that were stressed from pod formation stage with no SA application (M_2S_0), and it was on par with the unstressed plants that were sprayed with SA @ 0.1mM (M_0S_2).

Yield components viz., number of pods per plant, number of seeds per plant, test weight and seed yield were significantly reduced under water stress condition compared to control (no stress). The decrease in number of pods and test weight of the chickpea plants that were stressed from flowering stage was 32.7 and 5.3 per cent, respectively, over control (i.e. no stress). Exogenous application of SA @ 0.1 mM at 35 DAS increased the number of pods per plant by 40.7 per cent, over unsprayed plants.

Seed yield was decreased by 22.8 and 8.9 per cent with the plants that were subjected to water stress from flowering and pod formation stages, respectively, over control. SA spray @ 0.1 mM at 35 DAS increased the seed yield by 19.7 per cent over unsprayed plants. Foliar application of SA @ 0.1 mM at 35 DAS to the plants that were subjected to water stress from pod formation stage (M_2S_2) recorded 16.8 per cent increase in seed yield over the stressed plants from pod formation stage that have not sprayed with SA (M_2S_0), and it was on par with the unstressed plants sprayed with SA @ 0.1 mM (M_0S_2).

From the above results of this study, it can be concluded that the exogenous application of salicylic acid @ 0.1 mM at 35 DAS improved the growth and yield of chickpea plants that were stressed from pod formation stage than the plants that were stressed from flowering stage, by maintaining antioxidant defence system in terms of higher activity of superoxide dismutase and catalase and proline accumulation, which helped in the mitigation of adverse effects of water stress (i.e. oxidative damage) and can sustain the normal growth and development of chickpea plants under water stress.

CROP PHYSIOLOGY

Author	:	**GEETHANJALI, KOTLA.**
Title of the Thesis	:	**EFFECT OF FOLIAR APPLICATION OF NUTRIENTS AND PLANT GROWTH REGULATORS ON GROWTH, DEVELOPMENT, QUALITY AND YIELD OF *Bt* COTTON**
Chairperson	:	**Dr. R.ANKAIAH**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5408**

ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla, during *Kharif*, 2013-14 and *Kharif*, 2014-15 to find out the "Effect of foliar application of nutrients and plant growth regulators on growth, development, quality and yield of *Bt* cotton". The experiment was laid out in split plot design and replicated thrice. There are two main treatments *i.e. Bt* cotton hybrids *viz*., Bhaskara hybrid and Bunny BG II hybrid and fourteen sub treatments *viz*., macro nutrients Urea (2 %), DAP (2%), KNO_3 (2 %) and growth regulators *viz.,* NAA (30 ppm) and GA_3 (30 ppm). Nutrients and growth regulators were sprayed individually and in combinations at peak squaring/budding stage, peak flowering stage, peak boll formation stage and peak boll development stage.

The results revealed that significant differences were observed between two hybrids and among foliar treatments, however their interactions were non significant. The findings of the experiment revealed that the growth parameters such as plant height, number of branches, leaf area, total drymatter measured at different intervals were significantly influenced by Urea (2%), DAP (2%), KNO_3 (2%) and growth regulators *viz*., NAA (30 ppm) and GA_3 (30 ppm spray treatments compared to control.

Bhaskara hybrid recorded higher plant height (18.47%, 17.53%), number of branches plant^{-1} (8.06%, 8.26%) total dry matter (19.11%, 17.86%) and leaf area (10.89%, 10.41%) over Bunny BG II hybrid in both the years respectively.

Among all the treatments, application of gibberellic acid along with urea, DAP and KNO_3 (T_{14}) at different stages recorded higher plant height (18.71%; 16.82%), leaf area (18.61%; 15.92%) and total dry matter (18.29%; 17.63%) over control in both the years respectively.

The results indicated that the growth characteristics like CGR, RGR and NAR increased with the spray of GA3 and NAA combined with macro nutrients (Urea, DAP, KNO_3) due to increment in the leaf area and total dry matter production.

Biochemical parameters like total chlorophyll content, NPK content, nitrate reductase activity and photosynthetic rate increased with the foliar spray of GA3 combined with

nutrients compared to NAA combined with nutrients and nutrients alone and control in both the years of study.

Yield components viz., number of bolls plant^{-1}, boll weight, seed index, and seed cotton yield were significantly increased in Baskara hybrid compared to Bunny BG II hybrid in both the years of study. Number of bolls and squares dropped plant^{-1} reduced in GA_3, NAA treatments compared to control. Foliar spray of GA along with KNO_3 at different stages (T_{13}) recorded significantly higher yield and yield attributes. Number of pods plant^{-1} (25.64 %; 20.01), boll weight (16.37% ; 18.36%) and seed cotton yield (30.88%; 25.60) were high with the spray of GA_3 + KNO_3 (T_{13}). Fibre quality parameters viz., Ginning percentage, 2.5 per cent span length, bundle strength, and micronaire value were significantly influenced by the macro nutrients and growth regulator treatments.

In terms of genotypic performance Bhaskara hybrid showed better performance compared to Bunny BG II. Among all the foliar treatments GA_3 @ 30 ppm + KNO_3 @ 2% spray at peak squaring, peak flowering, peak boll formation stage and peak boll developmental stage (T_{13}) recorded higher growth, physiological efficiency, yield attributes and fiber quality traits.

CROP PHYSIOLOGY

Author	:	**KIRAN NAIK RAMAVATH**
Title of the Thesis	:	**STUDIES ON THE INFLUENCE OF BORON, NAA AND GA ON SPIKELET STERILITY AND YIELD IN RICE (*ORYZA SATIVA* L.)**
Chairperson	:	**Dr. K. JAYALALITHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5413**

ABSTRACT

A field experiment was carried out at the college farm, Agricultural College, Bapatla during *kharif* season of 2014-15 to study the influence of boron, NAA and GA on spikelet sterility and yield in rice (*Oryza sativa* L.). The experiment was laid out in randomized block design with thirteen treatments viz., foliar spray of boron @ 0.2 ppm at panicle initiation stage (T_1), boron @ 0.2 ppm at first flowering stage (T_2), boron@ 0.4 ppm at panicle initiation stage (T_3), boron@ 0.4 ppm at first flowering stage (T_4), NAA @ 5.0 ppm at panicle initiation stage (T_5), NAA @ 5.0 ppm at first flowering stage (T_6), NAA @ 8.0 ppm at panicle initiation stage (T_7), NAA @ 8.0 ppm at first flowering stage (T_8), GA_3 @ 300 ppm at panicle initiation stage (T_9), GA_3 @ 300 ppm at first flowering stage (T_{10}), GA_3 @ 450 ppm at panicle initiation stage (T_{11}), GA_3 @ 450 ppm at first flowering stage (T_{12}) and control (i.e., water spray, (T_{13}) in three replications.

Foliar spray of GA_3 @ 450 ppm at panicle initiation stage significantly increased the plant height by 28.2 percent over control plants, and it is superior over other treatmental sprays. GA_3 @ 450 ppm first flowering stage exhibited superior performance by increasing the leaf area by 1.33 folds over control (i.e., water spray). Boron @ 0.2 and 0.4 ppm foliar sprays were also recorded the leaf area, which is comparable with that of GA_3 @ 450 ppm . The increase in leaf area with foliar application of boron at both the concentrations was 1.21 to 1.31 folds higher than control.

In the current study, foliar spray of GA_3 450 and 300 ppm at first flowering stage and boron @ 0.2 ppm at panicle initiation stage increased the leaf dry matter by 1.20, 1.19 and 1.18 folds over control plants. Stem dry matter was increased by 16.5 11.4, 10.6 and 10.4 g with foliar sprays of GA_3 @ 450 ppm at first flowering stage, boron @ 0.4 and 0.2 ppm and GA_3 @ 450 ppm at panicle initiation stages, respectively, over control. Compared to control, foliar spray of GA_3 @ 450 ppm at first flowering stage and boron @ 0.2 ppm at panicle initiation stage exhibited superior performance by increasing the dry matter of reproductive parts by 18.2 and 14.7 per cent, respectively. The increase in total dry matter of rice plants with GA_3 application @ 450 ppm at first flowering stage and boron @ 0.2 ppm at panicle initiation stage was 24.1 and 17.6 percent, respectively, over control plants.

Number of panicles m^{-2} was increased by 108 and 106, and number of spikelets $panicle^{-1}$ increased by 31.3 and 27.4 per cent with GA_3 foliar spray @ 450 ppm at first flowering stage and boron @ 0.2 ppm at panicle initiation stages, respectively, over control. Foliar spray of NAA @ 8.0 ppm, GA_3 @ 450 ppm and boron @ 0.4 ppm at panicle initiation stage increased the length of the panicle by 3.2, 3.1 and 3.1 cm, respectively, over control. Weight of the panicle was increased by 21.7 and 19.5 per cent with foliar application of GA_3 @ 450 ppm at first flowering stage and boron @ 0.2 ppm at panicle initiation stage, respectively, over control.

Among all the treatments, the highest filled grains percentage (75.55%) was recorded with boron @ 0.2 ppm at panicle initiation stage, followed by boron @ 0.4 ppm (75.08%). GA_3 foliar sprays were also at par with boron sprays, recorded filled grains percentage in the range of 73.05 to 74.64%. Lesser sterility percentage was recorded with boron sprays @ 0.2 ppm (24.45%), 0.4 ppm (24.92%) at panicle initiation stage and GA_3 @ 450 ppm at first flowering stage (25.36%). NAA @ 5.0 and 8.0 ppm recorded higher sterility percentages than boron and GA_3 foliar sprays.

Foliar application of boron @ 0.2 ppm at panicle initiation stage and GA_3 @ 450 ppm at first flowering stage increased the test weight of rice grains by 1.11 and 1.07 g, respectively, over control. Grain yield of rice was increased by 28.1, 22.3 20.9 per cent with foliar spray of GA_3 @ 450 ppm at first flowering stage, boron @ 0.2 ppm and GA_3 @ 450 ppm at panicle initiation stage, respectively, over control.

With respect to quality parameters, head rice recovery was maximum with GA_3 @ 300 ppm at first flowering stage (64.56%) which is at par with boron @ 0.4 ppm at first flowering stage (64.26%) and boron @ 0.2 ppm at panicle initiation stage (63.89%). The remaining quality parameters viz., water uptake, volume expansion ratio (i.e. cooking quality trait), amylose content, kernel length, breadth and L/B ratio were not significantly differed with foliar sprays of boron, NAA and GA_3.

Hence, it can be concluded that the foliar application of GA_3 @ 450 ppm at panicle initiation and at first flowering stages and boron @ 0.2 ppm at panicle initiation stage

increased the grain yield of rice, var.BPT 2270 (Bhavapuri Sannalu) by reducing the spikelet sterility and improving the filled grains percentage in panicles, and other yield components.

CROP PHYSIOLOGY

Author	:	**NAGALAKSHMI, B.**
Title of the Thesis	:	**SCREENING OF GROUNDNUT GENOTYPES FOR IRON CHLOROSIS TOLERANCE**
Chairperson	:	**Dr. P.LATHA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5503**

ABSTRACT

The present investigation was aimed at evaluating the relative performance of 20 groundnut genotypes for iron deficiency chlorosis tolerance. Groundnut genotypes were tested in iron sufficient and deficient soil conditions for iron deficiency chlorosis tolerance in terms of morphological parameters, physiological parameters, biochemical parameters and yield attributes.

A pot culture experiment was conducted at RARS farm, S.V. Agricultural College, Tirupati, during *kharif*, 2016. The experiment was laid out in factorial randomized block design with 2 main treatments *i.e.,* iron sufficient soil and iron deficient soil and 20 groundnut genotypes as sub treatments.

The tested groundnut genotypes differed in their response to both iron sufficient and deficient soil conditions and observations were recorded on morphological (VCR), physiological (SLA and SCMR) and biochemical parameters (chlorophyll a, b and total chlorophyll content, peroxidase, catalase, superoxide dismutase, active iron content and total iron content at harvest) at 30, 60 and 90 DAS. Data on yield and yield components (plant height, 100-kernel weight, harvest index, shelling percentage, pod yield and total dry matter) were recorded at harvest.

The morphological parameter, VCR and the physiological parameters *viz.,* SCMR and SLA used for evaluation of groundnut genotypes for iron deficiency chlorosis (IDC) tolerance varied significantly among soil types, genotypes and their interactions at all stages of crop growth. The study reveals that, the physiological parameter SCMR recorded higher mean values in iron sufficient soil conditions compared to iron deficient soil conditions. Whereas SLA and VCR increased in iron deficient soil conditions compared to iron sufficient soil conditions. Among the genotypes, TCGS-1624 recorded higher SCMR and lower SLA and VCR followed by TCGS-1616 and the lowest SCMR and highest SLA and VCR were recorded in TCGS-1613 and TCGS-1609 compared to other genotypes.

The biochemical parameters like chlorophyll a, b and total chlorophyll content, active iron content and total iron content used for evaluation of groundnut genotypes for IDC

tolerance showed significant differences among soil types, genotypes and their interactions at all stages of crop growth. Chlorophyll content (a, b and total), active iron content and total iron content decreased in iron deficient soil conditions significantly compared to iron sufficient soil conditions. Among the genotypes, TCGS-1624 recorded higher values of chlorophyll content, active iron content and total iron content followed by TCGS-1616 and the lowest was recorded in the genotypes TCGS-1613 and TCGS-1609 compared to other genotypes.

The activities of peroxidase and catalase were higher in iron sufficient soil conditions whereas, the activity of superoxide dismutase decreased compared to iron deficient soil conditions. Iron sufficient and iron deficient soil conditions resulted variation in antioxidant enzymes (peroxidase, catalase and superoxide dismutase) in all the groundnut genotypes. Among the genotypes, TCGS-1624 maintained higher peroxidase, catalase and superoxide dismutase activities followed by TCGS-1616 and the lowest activities were observed in TCGS-1613 followed by TCGS-1609 compared to other genotypes.

Yield components *viz.,* plant height, pod yield, total dry matter, shelling percentage, harvest index and 100-kernal weight varied significantly among soil conditions, genotypes and their interactions at all stages of crop growth. Iron deficient soil condition resulted in reduction of yield and yield components compared to iron sufficient soil conditions. Among the genotypes, TCGS-1624 reported higher yield and yield components followed by TCGS-1616 while the lowest was recorded in TCGS-1613 and TCGS-1609 compared to other genotypes.

Association studies showed that in both iron sufficient and iron deficient soil conditions, VCR and SLA showed negative correlation with SCMR, active iron content (Fe^{2+}), total iron content, chlorophyll a, chlorophyll b, total chlorophyll, peroxidase, catalase and superoxide dismutase. However, SCMR values were in positive correlation with active iron content (Fe^{2+}), total iron content, chlorophyll a, chlorophyll b, total chlorophyll, peroxidase, catalase and superoxide dismutase. VCR and SLA showed negative correlation with yield and yield parameters whereas, SCMR, chlorophyll content and active iron content showed positive correlation with yield and yield parameters.

The present study revealed that TCGS-1624 and TCGS-1616 showed higher values of physiological (SCMR), biochemical (chlorophyll a, b and total chlorophyll content, peroxidase, catalase, superoxide dismutase, active iron content and total iron content) and yield (plant height, pod yield, total dry matter, shelling percentage, harvest index and 100-kernal weight) parameters and resulted in higher yields in both iron sufficient and iron deficient soil conditions compared to other genotypes.

The least values of physiological (SCMR), biochemical (chlorophyll a, b and total chlorophyll content, peroxidase, catalase, superoxide dismutase, active iron content and total iron content) and yield (plant height, pod yield, total dry matter, shelling percentage, harvest index and 100-kernal weight) parameters were recorded in TCGS-1613 followed by TCGS-1609 and resulted in lower yields in both soil conditions compared to other genotypes.

Hence TCGS-1624 and TCGS-1616 were considered to be tolerant to IDC and TCGS-1613 and TCGS-1609 were considered to be susceptible to IDC.

The IDC tolerant and susceptible groundnut genotypes could be further used in breeding and genetic transformation programs to generate high-yielding and IDC-tolerant lines. The IDC tolerant genotypes help the farmers to reap the potential yields of groundnut crop in calcareous soil and increase their economic returns.

CROP PHYSIOLOGY

Author	:	**RESHMA, A.**
Title of the Thesis	:	**PHYSIOLOGICAL BASIS FOR DROUGHT TOLERANCE IN MAIZE (*Zea mays* L.) GENOTYPES**
Chairperson	:	**Dr. V. RAJA RAJESWARI**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5505**

ABSTRACT

The experiment entitled "Physiological basis for drought tolerance in Maize (*Zea mays* L.) genotypes was conducted at Crop Physiology Laboratory (Lab study) and dry land farm (Field study), S.V. Agricultural College, Tirupati.

Thirty maize genotypes obtained from ARS, Peddapuram were screened for seedling traits such as germination percentage, root length, shoot length, seedling vigour index and coefficient of velocity of germination under laboratory conditions by imposing two levels of osmotic stress (-5 bar and -10 bar) using PEG-6000 against control. Germination percentage, seedling vigour index and coefficient of velocity of germination were decreased with increase in osmotic stress. Higher Seedling vigour index at -10 bar was observed in PDM 1452, PDM 1488, PDM 1474 and PDM 1465. Lower seedling vigour index was recorded in PDM 1439, PDM 14100, PDM 1401 and PDM 1430. Based on results obtained 12 genotypes were selected which includes ten tolerant and two susceptible genotypes. The selected genotypes were further investigated for drought tolerance and yield under imposed moisture stress field conditions during *rabi* 2015-16 and 2016-17.

Moisture stress was created at soft dough growth stage i.e for a period of 20 days starting from 60 to 80 DAS. Morphological characters like plant height, leaf area, total dry matter, physiological parameters, drought tolerance traits viz., rooting abilities, water use efficiency (WUE), relative water content (RWC), chlorophyll stability index (CSI), relative membrane injury (RI), proline (Osmoregulant), super oxide dismutase (Antioxidant enzyme) and yield related parameters were examined.

Growth and physiological traits *viz*. plant height, crop growth rate (CGR), net assimilation rate (NAR), leaf area index (LAI) and leaf area duration (LAD), WUE traits (SLA, SCMR), other drought tolerant traits viz., CSI, RI, RWC, yield and HI significantly reduced under moisture stress conditions compared to irrigated control, whereas proline and SOD were increased. The genotypes, PDM 1452, PDM 1465 and PDM 1498 maintained higher leaf area, dry matter and higher physiological traits viz., CGR, NAR, LAI and LAD compared to other entries. These genotypes also recorded higher drought tolerance in terms of WUE traits i.e moderate SLA and high SCMR, higher CSI, lower RI, high proline accumulation and SOD enzyme activity, which denotes the efficiency of these genotypes in performing under drought condition.

Genotypes PDM 1452, PDM 1428, PDM 1498 recorded higher mean root length and root dry weight and hence maintained higher tissue water content (RWC) to sustain cellular activities, whereas PDM 1439, PDM 1409 showed lower rooting abilities.

PDM 1465, PDM 1452 and PDM 1498 which maintained higher growth, physiological and drought tolerance attributes recorded higher harvest index, yield and its components followed by PDM 1428 and PDM 1474. The genotype PDM 1439, PDM 1409 recorded lower yields under imposed moisture stress conditions as these genotypes recorded lower physiological attributes and drought susceptibility characters. PEG induced water stress method could be used as effective method for screening of maize genotypes for moisture stress tolerance as selected genotypes exhibited similar tolerance or susceptibility under field conditions.

The present study reveals that moisture stress at soft dough stage is more sensitive. The genotypes PDM 1452, PDM 1465 and PDM 1498 are superior in terms of physiological efficiency, drought tolerance, yield and yield components. Hence these genotypes can be further tested in multilocation trials under rainfed condition before recommending to farmers. These genotypes are also valuable source for development of drought tolerant maize genotypes through conventional or molecular breeding.

CROP PHYSIOLOGY

Author	:	**RUPALI NILKANTH, MENGAJE**
Title of the Thesis	:	**EFFECT OF CALCIUM, BORON AND SALICYLIC ACID ON TOLERANCE OF BLACKGRAM [*Vigna mungo* (L.) Hepper)] TO YELLOW MOSAIC VIRUS**
Chairperson	:	**Dr. Y. ASHOKA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5410**

ABSTRACT

The field experiment was carried out at Agricultural College Farm, Bapatla during *Rabi* season 2016-17 to "study of the effect of calcium, boron and salicylic acid on tolerance of blackgram (*Vigna mungo* (L.) Hepper) to yellow mosaic virus". The experiment was laid out in Randomized Block Design with ten treatments viz., T_1 : Control ; T_2 : Gypsum @ 300 kg ha^{-1} + Boron @1kg ha^{-1}; T_3 : 0.3 % Calcium ($CaNO_3.4H_2O$) spray ; T_4 :0.25 % Boron (Borax) spray ; T_5 : 50ppm Salicylic acid spray ; T_6 : Complete nutrient solution spray ; T_7 : ($T_2 + T_5$) ; T_8: ($T_3 + T_5$) ; T_9 : ($T_4 + T_5$) ; T_{10} : ($T_6 + T_5$) in three replications.

The Observations were recorded on percent incidence of YMV disease, whitefly count, morphological, physiological and biochemical parameters ; nutrient composition (Ca, K, B) in leaf and yield components.

Seven days delay and significant reduction in YMV disease incidence was observed with application of calcium, boron and SA. The reduction in disease incidence ranged from 1.7 to 5.8 percent at 30 DAE and 15.1 to 30.5 percent at 45 DAE, high with T_2, T_6, T_7 and T_8 (30.5, 29.2, 28.3 & 26.1 % respectively).

Whitefly population reduced ranging from 12.4 to 35.6 percent at 15 DAE, 4.5 to 36.9 at 30 DAE and 8.1 to 21.9 at 45 DAE, high with T_8, T_2 and T_7.

The increase in branch number was 7.0 to 14.0 percent, high in gypsum 300kg + boron 1 kg ha^{-1}) and T_7 (gypsum 300 kg + boron 1 kg ha^{-1} + 50ppm SA spray).

Leaf dry matter accumulation $plant^{-1}$ with calcium, boron and SA application increased ranging from 14.2 to 133.9 percent at 30 DAE, 0.5 to 82.1 percent at 60 DAE and 32.2 to 111.7 percent at harvest, high with gypsum 300 kg + boron 1 kg ha^{-1} alone and with 50ppm SA sprays and low with sprays of 0.3% calcium + 50ppm SA.

Dry matter accumulation in stem increased by 6.3 to 14.3 folds at 30 DAE, 1.6 to 2.8 folds at 60 DAE and 1.1 to 1.2 folds at harvest over control.

Total dry matter production increased with application of calcium, boron and SA over control, ranged from14.5 to 176.3 percent at 30 DAE, 7.5 to 76.0 percent at 60 DAE and 0.7 to 42.0 percent at harvest, high in T_7 (42.0 %), T_2 (40.4 %), T_{10} (34.4 %) and T_6 (29.8 %).

Total phenols content was found higher in gypsum 300 kg + boron 1 kg ha^{-1} in both healthy and diseased leaves [62.2 % at 15 DAE, 97.9 % in healthy and 38.0 % in diseased leaves at 30 DAE and 80.6% in healthy and 49.3 % in diseased leaves at 45 DAE]. The percent increase in total phenol was recorded high in healthy than in diseased leaves.

POD activity in healthy plants was high with T_5 and T_7 before incidence of YMV, T_2 and T_7 just after incidence and T_2 at later stages. While in diseased plants, just after incidence at stages POD activity was high with T_7 and T_2. In both healthy and diseased plants less increase in POD activity was noticed in 0.25% boron spray in healthy and complete nutrient solution + 50ppm SA in diseased plants.

The PAL activity was found high with combination of gypsum 300 kg + boron 1 kg ha^{-1} + 50ppm SA (At 15 and 30 DAE) and with gypsum 300 kg + boron 1 kg ha^{-1} (at 45 DAE). The diseased plants showed the high value of PAL activity than that of healthy ones. The increase in PAL activity ranged from 27.7 to 64.8 percent at 15 DAE, 27.8 to 63.9 percent in healthy and 12.9 to 40.8 percent in disease infected leaves at 30 DAE, 19.4 to 97.2 percent in healthy and 2.7 to 19.8 percent at 45 DAE in diseased ones at 45 DAE.

All treatments showed the significant reduction in membrane injury index, high was observed with sprays of 0.3 % Calcium + 50 ppm SA and gypsum 300 kg + boron 1 kg ha^{-1}. The percent reduction in membrane injury index ranged from 2.7 to 7.9 at 15 DAE, 5.6 to 8.5 at 30 DAE and 5.0 to 10.8 percent at 45 DAE.

Chlorophyll-a, chlorophyll-b and carotenoids content increased due to application of calcium, boron and salicylic acid, high was recorded with T_2 and T_{10}, T_6 and T_6 & T_{10} respectively.

The increase in calcium content of leaf was high with T_2, T_3, T_7 and T_8 in both healthy and diseased plants before and after YMV incidence and low with T_4 and T_9.

Potassium content in leaf increased, ranging from 1.1 to 1.7 folds at 15 DAE, 1.2 to 1.8 folds in healthy and 1.3 to 3.1 folds in disease infected plants at 30 DAE and 1.2 to 1.6 folds in healthy and 1.6 to 2.7 folds in disease infected plants at 45 DAE, high with gypsum 300 kg + boron 1 kg ha^{-1} in both healthy and disease infected plants before and after YMV incidence.

Boron content in leaf raised by 14.8 to 46.7 percent at 15 DAE, 14.2 to 46.9 percent in healthy and 39.7 to 131.0 percent in disease infected plants at 30 DAE and 22.4 to 46.3 percent in healthy and 51.9 to 92.7 percent in disease infected plants at 45 DAE, high with T_2 and T_7 before YMV incidence and T_2 after incidence.

The extent of increase in percentage was 1.8 to 12.3 in number of pods $plant^{-1}$ (high in T_{10}), 20.6 to 28.1 in pod length (high in T_5)13.5 to 21.1 in number of seeds pod^{-1} (high in T_2), 9.3 to 30.6 in 100 seed weight (high T_{10} , T_2 & T_7). Seed yield in YMV infected blackgram by 16.7 to 40.7 percent. Seed yield obtained high with sprays of complete nutrient solution + 50ppm SA (40.7 %) followed by gypsum 300 kg + boron 1 kg ha^{-1} (37.7 %), 0.3% calcium spray (35.4 %) and by gypsum 300 kg + boron 1 kg ha^{-1} + 50ppm SA (34.6 %).

CROP PHYSIOLOGY

Author	:	**SUMAJA GANDHI, K.**
Title of the Thesis	:	**VARIATION IN PHOTOSYNTHESIS AND ASSOCIATED PARAMETERS IN RELATION TO YIELD IN RICE GENOTYPES**
Chairperson	:	**Dr. K. JAYALALITHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5412**

ABSTRACT

Field experiment was conducted at Agricultural College Farm, Bapatla, during *Kharif* 2016-17 to evaluate the variation in photosynthesis and associated parameters in relation to yield in rice genotypes. Fifteen treatments consisting of fifteen varieties viz., BPT rice genotypes i.e. BPT 2740, BPT 2615, BPT 2773, BPT 2743, BPT 2295, BPT 2782, BPT2270, BPT 5204, BPT 2595, BPT 1768, BPT 2571, BPT 2411, BPT 2675, BPT 2660 and BPT 2605, taking BPT 2270 and BPT 5204 as local checks, and laid out in a Randomized Block Design with three replications.

Observations were recorded on morphological, physiological and photosynthetic parameters at 30 days interval from 30 to 120 DAT and the data on yield and yield components were recorded at harvest.

At 90 and 120 DAT, BPT 2782 recorded superior performance by recording higher plant height by 20.1 and 17.8 per cent, respectively, over BPT 2740 and comparable

performance with that of local check i.e. BPT 5204. BPT 2740, BPT 2743, BPT 2595 and BPT 2660 were found shorter than local checks.

Highest leaf area, drymatter production and SLW were recorded in BPT 2411 at all the stages over local checks i.e. BPT 5204 and BPT 2270. Lower leaf area, drymatter production and SLW were recorded in BPT 2270 at all the stages of crop growth.

Varietal differences were recorded with respect to photosynthetic rate, stomatal conductance and transpiration rate. BPT 2411, BPT 2660 and BPT 1768 recorded 21.1, 19.9 and 19.3 per cent higher photosynthetic rate, respectively, 4.3, 4.1 and 3.9 per cent higher stomatal conductance, respectively and 32.1, 31.5 and 28.6 per cent higher transpiration rate, respectively, at 90 DAT than BPT 5204; and 21.7, 20.5 and 19.9 per cent higher photosynthetic rate, respectively, 4.7,4.5 and 4.3 per cent higher stomatal conductance, respectively and 34.1, 33.5 and 30.5 per cent higher transpiration rate, respectively than BPT 2270.

BPT 2411 recorded higher chlorophyll content in leaf (i.e. SCMR value) by 25.2 per cent, than BPT 2270 and 23.4 per cent, than BPT 5204. In the present study, the rice genotypes BPT 2411, BPT 2660 and BPT 1768 possessed higher SCMR value at all the stages, as well as higher photosynthetic rate and drymatter production and hence these three rice genotypes were found to be high yielders.

The rice genotypes BPT 2411, BPT 2660 and BPT 1768 showed higher number of panicles m^{-2} by 9.8, 8.3 and 7.77 per cent, respectively, number of grains $panicle^{-1}$ by 38.7, 36.5 and 34.4 per cent, respectively, test weight by 27.0, 25.2 and 23.9 per cent, respectively, grain yield by 27.7, 25.5 and 25.0 per cent, respectively and harvest index by 27.4, 24.9 and 18.7 per cent, respectively, than BPT 5204 and number of panicles m^{-2} by 11.5, 10.0 and 9.4 per cent, respectively, number of grains $panicle^{-1}$ by 50.0,47.7 and 45.3 per cent, respectively, test weight by 35.6, 33.6 and 32.2 per cent respectively, grain yield by 37.2, 34.9 and 34.4 respectively and harvest index by 35.4,32.7 and 26.2 per cent, respectively, than BPT 2270.

Correlation analysis among the traits revealed that photosynthetic rate exhibited significant positive association with transpiration rate and stomatal conductance at 60 and 90 DAT and with grain yield. A strong positive relationship between stomatal conductance and SLW; SLW and photosynthetic rate was observed at 60 and 90 DAT, in the present study. Total drymatter at 60 and 90 DAT is positively correlated with grain yield. Total drymatter exhibited significant positive association with rate of photosynthesis at 60 DAT, this suggests that selection for high biomass types would result in productive genotypes. Yield attributes showed positive correlation with grain yield.

Genotypic variability in terms of photosynthetic rate, stomatal conductance, transpiration rate, SLW, drymatter partitioning, HI and grain yield was found in the fifteen rice genotypes. The genotypes namely BPT 2411, BPT 2660 and BPT 1768 which recorded higher grain yield also recorded higher photosynthetic rate, stomatal conductance, total drymatter, SLW and harvest index. Correlation coefficients indicated strong positive correlation for stomatal conductance, transpiration rate, total drymatter, SLW and harvest index with photosynthetic rate and grain yield. Based on the present study, it could be concluded that the rice genotypes BPT 2411, BPT 2660 and BPT 1768 showed superior performance in terms of photosynthetic rate and associated parameters, drymatter partitioning and grain yield. BPT 1768 was released as Bapatla Sannalu and is popular in single cropped areas of Krishna zone. BPT 2411 and BPT 2660 are under minikit testing which may be popularized in the areas of adoption after release due to their superior performance.

CROP PHYSIOLOGY

Author	:	**SWETHA SREE, M.**
Title of the Thesis	:	**PHENOLOGICAL RESPONSES OF MAIZE (*Zea mays L.*) TO PHOTOPERIOD AND TEMPERATURE**
Chairperson	:	**Dr. V. RAJARAJESWARI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5504**

ABSTRACT

The experiment on phenological responses of maize (*Zea mays. L*) to photoperiod and temperature was conducted at Tirupathi located at 13.65^{0}N and 79.42°E of Southern Agro-climatic region of Andhra Pradesh. The experiment was conducted during *kharif*, 2016 in a split plot design with three replications. The treatments included are three hybrids (DS 900M, Pinnacle and CP818) of maize and dates of sowing (June II FN, July I FN, July II FN and August I FN)

The data on crop weather interactions interms of temperatures (GDD-Growing degree days), Day length (PTU- Photothermal units), Sunshine hours (HTU) and HUE (heat use efficiency) were calculated for the three hybrids sown at different dates of sowing. The data reveals that Pinnacle hybrid recorded higher accumulation of GDD (3053.3°C), PTU (3615.1°C day hour) and HUE of 1.0 kg ha^{-1}°C day^{-1} compared to D.S 900M and CP818. Incidentally the hybrid Pinnacle recorded higher physiological efficiency interms of leaf area index, drymatter accumulation and kernel yield and its attributes compared to other two hybrids.

Among the four dates of sowing photothermal units *i.e.,* GDD, HTU, PTU varied across the different growth stages. First date of sowing (June II FN) had favourable agro-climatic conditions particularly temperature, day length and sunshine hours interms of higher accumulated GDD, PTU and HTU from sowing to physiological maturity compared to other dates of sowing. Consequently LAI, drymatter accumulation and yield attributes were higher from the crop sown early *i.e.,* June II FN. This early planting crop resulted in higher kernel yields and Harvest index compared to delay sowings because of higher heat use efficiency of 1.2 kg ha^{-1} ^{o}C day^{-1}. LAI and drymatter accumulation showed significantly positive correlation with yield at different crop growth stages.

Using the data obtained from the field experiments conducted during *kharif*, 2016. The experimental file (AGCG1601MZ), weather file (ACGC2016), soil file (ACGC060016) were created for CERES-Maize validation. The crop genetic coefficients already developed for the three hybrids were also used as input for CERES-Maize validation. The model validated excellently for grain yield, number of days to anthesis and physiological maturity, number of grains per m^{-2} were as it was fair for unit grain weight at maturity and poor for stover weight and harvest index.

It is concluded that Pinnacle hybrid sown during second fortnight of June is effective interms of better accumulation of temperature, photoperiod and sunshine hours especially at grain filling stage there by higher dry matter, kernel yield and Harvest index. Estimation of heat use efficiency is an useful indicator for appraisal of yield potential of maize in different dates of sowing.

CROP PHYSIOLOGY

Author	:	**VERONICA, N.**
Title of the Thesis	:	**PHYSIOLOGICAL STUDIES ON HIGH TEMPERATURE TOLERANCE IN RICE (*Oryza sativa*)**
Chairperson	:	**Dr. Y. ASHOKA RANI**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5411**

ABSTRACT

Experiment entitled "**Physiological studies on high temperature tolerance in rice (*Oryza sativa*)**" was conducted at ICAR- Indian Institute of Rice Research, Rajendranagar, Hyderabad during *kharif* 2014, *rabi* 2014-15, *kharif* 2015, *rabi* 2015-16.

A set of 60 diverse rice germplasm were screened in *kharif* 2014 and *rabi* 2014-15 for high temperature tolerance. The physiological traits based on which they were screend were membrane thermostability, chlorophyll fluorescence, paraquat tolerance assay, spikelet fertility, grain yield and yield based indices. Based on these genotypes both tolerant and susceptible to high temperature stress were identified.

The cell membrane thermostability (MTS) reduced under high temperature by 23.1% over control. However under high temperature, genotypes N22 (80.5%), Rasi (78.9%), IR64 (69.8%), GSR330 (59.4%) and Akshayadhan (61.3%) had a higher MTS whereas it was lower in MTU1001 (20.5%), ADT43 (19.1%), Sumati (18.7%), Pantdhan12 (21.1%) and IR36 (22.4%).

Chlorophyll fluorescence traits such as F_v/F_m (maximum quantum yield of PSII), electron transport rate (ETR), effective quantum yield (ΦPSII), co-efficient of photochemical quenching (qP) and co-efficient of non-photochemical quenching (qN) were reduced under high temperature conditions except for an increase in qN of some genotypes. The mean F_v/F_m reduced by 18.3% over control. The maximum F_v/F_m values under high temperature were noted in N22 (0.746), Rasi (0.734) and Khudaridhan (0.726) and minimum in NDR359 (0.335), RNR6378 (0.390) and MTU1001 (0.417). Lesser reduction in ETR was evident in

N22 (5.0%), Sonkaichi (6.6%), Khudaridhan (8.6%), Akshayadhan (9.0%), Rasi (9.3%), Assanchidiya (10.5%) and IR64 (11.0%). On the other hand, higher reduction in ETR was in Mahamaya (76.1%), ADT49 (77.6%), MTU1001 (78.0%), ADT43 (78.0%) and WGL14 (79.7%). The ΦPSII under high temperature conditions was the highest in Rasi, N22 and Akshayadhan and the lowest in WGL14, ADT49, MTU1001 and Mahamaya.

Paraquat treatment resulted in reduction in chlorophyll a, chlorophyll b and total chlorophyll content. Minimum reduction in the total chlorophyll content was noted in N22 (15.6%), IR64 (16.9%), BPT5204 (17.4%) and Rasi (17.4%). Maximum reduction was in Vandana (74.4%), Sugandhasamba (73.4%) and RPHR517 (64.6%). Regression analysis revealed that there existed a negative association between yield under high temperature and the per cent reduction in chlorophyll content.

A reduction in all the yield components (number of panicles m^{-2}, number of grains panicle^{-1}, number of filled grains panicle^{-1}, spikelet fertility, total dry matter, 1000 grain weight and harvest index) and grain yield with a subsequent increase in the number of unfilled grains panicle^{-1} in both *kharif* and *rabi* seasons was observed under high temperature.

In both *kharif* 2014 and *rabi* 2014-15, maximum spikelet fertility under high temperature was recorded in N22, Rasi, Akshayadhan and IR64 and minimum in IR36, Vandana, ADT43, Sugandhasamba and Sumati.

In *kharif* 2014, the grain yield under high temperature was maximum in N22 (5308.3 kg ha^{-1}), Rasi (5133.3 kg ha^{-1}), Assanchidiya (5083.3 kg ha^{-1}), HKR47 (4816.7 kg ha^{-1}) and TJP82 (4450.0 kg ha^{-1}) and minimum was in Sumati (116.7 kg ha^{-1}), Sugandhasamba (283.3 kg ha^{-1}) and MTU1001 (400.0 kg ha^{-1}). In *rabi* 2014-15 there was 26.8% reduction in grain yield under high temperature. Maximum yield under high temperature was in Rasi (6400 kg ha^{-1}), Akshayadhan (6266.7 kg ha^{-1}), HKR47 (6233.3 kg ha^{-1}) and IR64 (6133.3 kg ha^{-1}) and minimum was in ADT43 (2516.7 kg ha^{-1}), Vandana (2866.7 kg ha^{-1}) and NDR359 (3950.0 kg ha^{-1}).

Based on the grain yield in normal and in high temperature stress conditions, eleven yield based indices were computed and correlation analysis revealed that in *kharif* 2014, Stress Tolerance Index (STI), Geometric Mean Production (GMP), Mean Production (MP), Yield Index (YI) and Modified stress tolerance index (STIK2) had a significant correlation in both control and heat stress. In *rabi* 2014-15, besides the above indices Heat resistance index (HI) and Modified stress tolerance index (STIK1) also showed significant correlation. Hence these could be considered as suitable indices.

The performance of the genotypes was assessed based on the above screening parameters and 4 genotypes (2 tolerant and 2 susceptible genotypes) were selected. Rasi and IR64 were selected as tolerant genotypes and MTU1001 and ADT43 as susceptible genotypes. N22 and Vandana were taken as tolerant and susceptible checks respectively. In-depth studies were carried out in *kharif* 2015 and *rabi* 2015-16 with the selected rice genotypes. Morpho-phenological parameters, physiological parameters, biochemical parameters, yield components and yield along with quality analysis were studied in these six genotypes.

An increase in the mean plant height under high temperature in both vegetative and reproductive stages in both the seasons was observed. Tiller number m^{-2} and stem thickness

reduced under high temperature in both the stages in *kharif* and *rabi*. Among the genotypes, the reduction was lesser in N22 and Rasi and higher in Vandana and MTU1001. In *kharif* and *rabi* the mean days to 50% flowering and days to physiological maturity reduced under high temperature.

The shoot and root biomass at vegetative and reproductive stage and total dry matter at harvest reduced considerably due to the impact of high temperature. The mean total dry matter in *kharif* and *rabi* reduced by 27.2% and 40.5% respectively.

High temperature resulted in the reduction of photosynthetic rate (P_N). In *kharif* season, in both vegetative and reproductive stages higher P_N under high temperature was noted in N22 (16.9 and 19.44 µmol [CO_2] m^{-2} s^{-1} respectively) and Rasi (15.6 and 20.17 µmol [CO_2] m^{-2} s^{-1} respectively). Lower P_N in vegetative stage was in MTU1001 (11.07 µmol [CO_2] m^{-2} s^{-1}) and in reproductive stage in Vandana (13.27 µmol [CO_2] m^{-2} s^{-1}). Similarly in *rabi* also at both stages, N22 (15.55 and 21.18 µmol [CO_2] m^{-2} s^{-1} respectively) and Rasi (15.12 and 20.78 µmol [CO_2] m^{-2} s^{-1} respectively) maintained relatively higher photosynthetic rate under high temperature conditions. Lower P_N was in Vandana (10.69 µmol [CO_2] m^{-2} s^{-1}) in vegetative stage and in MTU1001 (12.97 µmol [CO_2] m^{-2} s^{-1}) in reproductive stage. The stomatal conductance (g_s) increased under high temperature in N22 and Rasi genotypes which led to subsequent increase in E under high temperature while both g_s and E reduced in the susceptible genotypes. There was a reduction in C_i in all the genotypes but under high temperature higher C_i was noted in Rasi and N22.

High temperature resulted in the reduction of F_v/F_m, ETR, ΦPSII and qP in all the tested rice genotypes. However the extent varied. The reduction in the observed fluorescence traits was higher in Vandana, MTU1001 and ADT43 and lower in N22 and Rasi. However, qN increased in all the genotypes under high temperature.

The chlorophyll content reduced in response to high temperature in both the seasons at vegetative and reproductive stages. Reduction was less in N22 and Rasi and high in MTU1001, Vandana and ADT43.

Pollen viability and stigma receptivity were affected due to high temperature stress. The mean pollen viability reduced by 28.3% over control. However, a higher pollen viability and a better stigma receptivity under high temperature was recorded in N22, Rasi and IR64 while, lesser pollen viability and poor stigma receptivity was seen in Vandana, ADT43 and MTU1001.

Elevated levels of the leaf antioxidant enzymes, Superoxide dismutase (SOD), Peroxidase (POD) and Catalase (CAT) activity was noted in vegetative and reproductive stage in both the seasons. Higher SOD and CAT activity in reproductive stage was evident in N22 and Rasi.

Imposition of high temperature stress significantly reduced the non-structural carbohydrates content in both the stem and leaf sheath. In *kharif* and *rabi*, under high temperature NSC's in stem and leaf sheath was maximum in IR64 in both reproductive stage and at harvest. NSC's in stem in *kharif* and *rabi*, in reproductive stage was minimum in Vandana and at harvest in N22.

All the yield components and grain yield were reduced in the tested rice genotypes. A significant reduction in number of panicles m^{-2}, panicle length, panicle weight, number of grains $panicle^{-1}$, number of filled grains $panicle^{-1}$, spikelet fertility, 1000 grain weight, grain yield and harvest index was noted in both the seasons. Higher spikelet fertility under high temperature condition in both *kharif* and *rabi* seasons was recorded in N22 (75.6 and 70.7% respectively) followed by Rasi (74.2 and 68.7% respectively). The lowest was noted in Vandana (27.5 and 19.03% respectively). The reduction in grain yield was lower in N22 and Rasi and higher in MTU1001.

Quality parameters such as amylose content, gel consistency and gelatinization temperature were influenced by high temperature stress. Amylose content reduced in all the tested genotypes in both normal and chalky grains. There was an overall reduction in the GC of the tested rice genotypes. GT increased in Vandana and ADT43 and remained unchanged in other genotypes.

A pot culture experiment was conducted to study the interaction of high temperature and water stress in 4 selected rice genotypes (N22, Rasi, Vandana and MTU1001). Plant height increased in response to high temperature (Ht), whereas reduced marginally in water stress treatment (Ws) and combined water stress and high temperature (Ht+Ws). Stem thickness reduced in response to stress and the reduction was maximum in MTU1001 and minimum in Rasi and N22. Compared to control, there was decrease in the number of days to 50% flowering and days to maturity under Ht and Ht+Ws.

Shoot biomass and total dry matter reduced in Ws, Ht and Ht+Ws condition in all the genotypes. The extent of reduction in both the stages was higher under combined stress than the individual stresses. The reduction was higher in MTU1001 and lesser in N22 and Rasi.

Significant reduction in the P_N in both vegetative and reproductive stages in Ws (20.4 and 25.0% respectively), Ht (24.0 and 31.8% respectively) and Ht+Ws (51.8 and 52.3% respectively) was noted. In both the stages higher P_N under stress conditions was in N22 and Rasi. g_s and E reduced under Ws and Ht+Ws, however increased in N22 and Rasi under Ht conditions. C_i reduced in Ws, Ht and Ht+Ws.

F_v/F_m, ETR, ΦPSII and qP reduced in both vegetative and reproductive stages under Ws, Ht and Ht+Ws; whereas qN increased. A higher F_v/F_m, ETR, ΦPSII and qP under stress was noted in N22 and Rasi.

Chlorophyll content was also affected by Ws and Ht and the combined stress in all the genotypes at both the stages. The reduction in the total chlorophyll content at both the stages was higher in MTU1001 and Vandana and lower in N22 and Rasi.

Relative water content (RWC) reduced drastically in both vegetative and reproductive stage under Ws and Ht+Ws and marginally under Ht. N22 and Rasi maintained a higher RWC under all the stress conditions.

The proline content in both vegetative and reproductive stages, increased significantly under Ws (4.5 and 3.9 folds), Ht (2.4 and 2.9 folds) and under Ht+Ws (5.1 and 4.7 folds). Comparitively, N22 and Rasi maintained a higher proline content under stress conditions.

Imposition of Ws, Ht and Ht+Ws led to reduction in all the yield components (panicle weight, number of grains panicle^{-1}, filled grains panicle^{-1}, spikelet fertility, 1000 grain weight and harvest index) and grain yield in Ws, Ht and Ht+Ws conditions. In Ws, Ht and Ht+Ws, higher spikelet fertility and lesser reduction in grain yield was in Rasi and N22 whereas lower spikelet fertility and higher reduction in grain yield was in MTU1001.

CROP PHYSIOLOGY

Author	:	**VINOD KUMAR, P.**
Title of the Thesis	:	**PHYSIOLOGICAL STUDIES ON SENESCENCE OF LEAVES AND NODULES IN BLACKGRAM (*VIGNA MUNGO* (L.) HEPPER)**
Chairperson	:	**Dr. B. SREEKANTH**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5414**

ABSTRACT

The present investigation entitled "Physiological studies on senescence of leaves and nodules in blackgarm (*Vigna mungo* (L.) Hepper)" was undertaken at Agricultural College Farm, Bapatla during *Rabi,* 2016. Three different concentrations of kinetin (10^{-4}, 10^{-5} and 10^{-6} M) and paraquat (10, 15 and 20 mg L^{-1}) along with an untreated control and water application control were imposed as foliar treatments on blackgram *cv* PU- 31 in a randomized block design. Treatments were applied at three different times of reproductive growth *viz*., 10 days before 50% flowering, 50% flowering and 10 days after 50% flowering.

Leaves, roots and root nodules were sampled after visible appearance of senescence over foliage *i.e.,* at 4 days after application. Different parameters, both biochemical and physical, were estimated, which are known to indicate the degree of senescence or active metabolism in these organs. At harvest, grains were sampled and analyzed for quality parameters.

From the above investigation, at all the three successive stages of treatmental applications, there was increase in total chlorophyll content with increasing kinetin concentration, which decreased with increasing paraquat concentration. Soluble leaf protein content increased under kinetin application, while paraquat application decreased it. Kinetin and paraquat affected the leaf soluble sugars of blackgram in a positive and negative manner, respectively. Though, leaf SOD activity was increased by both kinetin and paraquat, the former raised it much higher. Foliar application of kinetin decreased the leaf malondialdehyde content, while the paraquat increased the same.

Kinetin application increased the root FWT and DWT of blackgram, whereas the paraquat application decreased the same, which became more significant as crop aged. Kinetin had a positive influence over the nodule FWT and DWT, while paraquat had a negative influence on the same parameters in blackgram. Nodule soluble protein increased with kinetin and decreased with paraquat in blackgram. Kinetin showed a positive, while paraquat showed a negative influence over the nodule soluble sugar content. Both kinetin and paraquat increased nodule SOD activity. Kinetin in general increased the Lb content of nodules, while paraquat decreased the same.

The computations of correlation between leaf and nodule parameters showed that there is a strong relation between indices of senescence of leaves and the indicators of root nodule activity in the blackgram. These showed that factors promoting the senescence of leaves are also promoting the nodule senescence and functional leaves have a promotive effect on nodule functioning.

At all the three sampling times Fok-4 (kinetin @ 10^{-4} M) inhibited the leaf, root and nodule senescence and FoP20 (paraquat @ 20 mg L^{-1}) promoted the same.

Nitrogen and protein contents in grain samples at harvest increased with kinetin @ 10^{-4} treatment by 32.76, 14.56 and 43.93, 34.06 per cent respectively, in comparison to untreated and water application controls. Paraquat @ 20 mg L^{-1} decreased the nitrogen and protein contents of blackgram by 86.01, 115.56 and 83.41, 97.38 per cent, respectively as compared to the controls (NFo and FoW).

CROP PHYSIOLOGY

Author	:	**YOHAN, Y.**
Title of the Thesis	:	**SCREENING OF BLACKGRAM (Vigna mungo L. Hepper) GENOTYPES FOR PHYSIOLOGICAL EFFICIENCY AND DROUGHT TOLERANCE**
Chairperson	:	**Dr. P. SUDHAKAR**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5506**

ABSTRACT

The experiment entitled “Screening of Blackgram (*Vigna mungo* L. Hepper) genotypes for Physiological efficiency and Drought tolerance” was conducted at crop physiology laboratory (Lab study) and dry land farm (Field study), S.V. Agricultural College, Tirupati.

Forty five blackgram genotypes obtained from RARS, LAM, ANGARU were screened for heat tolerance using the standardized Thermo Induced Response (TIR) protocol, where

seedlings were exposed to gradual and challenging temperatures in environment chamber. Among the 45 genotypes, top ten genotypes (KU-12-55, LBG-623, LBG-680, NDU-12-300, LBG-685, KU-12-14, LBG-645, KU-12-37, TBG-104, KU-12-13) having higher heat tolerance in terms of higher seedling survival and less reduction in root and shoot growth were selected along with two genotypes having lower heat tolerance *viz.,* LBG-752, LBG-20.

A field trail was conducted with two irrigation treatments (Control and stress) and 12 blackgram genotypes replicated thrice in split plot design. Moisture stress was created at pod formation stage i.e for a period of 15 days starting from 40 to 60 DAS. Sufficient moisture stress was created among stress treatments leaf relative water content was reduced by 25.2 per cent.

Morphological characters like plant height, number of nodules, leaf area, total dry matter, physiological parameters, drought tolerance traits viz., rooting abilities, Water Use Efficiency (WUE), Relative Water Content (RWC), chlorophyll Stability Index (CSI), Proline (Osmoregulant), Super oxide dismutase, Perioxidase (POD) (Antioxidant enzyme) and Nitrate reductase (NR) and yield related parameters were examined.

Growth and physiological traits *viz.* plant height, crop growth rate (CGR), net assimilation rate (NAR), leaf area index (LAI) and leaf area duration (LAD), WUE traits (SLA, SCMR), other drought tolerant traits viz., CSI, RWC, yield and HI significantly reduced under moisture stress conditions compared to irrigated control, where as proline, POD and SOD were increased. The genotypes TBG-104, KU-12-13, KU-12-37 and LBG-623 maintained higher leaf area, dry matter and higher physiological traits viz., CGR, NAR, LAI and LAD compared to other entries under irrigated as well as stress conditions. These genotypes also recorded higher drought tolerance interms of WUE traits i.e moderate SLA and high SCMR, higher chloroplast stability (CSI), higher accumulation of proline and SOD enzyme, which denotes the efficiency of these genotypes in conserving water as well as maintaining osmoregulation and cell membranes integrity under drought condition.

Genotypes TBG-104, KU-12-13 and KU-12-37 recorded higher mean root length and low root dry weight and hence maintained higher tissue water content compared to other genotypes. TBG-104, KU-12-13 and KU-12-55 which maintained higher growth, physiological and drought tolerance attributes also recorded higher HI, yield and its components followed by LBG-680, KU-12-37 and LBG-623. The genotype NDU-12-300, KU-12-14 and LBG 645 recorded lower yields under imposed moisture stress conditions as these genotypes recorded lower physiological attributes and drought susceptibility characters. TBG-104, KU-12-13 and KU-12-37 recorded lower percent yield loss in terms of higher drought tolerance index.

The genotypes TBG-104, KU-12-13 and KU-12-55 were superior in terms of physiological efficiency, heat and moisture stress tolerance with high seed yield. These genotypes can be fit in rainfed cultivation or can be used as donor source for development of drought tolerant blackgram genotypes through conventional as well as molecular breeding.

ENTOMOLOGY

Author	:	**APPALA RAJU , ANNEPU.**
Title of the Thesis	:	**EVALUATION OF CERTAIN COTTON GENOTYPES AGAINST LEAFHOPPER, *Amrasca devastans* Dist. (HEMIPTERA: CICADELLIDAE) AND ITS MANAGEMENT THROUGH ECO-FRIENDLY APPROACH**
Chairperson	:	**Dr. M.SESHA MAHALAKSHMI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5418**

ABSTRACT

Studies on "Evaluation of certain cotton genotypes against leafhopper, *Amrasca devastans* Dist. (Hemiptera: Cicadellidae) and its management through eco-friendly approach" were undertaken during *Kharif,* 2016-2017 at Regional Agricultural Research Station, Lam, Guntur.

Fourteen cotton genotypes including one susceptible check were selected for screening against leafhoppers and replicated twice in a simple Randomized Block Design. The evaluation of different cotton genotypes against leafhopper under field conditions revealed that, among all the genotypes, GISV-267 was resistant against leafhoppers by recording the lowest damage injury index level (1.0-1.5 per cent) harbouring mean population of only 5.3/3 leaves/plant and also recorded the highest yield (18.5 q/ha). GSHV-173 genotype was also found promising with low leafhopper population together with high yield.

Morphological and biochemical characters were studied for fourteen cotton genotypes to asses the characters associated with tolerance or resistance to leafhoppers. The study revealed that the genotypes with the highest hair density in leaf lamina and midrib had exhibited the lowest leafhopper injury index and proved as resistant genotypes against leafhoppers. The genotypes with higher quantity of biochemical components such as tannins and phenols both at vegetative stage and reproductive stage showed resistance or tolerance against leafhoppers.

The experiment for management of leafhoppers through eco friendly approach was carried out in Randomized Block Design with seven treatments along with control which were replicated thrice. Two each of botanicals, entomopathogens and inorganic insecticides evaluated against leafhoppers infesting cotton. Among all the treatments, thiacloprid + flubendiamide 480 SC was proved as significantly superior over the other treatments in suppressing the leafhopper population both at 3 and 7 days after treatment by recording the highest reduction over control. The other treatments in the order of efficacy in suppressing the leafhopper population are thiacloprid 48 SC and azadirachitin 10000 ppm with more than 50

per cent reduction in leafhopper population over untreated control.The entomopathogens *Lecanicillium lecani* and *Beauveria bassiana* had exerted comparatively less efficacy in suppressing the leafhopper population when compared to botanicals and inorganic insecticides. Natural enemy population was more in the entomopathogens and botanical based treatments which were found to be on par with control plots. The seed cotton yield was highest from thiacloprid + flubendiamide 480 SC @ 0.4 ml / l (18.98 q / ha) but it was found on par with thiacloprid 48 SC 0.3 ml / l (18.80 q / ha.) and azadirachitin 10000 ppm @ 1.5 ml / l (17.62 q / ha).

ENTOMOLOGY

Author	:	**DEVAKI, K.**
Title of the Thesis	:	**MOLECULAR CHARACTERIZATION OF *Bacillus thuringiensis cry* GENES WITH INSECTICIDAL ACTIVITY AGAINST *Spodoptera litura* IN GROUNDNUT**
Chairperson	:	**Dr. T. MURALI KRISHNA**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5514**

ABSTRACT

A total of 925 soil samples representing Chittoor, Kadapa, Nellore districts of Andhra Pradesh covering different ecosystems was collected to isolate bacterial cultures. These bacterial cultures were subjected to Gram staining, endospore staining and crystal staining for identification of *Bacillus thuringiensis*. Out of 324 Gram positive isolates, 227 isolates were able to produce endospores and maximum number of endospore producing isolates were observed in soil samples of forest ecosystem (95.77%), compared to other soil samples collected from Nellore, Chittoor and Kadapa districts.

About 203 crystal staining positive *Bt* strains were identified. Soil samples from cultivated fallow harboured maximum crystal positive isolates (39.82%). Study on crystal morphology revealed that spherical crystals (26.11%) were most dominant, followed by irregular (24.14%) and bipyramidal (13.30%). A combination of bipyramidal and cuboidal (6.40%), cuboidal and spherical (4.43%) and bipyramidal and spherical (1.97%) were observed in 13, 9 and 4 isolates, respectively.

Most of the effective isolates were observed with bipyramidal, cuboidal crystals against *S. litura*. In laboratory bioassay 21 isolates (C44, C33, C59, C63, C79, C92, C97, C105, C134, C212, K18, N3, N30, N44, N48, N58, N115, F287, F468, F493 and F504) were found effective against third instar *S. litura* larvae with 76-100 per cent mortality.

The isolate from Talakona forest area (F493) was effective with 100 per cent mortality, followed by F468 (86.67%) from Bhakarapet Ghats and F287 (76.67%) from Talakona forest area and F504 (76.67%) from S.V. Zoo park area.

Twenty one effective isolates were further studied for determining lethal concentrations to arrive 50 per cent mortality (LC50) and time to kill 50 per cent larval population (LT50). LC50 values were in the range of 9.59 10^4 to 1.88 10^6 and HD-1 recorded lowest LC50 value, followed by F493 (9.76 10^4) and N30 (1.90 10^5). Lowest LT50 of 61.99h was observed in treatment with HD-1 followed by F493 (78.52h).

Ninety two *Bt* strains were characterized for the presence of various *cry* genes by using primers viz., *cry*1Aa, *cry*1Ab, *cry*1Ac, *cry*1C, *cry*1Da1, *cry*1Ea1, *cry*1F, *cry*1Fa1, *cry* 1I, *cry*2, *cry*2Aa1, *cry*8, *cry*9Aa1, *cry*9Ca1, *cry*18 and *cry*20. Among the nine *cry*1 genes analyzed in the present study, *cry*1I was the predominant gene and present in 35 isolates (38.46%), followed by *cry*1Aa in 30 *Bt* isolates (31.87%), *cry*1Ac in 26 isolates (28.57%), *cry*1C in 18 isolates (19.78%) and *cry*1Fa1 in 17 isolates (18.68%), whereas, *cry*1Ab gene was observed in only one isolate *i.e.* C36. In case of *cry*2 genes, *cry*2 was observed in 14 (15.38%) isolates and *cry*2(a)1 was observed in 19 (20.88%) isolates. Among the two *cry*2 genes, *cry*2A(a)1 was dominant compared to *cry*2 in Chittoor, Nellore and forest ecosystems, whereas *cry*2 positive isolates were more in Kadapa district *Bt* samples.

Among the two *cry*9 family genes, *cry*9Ca1 was dominant in 22 *Bt* isolates (24.18%) and 13 isolates were observed with *cry*9Aa1 (14.29%). In Chittoor (10 isolates), Nellore (4 isolates) and forest ecosystem (7 isolates) *cry*9Ca1 gene positive isolates were more compared to Kadapa district samples, where *cry*9Aa1 (4 isolates) samples were high compared to *cry*9Ca1.

Eight *cry* genes (*cry*1Aa, *cry*1Ac, *cry*1Fa1, *cry*1I, *cry*2, *cry*2A(a)1, *cry*8, *cry*9Ca1) were observed in F493, a isolate from Talakona forest area, which was away from human interference and observed with high organic matter. This isolate harboured *cry* gene belongs to *cry*1, *cry*2, *cry*8 and *cry*9 groups. Similarly, isolate C67 observed with 66.67 per cent also amplified with eight *cry* primers (*cry*1Aa, *cry*1Ac, *cry*1C, *cry*1Da1, *cry*1Ea1, *cry*1Fa1, *cry*2, *cry*2A(a)1) followed by C134 with 7 *cry* genes (*cry*1Ac, *cry*1C, *cry*1Da1, *cry*1Fa1, *cry*1I, *cry*2A(a)1, *cry*8). These types of strains might be resulted in multifunctional insecticide activity, which is useful for control of several groups of insect pests. C134 (83.33%) consisting 7 *cry* genes. While, C68 (50.00%), F323 (50.00) and F504 (76.67%) were observed with 6 *cry* genes. Some of the isolates C63 (76.67%), K18 (86.67%) and N48 (76.67%) which were effective in bioassays, did not show amplification with any one of the *cry* genes screened in the present study.

Sequencing of 16s ribosomal RNA results of three *Bt* strains (F493, F504, N115) confirmed that, these three strains are *B. thuringiensis* strains with high insecticidal activity. Blast analysis of these strains showed 99, 97 and 96 per cent similarity with the existing *Bt* gene sequences available in NCBI, GenBank and these three strains were deposited in NCBI, GenBank with Accession Nos. MF487790, MF487791 and MF197874.

Field evaluation of solid and liquid formulations of *Bt* isolates revealed that, solid formulations were comparatively more effective in some of the isolates. Larval population/ m row at 3 and 7 days after spray, foliar damage due to *S. litura* at 7 and 14 days after spray was low in treatments with F493, F504 which were comparable with standard check HD-1 in both solid and liquid formulations. Highest pod yield was recorded in HD-1, F493 and F504 treated plots.

ENTOMOLOGY

Author	:	**ESWAR NAIK, M.**
Title of the Thesis	:	**TRI-TROPHIC INTERACTIONS OF CASTOR SEMILOOPER, *Achaea janata* L AND ITS ENDOLARVAL PARASITOID *Snellenius maculipennis* (Szepligate)**
Chairperson	:	**Dr. K.V. HARI PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5507**

ABSTRACT

Laboratory studies on the "Tri-trophic interactions of castor semilooper, *Achaea janata* L and its endolarval parasitoid *Snellenius maculipennis* (Szepligate)" were carried out during 2016-17 at Insectary, Department of Entomology, S. V. Agricultural College, Tirupati. Six varieties of castor *viz*., DPC-9 (Green zero bloom), DCH-177 (Red single bloom), PCH-111 (Green double bloom), 48-1 (Red double bloom), DCH-519 (Green triple bloom) and GCH-4 (Red triple bloom) were grown in plastic pots during *kharif* 2016 from August onwards under net house conditions. Excised leaves of equal maturity castor varieties with different blooms were used for studying the biology of *A. janata* at 28 ± 2˚C temperature and 75-80 per cent RH.

Longest larval duration, adult longevity, total life cycle with more larval weights and fecundity of *A. janata* were observed when reared on DPC-9 (14.42 ±0.87 days; 13.15±0.93 days; 40.77 ± 01.52 days and 1.253 ± 0.129 g; 316.5 ± 20.07 eggs, respectively), indicating DPC-9 as the most preferred variety for growth and multiplication of *A. janata* followed by DCH-177 (14.25 ±0.81 days; 13.00 ±0.72 days; 40.70 ±01.17 days and 1.202 ± 0.090 g; 276.5 ± 35.19 eggs, respectively).

The Shortest larval duration, adult longevity, total life cycle with less larval weight and fecundity of *A. janata* were observed when reared on GCH-4 (12.42 ±0.81 days; 12.75 ±0.73 days; 36.47 ±03.21 days and 0.925 ± 0.218 g; 234.25 ± 20.27 eggs, respectively) followed by DCH-519 (12.50 ±0.58 days; 12.65 ±0.58 days; 37.15 ±01.25 days and 1.191 ± 0.095 g; 231.0 ± 13.16 eggs, respectively), recording as least preferred hosts for growth and multiplication of *A. janata.*

The performance of *A. janata* on the remaining varieties were in between DPC-9 and GCH-4. Approximate digestibility (AD) of third instar was highest when reared on GCH-4 (0.953±0.003 mg) and lowest when reared on DCH-177 (0.469±0.191 mg).

Efficiency of conversion of ingested food (ECI) of fourth instar was highest when reared on DPC-9 (0.840±0.190 mg) and lowest ECI were observed when reared on GCH-4 (0.521±0.152 mg).

Efficiency of conversion of digested food (ECD) and consumption index (CI) of fifth instar was highest when reared on DPC-9 (0.675±0.132 mg; 0.914±0.009 mg) and lowest

efficiency of conversion of digested food (ECD) and consumption index (CI) were observed when reared on GCH-4 (0.379±0.050 mg; 0.219±0.045 mg, respectively).

Protein content, total free amino acids, total carbohydrates and reducing sugars were positively correlated with total larval duration, adult longevity, total life cycle and fecundity of *A. janata* (statistically not significant). Total phenols content was negatively correlated with total larval duration, adult longevity, total life cycle and fecundity of *A. janata.* (statistically significant).

Per cent parasitization by *S. maculipennis* on *A. janata* larvae released on castor varieties with different blooms was higher on PCH-111 (67.5±7.73 %) followed by DCH-177 (63.3±31.97 %), 48-1 (61.2±10.38 %), DCH-519 (61.2±10.30 %), GCH-4 (60.4±12.50 %) and DPC-9 (50.7±15.32 %) (Not statistically significant).

Biological parameters of parasitoid, *S. maculipennis* such as egg+larval duration, cocoon duration, adult longevity and total life cycle, when larvae released on different castor varieties at different blooms *viz.,* DPC-9, DCH-177, PCH-111, 48-1, DCH-519 and GCH-4 were 5.25 to 5.75, 4.50 to 4.75, 3.50 to 3.75, 13.2 to 13.75 days, respectively.

ENTOMOLOGY

Author	:	**IMMANUEL CHETHAN PREMDAS, M.**
Title of the Thesis	:	**SEASONAL INCIDENCE, DISTRIBUTION PATTERNS OF INSECT PEST COMPLEX OF SESAME AND THEIR MANAGEMENT WITH CERTAIN INSECTICIDES**
Chairperson	:	**Dr. K.V. HARI PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5508**

ABSTRACT

Field studies on seasonal incidence, distribution patterns of insect pest complex of sesame and their management with certain insecticides were carried out during *summer* 2017 at wet land farm, S.V. Agricultural college, Tirupati.

Sesame crop (var., YLM-66) was sown two times at fortnightly intervals *i.e.,* on 03-01-2017 and 17-01-2017 to assess the seasonal incidence and distribution patterns of different insect pests. Trial on evaluation of insecticides against sesame pests was sown on March 7th 2017.

High incidence of leaf webber, *Antigastra catalaunalis* larvae was noticed in 2nd week of Febrauary at 40 DAS in 1st sowing and 2nd week of Febrauary at 26 DAS in 2nd sowing. Peak infestation of leaf webber, *A. catalaunalis* in terms of symptoms of infestation was observed in 2nd week of Febrauary at 40 DAS in 1st sowing and 3rd week of February at 33

DAS in 2nd sowing. Incidence of hawk moth, *Acherontia styx* larvae was high during 2nd week of Febrauary at 40 DAS in 1st sowing and 2nd week of Febrauary at 26 DAS in 2nd sowing. Peak infestation of hawk moth, *A. styx* in terms of symptoms of infestation was observed in 2nd week of Febrauary at 40 DAS in 1st sowing and 3 rd week of February at 33 DAS in 2nd sowing. Peak infestation of ash weevil, *Myllocerus undecimpustulatus* in terms of symptoms of infestation was observed in 2nd week of Febrauary at 40 DAS in 1st sowing and 2nd week of February at 33 DAS in 2nd sowing. Peak infestation of gall fly, *Asphondylia sesami* in terms of symptoms of infestation was recorded in 3rd week of March at 75 DAS in 1st sowing and 1st week of April at 75 DAS in 2nd sowing. High incidence of leafhopper, *Orosius albicinctus* nymphs was noticed in 2nd week of Febrauary at 40 DAS in 1st sowing and 2nd week of Febrauary at 26 DAS in 2nd sowing. Incidence of aphid, *Aphis gossypii* was high in 2nd week of Febrauary at 40 DAS in 1st sowing and 2nd week of Febrauary at 26 DAS in 2nd sowing.

The incidence of leaf webber, *A. catalaunalis* and hawk moth, *A. styx,* in terms of larvae and symptoms of infestation was negatively correlated with mean maximum / minimum temperature and evaporation during *summer* 2017. The correlation was negative and significant between ash weevil, *M. undecimpustulatus* symptoms of infestation for mean maximum / minimum temperature and evaporation in 1st sowing. Ash weevil, *M. undecimpustulatus* and gall fly, *A. sesami* in terms of symptoms of infestation was positively correlated with evaporation in 2nd sowing. Gall fly, *A. sesami* symptoms of infestation was positively correlated with no. of rainy days in 2nd sowing. Leafhopper, *O. albicinctus* nymphs exhibited negative correlation with minimum temperature and positive correlation with bright sunshine hours in 1st sowing. Aphid, *Aphis gossypii* exhibited negative correlation with minimum temperature in 1st sowing. No significant correlation was found between aphids, *A. gossypii* incidence and meteorological parameters in 2nd sowing.

Studies on distribution patterns revealed that larvae of leaf webber, *A. catalaunalis,* hawk moth, *A. styx* exhibited a uniform distribution at various stages of crop growth, *viz.,* early vegetative stage, peak vegetative stage, flowering stage, pod formation stage.

Ash weevil, *M. undecimpustulatus* symptoms of infestation also showed an uniform distribution pattern at early vegetative stage, peak vegetative stage while gall fly, *A. sesami* symptoms exhibited uniform distribution at pod formation stage only.

Both the sucking insect pests *i.e.,* leafhopper, *O. albicinctus* (nymphs) and aphids, *A. gossypii* exhibited clumped or aggregate distribution though it is more conspicuous in case of aphids.

Results on efficacy of certain insecticides against leaf webber, *A. catalaunalis,* hawk moth, *A. styx,* leafhopper, *O. albicinctus* and aphid, *A. gossypii* revealed that the chemical treatment with chlorantraniliprole @ 0.3 ml L^{-1} was found to be highly effective against leaf webber, *A. catalaunalis.* Lambda cyhalothrin @ 1 ml L^{-1} was superior against hawk moth, *A. styx* where as pymetrozine @ 0.4 g/L was performed highly against leafhoppers, *O. albicinctus* and aphids, *A. gossypi.*

ENTOMOLOGY

Author	:	**JAKEER SHAREEF, S.**
Title of the Thesis	:	**SCREENING OF CERTAIN GENOTYPES OF BLACKGRAM (*Vigna mungo* L. Hepper), MONITORING AND INSECTICIDAL MANAGEMENT OF WHITEFLY *Bemisia tabaci* Gennadius**
Chairperson	:	**Dr. A. RAMAKRISHNA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5509**

ABSTRACT

The present study entitled "Screening of certain genotypes of blackgram (*Vigna mungo* L. hepper), monitoring and insecticidal management of whitefly *Bemisia tabaci* Gennadius" was carried out during *rabi* 2016-17 at Department of Entomology, S. V. Agricultural College, Tirupati.

The incidence of whitefly was observed from 3rd standard (std.) week (3rd week of January) with a population of 0.16 nymphs/ trifoliate leaf during 1st date of sowing of LBG 623 in blackgram. Among all the three dates of sowing, peak incidence of whitefly population (10.58 nymphs /trifoliate leaf) was observed in 13th std. week (last week of March). Weather parameters like evening relative humidity, rainfall and wind speed showed negative association with whitefly incidence in terms of number of nymphs/trifoliate leaf while maximum temperature showed positive association with whitefly incidence.

The multiple linear regression analysis revealed that all the weather factors together were responsible for 82 per cent (R^2= 0.82) and 77.4 per cent (R^2= 0.774) total variation in whitefly population in two blackgram varieties LBG 623 and PU 31 sown during January first fortnight (D_1). Among these evening relative humidity, rainfall, sunshine hours and wind speed also could independently affect changes in whitefly population.

Thirty-six blackgram genotypes including one susceptible check LBG-623 and one resistant check were selected for screening for resistance to whitefly and replicated thrice in a simple Randomized Block Design. The evaluation of different genotypes against whitefly under field conditions revealed that the genotypes with high trichome density *i.e*., PU-31 (43.50/cm^2), TBG-104 (43.20/cm^2), GBG-1 (42.90/cm^2) and GBG-103 (42.60/cm^2) recorded less number of whitefly population *viz*., 2.83, 2.91, 3.03, 3.13 nymphs/ trifoliate leaf/ plant, respectively. The trichome density had highly significant negative correlation (r= -0.951) with the population of whitefly nymphs. SCMR values are significantly negatively correlated with MYMV incidence (r= -0.700) as well as whitefly population (r= -0.871). Leaf thickness had non-significant negative influence (r= -0.280) on whitefly population.

Seed treatment with imidacloprid 600 FS @ 2.0 ml+4.0 ml water kg^{-1} seed was effective upto 30 DAS with more than 50.0 per cent reduction in the whitefly population over control.

Among all the insecticides evaluated as foliar sprays, buprofezin 25 SC @ 1.5 ml L^{-1} was the most effective and significantly superior over all other treatments with more than 70.0 per cent reduction in whitefly population when compared to untreated control. The next best treatments were acetamiprid 20 SP @ 0.2 g L^{-1} (48.79 %) and thiacloprid 21.7 SC @ 0.25 ml L^{-1} (43.89 %). Thiamethoxam 25 WG @ 0.2 g L^{-1} (39.05 %) expressed better efficacy against whiteflies with more than 35.0 per cent reduction in whitefly population over untreated control. Thiamethoxam 25 WG @ 0.2 g L^{-1} and triazophos 40 EC @ 2.0 ml L^{-1} were on par with each other. Dimethoate 30 EC @ 2.0 ml L^{-1} (30.56 %) was found to be least effective with less than 35.0 per cent reduction in population over untreated control.

Among the neonicotinoid insecticides, imidacloprid 200 SL was found to be less effective against whiteflies with less than 40 per cent reduction in population over untreated control. Development of resistance in whitefly population to imidacloprid, due to injudicious and indiscriminate use of imidacloprid 200 SL in different crops by the farmers may be the reason for the low level of suppression by the insecticide. However, in terms of whitefly suppression all the treatments were found significantly superior over untreated control.

ENTOMOLOGY

Author	:	**MANEESHA, A.**
Title of the Thesis	:	**BIOLOGY, PREDATORY POTENTIAL OF *Cryptolaemus montrouzieri* Mulsant ON PAPAYA MEALYBUG AND SAFETY EVALUATION OF CERTAIN INSECTICIDES ON PREDATOR**
Chairperson	:	**Dr. S.R. KOTESWARA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5510**

ABSTRACT

The present studies on “Biology, Predatory potential of *Cryptolaemus montrouzieri* Mulsant on papaya mealybug and Safety evaluation of certain insecticides on predator’’ were carried out at Insectary, Department of Entomology, S.V. Agricultural College, Tirupati during 2016-17. Biology including morphometrics, predatory potential of *C. montrouzieri* on papaya mealybug, biology on different life stages of papaya mealybug and evaluation of toxicity of different insecticides on predator were studied.

Studies on the biology of *C. montrouzieri* on *Paracoccus marginatus* revealed that the oviposition period, male longevity and female longevity was 43.60 ± 2.95, 70.70 ± 2.75 and 77.30 ± 5.03 days, respectively. The mean egg period, duration of I, II, III and IV instars, pre-

pupa and pupa was 3.13 ± 1.12, 2.96 ± 0.65, 4.30 ± 0.57, 5.73 ± 0.75 and 6.40 ± 0.78, 2.30 ± 0.49 and 7.50 ± 0.96 days, respectively. The total grub period and developmental period *i.e.* from egg to adult was found to be 22.50 ± 1.33 and 32.30 ± 1.55 days, respectively. The mean fecundity of female was 272.60 and sex ratio was 1: 1.

The morphometrics of the *C. montrouzieri* revealed that the average length and breadth of egg was 0.81 ± 0.05 mm and 0.41 ± 0.04 mm. Similarly, the average length and breadth of I, II, III and IV instar grubs was 1.26 ± 0.26 mm and 0.49 ± 0.05 mm; 4.60 ± 0.47 mm and 1.17 ± 0.08 mm; 6.06 ± 0.53 mm and 2.00 ± 0.30 mm; 8.44 ± 0.64 mm and 4.12 ± 0.15 mm, respectively. The average length and breadth of pre- pupa and pupa was found to be 8.96 ± 0.36 mm and 4.30 ± 0.35 mm; 9.08 ± 0.46 and 4.32 ± 0.58 mm, respectively. The average length and breadth of adult male and adult female was 3.85 ± 0.24 mm and 2.89 ± 0.12 mm; 4.25 ± 0.28 mm and 3.20 ± 0.20 mm.

The total developmental period of *C. montrouzieri* was significantly highest when reared on ovisacs of papaya mealybug, when compared to that of I, II and III instar nymphs of *P. marginatus*.

Feeding potential of *C. montrouzieri* on different stages of papaya mealybug was studied. The mean predatory potential of I, II, III and IV instar grub on Ovisac, I, II and III instar nymphs of mealybug was 1.40 ± 0.12, 30.60 ± 0.51, 20.53 ± 0.98 and 13.46 ± 1.15; 1.68 ± 0.13, 43.52 ± 0.41, 30.40 ± 0.68 and 17.33 ± 0.88; 1.90 ± 0.14, 47.04 ± 0.84, 31.56 ± 0.51 and 20.45 ± 0.84 and 1.91 ± 0.15, 54.10 ± 0.45, 38.20 ± 0.58 and 26.32 ± 1.13. Average consumption capacity of male and female on ovisac, I, II and III instar nymphs was 2.98 ± 0.09, 57.81 ± 0.24, 41.39 ± 0.12 and 28.51 ± 0.02 and 3.05 ± 0.10, 58.19 ± 0.26, 43.00 ± 0.19 and 29.28 ± 0.08, respectively.

Among safety evaluation of different insecticides on life stages of *C. montrouzieri,* dimethoate was found to be highly toxic whereas, flonicamid, buprofezin and neem oil were found to be non-toxic through food contamination method. In dry film method, acephate was highly toxic while, buprofezin and neem oil were least toxic to all the stages of the predator.

ENTOMOLOGY

Author	:	**MOUNICA, B.**
Title of the Thesis	:	**BIO-PHYSICAL, BIO-CHEMICAL CHARACTERS AND MOLECULAR CHARACTERISATION OF DIFFERENT CASTOR GENOTYPES FOR RESISTANCE TO LEAFHOPPER, *Empoasca flavescens* Fabricius.**
Chairperson	:	**Dr. N. C. VENKATESWARLU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5511**

ABSTRACT

The present study on "Bio-physical, bio-chemical characters and molecular characterisation of different castor genotypes for resistance to leafhopper**,** *Empoasca flavescens* Fabricius." was carried out in Dryland farm of Sri Venkateswara Agricultural College and IFT, RARS, Tirupati during *kharif,* 2016-17.

Screening of twenty eight castor genotypes against leafhopper *E. flavescens* revealed that the mean leafhopper population varied significantly among the genotypes and high population was recorded in DPC-9 (54.28/3 leaves) followed by DCH-177 (42.93). Least leafhopper population was recorded in GCH-7 (20.48), VP-1 (20.63). The genotypes DPC-9, PCH-111 and DCH-177 recorded highest hopper burn scores of 2.4, 2.4 and 2.0 respectively. Lowest hopper burn scores were recorded in genotypes GCH-7 (0.00), PCH-254 (0.00) and SKI-336 (0.00).

Genotypes GCH-7, PCH-254 and SKI-336 could be ranked as the least preferred genotypes with lowest leafhopper population and hopper burn scores while the genotypes DPC-9, DCH-177 could be ranked as most preferred genotypes with highest leafhopper population and hopper burn scores. This could be supported by the fact that GCH-7, PCH-254 and SKI-336 were triple bloom genotypes imparting resistance to the leafhopper by antixenotic mechanism while DPC-9, DCH-177 and PCH-111 were zero and single bloom genotypes, respectively with no wax bloom on their leaf lamina.

The correlation studies on leafhopper population with abiotic factors showed that maximum temperature, minimum temperature, rainfall, number of rainy days and evaporation were negatively correlated whereas relative humidity and sunshine hours were positively correlated with leafhopper population.

Leaf colour of different castor genotypes was recorded through SCMR at monthly intervals upto 90 DAS. The correlation studies of SCMR with leafhopper population and hopper burn scores in castor showed that there was a negative significant correlation between SCMR and both the leafhopper population and hopper burn scores. In the present investigation no trichomes were observed on castor leaves.

Among bio-chemical components of castor, phenols had a significant negative correlation with both leafhopper population and hopper burn scores. Total carbohydrates showed a significant positive correlation with leafhopper population. Total free amino acids exhibited significant negative correlation with hopper burn scores.

The yield of different genotypes ranged from 217.25 to 31.31g/ plant. Highest yield was recorded in SKI-336 (217.25 g/plant) followed by M-574 (174.44 g/ plant), PCH-254 (152.16 g/ plant) while the lowest yield was recorded in SKI-335 (31.31 g/ plant) followed by SKI-84 (38.85 g/ plant) DCH-519 (52.51 g/ plant) and DCS-107 (55.95 g/ plant).

Twelve contrasting genotypes were selected out of twenty eight genotypes for studying the molecular diversity by RAPD and SSR techniques. Eleven random primers (OPA 01, 07, 15, 19, OPC 02, 07, 08, 15 OPD 07, 09, 10) were used for RAPD analysis and generated scorable PCR products by amplifying the template DNA with Taq polymerase. The RAPD products generated a total 155 fragments with an average of 14.09 fragments per primer and the fragments were found 100 per cent polymorphic. The number of scorable bands produced per primer ranged from 2 to 34 and size of the products ranged from 75 bp to 6900 bp.

The phylogenetic relationship among 12 castor genotypes was analysed by UPGMA method. The cluster analysis showed three major clusters having GCH-4, PCH-111, Jwala,

Pragathi in one cluster, DPC-9, SKI-336, GCH-7, VP-1 in one cluster and PCH-282, Kranthi, SKI-341, DCH-177 in another cluster.

Molecular diversity was studied with a set of 41 microsatellite or SSR primers in twelve contrasting castor genotypes. The SSR markers generated a total 120 fragments with an average of 2.86 fragments per primer and the fragments were found 81.09 per cent polymorphic. The number of scorable bands produced per primer ranged from 1 to 5 and size of the products ranged from 85 bp to 880 bp.

The phylogenetic relationship among 12 castor genotypes was analysed by UPGMA method. The dendrogram constructed showed three major clusters having DPC-9, SKI-336, GCH-7 in one cluster, PCH-111,Pragathi, GCH-4, Jwala in one cluster and SKI-341, PCH-282, DCH-177, Kranthi and VP-1 in another cluster. Out of 41 primers, six primers exhibited 0 per cent polymorphism, three primers exhibited 50 per cent polymorphism and remaining 32 primers exhibited 100 per cent polymorphism.

ENTOMOLOGY

Author	:	**NAGA SATYASRI, CHAVAKULA.**
Title of the Thesis	:	**ASSESSMENT OF INSECTICIDE RESISTANCE IN *TRIBOLIUM CASTANEUM* HERBST. (TENEBRIONIDAE:COLEOPTERA) AND ITS MANAGEMENT WITH NEW INSECTICIDES**
Chairperson	:	**Dr. T. MADHUMATHI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5415**

ABSTRACT

The present investigation on “Assessment of Insecticide Resistance in *Tribolium castaneum* Herbst. (Tenebrionidae: Coleoptera) and its Management with new Insecticides” was conducted in the laboratory, Department of Entomology, Agriculture college, Bapatla, Guntur district, Andhra Pradesh during 2015.

The Amalapuram, Eluru and Bapatla strains of *T. castaneum* has developed 20.11, 19.44 and 23.88 folds resistance at LC_{50} level and 1.13, 1.02 and 2.00 folds resistance at $LC_{99.9}$ to malathion respectively. While the corresponding resistance levels of the Machilipatnam, Visakhapatnam, Srikakulam, Tirupati and Nellore strains were 12.22, 15.55, 16, 17.44 and 22.88 at LC_{50} and 1.63, 1.55, 2.11, 2.51 and 2.22 at $LC_{99.9}$ level. All the examined strains of *T. castaneum* have not developed any resistance to dichlorvos at both LC_{50} and $LC_{99.9}$ levels. Except Bapatla and Srikakulam strains remaining all strains have developed two folds resistance to deltamethrin at LC_{50} level whereas Bapatla and Srikakulam strains developed three folds resistance to deltamethrin and at $LC_{99.9}$ levels the resistance level ranged from one fold to three fold for all the strains against deltamethrin.

The synergists *viz.,* as PBO, DEF and TPP showed synergistic factors of 89.58, 238.80 and 153.57 at LC_{50} and 3.17, 6.70 and 5.03 at $LC_{99.9}$ level, respectively with malathion. The corresponding synergistic values for dichlorvos were 58.80, 35.33 and 15.14 at LC_{50} and 2.50, 2.13 and 0.32 at $LC_{99.9}$ level, while these values were 56.42, 25.48 and 21.03 at LC_{50} level and 1.80, 0.60 and 0.49 at $LC_{99.9}$ level for deltamethrin. The levels of resistance to malathion, dichlorvos and deltamethrin are brought down significantly with all the three synergists *viz.,* PBO, DEF and TPP.

Among the new insecticides tested in the management of insecticide resistant Bapatla strain of *T. castaneum*, chlorantraniliprole was found to be the best at $LC_{99.9}$ level for complete incapacitation of *T. castaneum* with the highest relative toxicity (25.59, 6.30 and 18.80 times) than malathion, dichlorvos and deltamethrin, respectively followed by emamectin benzoate (14.52, 3.58 and 10.67 times). Nimbicidin showed its better toxicity (7.16, 1.76 and 5.26 times) compared to malathion, dichlorvos and deltamethrin at LC_{50} level. Lufenuron, spinosad and chlorfenapyr found effective at LC_{50} level (7.19, 3.07 and 13.35 times) compared to malathion.

ENTOMOLOGY

Author	:	**RAJASEKHAR, N.**
Title of the Thesis	:	**INCIDENCE AND MANAGEMENT OF MAJOR SUCKING PESTS OF COTTON UNDER HIGH DENSITY PLANTING SYSTEM (HDPS)**
Chairperson	:	**Dr. N. V. V. S. DURGA PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5417**

ABSTRACT

The studies on **"Incidence and Management of Major Sucking Pests of cotton under High Density Planting System (HDPS)"** were conducted at Regional Agricultural Research Station (RARS), Lam, Guntur during *Kharif,* 2016 with an aim to study the incidence of major sucking pests in cotton under HDPS (Unprotected). The experiment was conducted in two bulk plots (500 m^2) *viz*., 15873 (Normal) and 133333 (HDPS) plants ha^{-1} to evaluate the influence of high density planting system (HDPS) on the efficacy of insecticides against major sucking pests in cotton. The experiment was laid out in split plot design with two main plots (one with normal spacing (105×60 cm) and another in HDPS (75×10 cm)) and each main plot carried eight treatments *viz*., flonicamid 50% WG (Ulala), diafenthiuron 50% WP (Polo), acephate 75% SP (Lancer gold), monocrotophos 36% SL (Phoskill), fipronil 5%SC (Regent), buprofezin 25% SC (Applaud), imidacloprid 17.8% SL (Confidor) and control. All the treatments were replicated thrice and a variety, NDLH-1938 non- *Bt* was selected for this experiment.

In the study, to ascertain the influence of plant densities on incidence and development of insect pests of cotton, the dynamics of sucking insect pests was studied where, initial days of crop growth period thrips population in HDPS showed significant difference with normal spacing at 45, 60, 75 and 90 DAS. The thrips population crossed ETL and attained peak incidence at 45 and 60 DAS and the leafhopper population crossed ETL at 45 and 75 DAS in HDPS and its population did not show any significant difference with normal spacing throughout the crop growth period. In case of normal spacing, leafhopper population did not cross the ETL throughout the crop growth period. The aphid population crossed ETL at 120 DAS *i.e.* 40.5 aphids /3 leaves in HDPS, whereas in case of normal spacing aphid population never crossed the ETL and the aphid population in HDPS showed significant difference with the normal spacing at 105, 120 and 135 DAS remaining days of observation did not show any significant difference. Throughout the crop growth period whitefly population did not cross ETL in normal as well as HDPS, but peak incidence of whitefly was observed at 60 DAS. More number of spiders and coccinellid population were observed at 120 DAS in HDPS than in normal spacing. The enhanced activity of natural enemies like spiders and coccinellid beetles as observed at higher plant densities due to the availability of more prey. Pest population increased as plant densities increased.

Among the different insecticides tested in HDPS, flonicamid 50% WG was found effective against aphids and leafhopper population. Fipronil 5% SC was found to be effective in managing thrips population. Diafenthiuron 50% WP was found to be effective in suppressing whitefly population.

In normal spacing, flonicamid 50% WG and monocrotophos 36% SL were found effective against aphid population. Flonicamid 50% WG was found effective againist leafhopper population. Thrips population was effectively managed by fipronil 5% SC. Diafenthiuron 50% WP found to be effective against whitefly population. All the insecticides were similar in cotrolling sucking pest in normal and HDPS as there is no difference in population reduction over control.

In HDPS, the highest seed cotton yield was obtained from plots treated with flonicamid 50% WG (25.83 $q.ha^{-1}$). Diafenthiuron 50% WP which is on par with flonicamid 50% WG recorded the yield of 23.55$q.ha^{-1}$. Fipronil 5% SC, acephate 75% SP, buprofezin 25% SC, monocrotophos 36% SL and imidacloprid 17.8% SL were on par and recorded the yields of 19.50, 18.38, 17.44, 16.94 and 16.94 $q.ha^{-1}$, respectively. Lowest yield of 14.06 $q.ha^{-1}$ was recorded in control plot.

In case of normal spacing, flonicamid 50% WG recorded the highest yield of 19.72 $q.ha^{-1}$. Diafenthiuron 50% WP, fipronil 5% SC, acephate 75% SP and monocrotophos 36% recorded the yields of 16.78, 15.77, 15.01 and 14.72 $q.ha^{-1}$ respectively and were at par. Lower yields were recorded in buprofezin 25% SC, imidacloprid 17.8% SL and the least from control plot with 13.38, 11.01 and 9.42 $q.ha^{-1}$.

ENTOMOLOGY

Author	:	**SAI, YADDANAPUDI .**
Title of the Thesis	:	**BIO-INTENSIVE MANAGEMENT OF *HELICOVERPA ARMIGERA* (HUBNER) AND *MARUCA VITRATA* (GEYER) IN PIGEONPEA**
Chairperson	:	**Dr. M. SREEKANTH**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5423**

ABSTRACT

A field experiment entitled "Bio-intensive management of *Helicoverpa armigera* (Hubner) and *Maruca vitrata* (Geyer) in Pigeonpea" was conducted at Regional Agricultural Research Station, Lam, Guntur during *Kharif,* 2014-15. Twenty pigeonpea genotypes were screened and morphological and biochemical factors like trichome density, trichome length, phenol, protein and sugar content were studied and the efficacy of certain bio-insecticides were evaluated against pod borers, *H. armigera* and *M. vitrata*.

Among 20 genotypes screened against pod borers viz., *H. armigera* and *M. vitrata*, five genotypes viz., LRG 30, LRG 41, ICPL 87119, ICP 8863 and BSMR 853 were found resistant with regard to per cent pod and grain damage. The results also showed that none of the genotypes were free from pod borer damage. The genotype, LRG 41 recorded highest pod and grain yield per plant *i.*e., 549.5 and 382.7 g, respectively.

Among the morphological factors, trichome density on upper and lower surface of leaf showed a significant negative correlation with pod damage due to pod borers. Thus, the genotypes having higher density of trichomes on leaves suffered less pod damage due to pod borers. Among the biochemical factors, sugars and proteins present in flowers, pod walls and seeds showed significant positive correlation, whereas phenols showed significant negative correlation with pod damage by pod borers.

Results on management of pod borers with bio-insecticides revealed that spinosad 45 % SC @ 73 g a.i., ha^{-1} was highly effective in controlling the two lepidopteron pod borers viz., *H. armigera* and *M. vitrata* by recording lowest per cent pod and grain damage with highest yield (1671 kg ha^{-1}) and incremental cost benefit ratio (2.47).

ENTOMOLOGY

Author	:	**SARADA, V.**
Title of the Thesis	:	**ASSESSMENT OF INSECTICIDE RESISTANCE IN PULSE BEETLE, *CALLOSOBRUCHUS MACULATUS* FAB. (BRUCHIDAE: COLEOPTERA) AND ITS MANAGEMENT**
Chairperson	:	**Dr. S. V. S. GOPALA SWAMY**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5421**

ABSTRACT

The investigation entitled, "Assessment of insecticide resistance in pulse beetle, *Callosobruchus maculatus* (Fab.) (Bruchidae: Coleoptera) and its management" was conducted at Post Harvest Technology Centre, Bapatla, Guntur district, Andhra Pradesh during the year 2016-17.

The populations of the pulse bruchid, *C. maculatus* were collected from Agricultural Research Station- Darsi, Prakasam District, Agricultural Research Station- Ghantasala, Krishna District and Regional Agricultural Research Station- Lam, Guntur District in Andhra Pradesh and maintained separately as different strains. Bioassays were conducted to know the degree of resistance acquired by the bruchid populations to the commonly used insecticides, malathion 50% EC and deltamethrin 2.8% EC. All the three strains namely; Ghantasala, Darsi and Lam strains recorded higher to moderate level of resistance of 136.83, 50.25 and 25.58 folds at LC_{50} and showed lower level with 3.24, 1.94 and 1.89 folds at $LC_{99.9}$ to malathion in comparision with Bapatla laboratory susceptible strain. With reference to deltamethrin, the Ghantasala strain recorded moderate level of resistance with 32.04 folds at LC_{50} and lower resistance with 2.14 at $LC_{99.9}$ when compared with laboratory susceptible strain. The strains of *C. maculatus* of Darsi and Lam showed lower levels of resistance with 1.07 and 1.43 folds at LC_{50} and 1.76 and 1.85 folds at $LC_{99.9}$ to deltamethrin respectively in comparison with laboratory susceptible strain. Reduced susceptibility of the three strains tested, to both malathion and deltamethrin indicated that the strains were subjected to constant selection pressure to these insecticides which are being routinely used on scheduled basis in the seed godowns. Development of resistance in all the test populations further indicates that necessary measures should be taken to delay the increase in resistance levels and extend the use of deltamethrin.

In order to identify an effective alternate insecticide for the management of resistant populations of pulse bruchid, the toxicity of newer insecticides *viz.,* spinosad 45 sc, emamectin benzoate 5 SG, diafenthiuron 50 WP, Imidacloprid 350 SC, bifenthrin 10 EC AND ß-cyfluthrin (19.81%) + imidacloprid (8.49%) was assessed by following the jute cloth disc impregnation method against ghantasala strain of *c. maculatus*. among the insecticides tested, spinosad was found effective at LC_{50} level with the highest relative toxicity of 18.443 and

28.148 folds compared to malathion and deltamethrin respectively followed by ß-Cyfluthrin + Imidacloprid (17.675 and 26.975 folds).

Among the indigenous techniques, sand layer treatment recorded nil oviposition, adult emergence and grain damage and resulted in cent per cent germination even after 180 days of treatment. Whereas neem seed powder, sweet flag rhizome bits and vasaka plant powder have recorded minimum oviposition (0.33, 0.33 and 0.67 eggs/100 grains respectively), total adult emergence (24.33, 40.67 and 54.0 no.s respectively), grain damage (1.67, 2.67 and 3.0% respectively), weight loss (3.67, 4.67 and 5.33% respectively) and germination (99.0, 98.67 and 96.67% respectively). Red earth, neem leaves and ocimum leaves treatments recorded more progeny build up (5138.0, 3583.67and 1225.67 adults respectively) and grain damage (77.0, 58.83 and 50.81% respectively) compared to the untreated control with 5627.33 adults and 83.0% grain damage. The free choice tests also confirmed that sand layer and sesamum oil treatments were superior recording no oviposition, adult emergence and grain damage.

ENTOMOLOGY

Author	:	**SIVA KUMAR, GOLLA.**
Title of the Thesis	:	**BIOCHEMICAL AND MOLECULAR MECHANISMS OF RESISTANCE TO *Helicoverpa armigera* (Hubner) IN WILD RELATIVES OF CHICKPEA**
Chairperson	:	**Dr. P. RAJASEKHAR**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5512**

ABSTRACT

The present studies on “Biochemical and molecular mechanisms of resistance to *Helicoverpa armigera* (Hubner) in wild relatives of chickpea” were carried out at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, during 2014-16. A total of 20 accessions (15 wild relatives and five varieties of cultivated chickpea) were used to evaluate the mechanism of resistance to *H. armigera*. Under field conditions, during post-rainy seasons 2014-15 and 2015-16, all genotypes of wild relatives of chickpea recorded less number of *H. armigera* larvae, low visual leaf damage rating and per cent pod damage compared to cultivated chickpea.

The genotypes IG 70012, PI 599046, IG 70022, PI 599066, IG 70006, IG 70018 (*Cicer bijugum*), ICC 506EB, ICCL 86111 (resistant checks), IG 72933, IG 72953 (*C. reticulatum*) IG 69979 (*C. cuneatum*) and IG 599076 (*C. chrossanicum*) showed high levels of antixenosis for oviposition of *H. armigera* under multi-, dual- and no-choice cage conditions.

Studies on detached leaf assay revealed that the genotypes IG 70012, IG 70022, IG 70018, IG 70006, PI 599046, PI 599066 (*C. bijugum*), IG 69979 (*C. cuneatum*), PI 568217, PI 599077 (*C. judaicum*) and ICCW 17148 (*C. microphyllum*) showed less damage rating and low larval weights compared to susceptible checks. Larval survival was greater on the wild

relatives than on the cultivated chickpea. Detached pod assay studies revealed that all wild relatives of chickpea exhibited less damage rating, lower per cent pod damage and lower percentage of weight gained by third-instar larva compared to cultivated chickpea.

Survival and development of *H. armigera* on artificial diet impregnated with lyophilized leaf powders revealed that all wild relatives of chickpea genotypes showed high levels of antibiosis to *H. armigera* compared to cultivated chickpea in terms of lower larval survival, per cent pupation and adult emergence, decreased larval and pupal weight, prolonged larval and pupal developmental periods and reduced fecundity.

Among morphological characters, glandular and non-glandular trichomes showed negative association with oviposition under multi-choice and no-choice conditions. Glandular trichomes had significant negative association with damage rating, whereas non-glandular trichomes had significant positive association with damage rating and larval weight but negative association with larval survival in detached leaf assay. Pod wall thickness showed significant negative association with damage rating and per cent pod damage in detached pod assay.

HPLC finger prints of leaf organic acids revealed a negative association of oxalic acid with oviposition, while malic acid showed positive and significant association with oviposition under multi- and no-choice conditions. Oxalic acid and malic acid had significant and negative correlation with larval survival in detached leaf assay, which indicates that higher amounts of these acids in cultivated chickpea resulted in reduced larval survival compared to wild relatives.

The flavonoid compounds *viz*., chlorogenic acid, ferulic acid, naringin, 3, 4-dihydroxy flavones, quercetin, naringenin, genestein, formononetin and biochanin A identified through HPLC finger prints exhibited negative effects on survival and development of *H. armigera* reared on artificial diet impregnated with lyophilized leaf powders. Proteins and phenols showed negative effect, while tannins and total soluble sugars showed positive effect on survival and development of *H. armigera* reared on artificial diet with lyophilized leaf powders of wild relatives of chickpea.

Zymogram analysis revealed presence of 3 to 7 trypsin inhibitor (TI) isoforms in all 20 genotypes. The genotypes, IG 70018, IG 70012, IG 70006, IG 70022, PI 599066, IG 72933, IG 72953 and IG 69979 showed higher inhibitory activity of *H. armigera* gut (HG) proteases, while genotypes PI 510663, PI 599109, PI 568217 and ICCW 17148 showed low inhibitory activity under *in vitro* conditions. Studies on hemagglutination of lectins revealed that wild relatives of chickpea genotypes showed more agglutination even at less concentration. Schiff's base staining of lectins revealed that only one isoform with a molecular weight of 29 kDa was observed in wild relatives of chickpea.

GC-MS profile peaks of leaf surface chemicals identified with hexane extracts showed 56 peaks in all genotypes. Correlation studies with detached leaf assay and oviposition preference indicated presence of feeding and oviposition repellents as well as phagostimulants and oviposition attractants. A total of 107 GC-MS profile peaks were identified with methanol extracts. Correlation studies indicated that methanol extracts had higher amount of phagostimulants and oviposition repellents than antifeedants and oviposition attractants.

The 26 SSR markers used for assessing genetic diversity of wild relatives of chickpea detected a total of 186 alleles with an average of 7.15 alleles per marker. PIC values varied from 0.21 (CaM2064) to 0.89 (CaM0958, ICCM0249 and TAA58). Gene diversity varied from 0.24 (CaM2064) to 0.90 (CaM0958, ICCM0249 and TAA58). The average observed heterozygosity was 0.20.

The dendrogram based on UPGMA showed that cultivated chickpea showed a closer genetic relation with the *C. reticulatum*, while, the species *C. microphyllum*, *C. judaicum*, *C. bijugum* and *C. pinnatifidum* were placed in other cluster. The other species *C. cuneatum* was placed in separate cluster indicated that it is distantly related to species in other two clusters.

ENTOMOLOGY

Author	:	**SRINU, K.**
Title of the Thesis	:	**MONITORING OF STEM BORER SPECIES AND THEIR EGG PARASITOIDS IN IRRIGATED RICE ECOSYSTEM**
Chairperson	:	**Dr.N. MALLIKHARJUNA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5422**

ABSTRACT

A field experiment entitled "Monitoring of stem borer species and their egg parasitoids in irrigated rice ecosystem" was conducted at Andhra Pradesh Rice Research Institute (APRRI) & Regional Agricultural Research Station (RARS), Maruteru, West Godavari district during *kharif* and *rabi,* 2016-17, respectively to study the influence of weather parameters on the occurrence of rice yellow stem borer (YSB) *Scirpophaga incertulas* (unprotected), species composition of different rice stem borers and record the occurrence of different egg parasitoids in the rice ecosystem.

Incidence of YSB observed from the 35th standard meteorological week (SMW) *i.e.*, the first week of September (1.93 % Dead hearts) and attained peak infestation during 40th SMW (7.53 % DH) and continued up to 47nd SMW with 2.07 per cent white ears during *kharif,* 2016-17, during *rabi,* 2016-17 it was started from the 4th SMW (last week of January) with 2.10 per cent DH with the peak infestation at 7th SMW (6.28 % DH) and continued up to 12th SMW (2.84 % WE).

The results of correlation studies on field infestation of YSB with weather parameters indicated that a significant and positive correlation with evening relative humidity during *kharif,* 2016-17 and there was no significant correlation was existed with other parameters during both the seasons.

The predominant stem borer larval species observed were YSB (83.14 %), DHSB (15.86 %) and PSB (1.00 %) during *kharif,* 2016-17, YSB (89.86 %) and DHSB (10.14 %) during *rabi,* 2016-17. Among the diversity indices Simpson index and Evenness indicated more diversity and no evenness among the species during both the seasons.

The relative abundance of light trap catches indicated that YSB (96.70 and 98.36 %) were more dominant followed by DHSB (3.30 and 1.64 %) and PSB *S. inference* light trap catches were nil during *kharif* and *rabi,* 2016-17, respectively.

In light trap catches, the YSB moths were appeared maximum at 38th SMW (2071) and the minimum during 34th SMW (15), DHSB moths was noticed highest at 45th SMW (81) and lowest in 41st SMW (9) during *kharif,* 2016-17. The light trap catches of YSB population had a significant and positive correlation with minimum temperature (0.631) and rainfall (0.486). In contrast, the light trap catches of DHSB population showed a significant and negative correlation with minimum temperature (-0.631) and rainfall (-0.486).

In light trap catches, the YSB moth was maximum at 15th SMW (1137) and the minimum at 6th SMW (27). DHSB moth was highest at 12th SMW (17) and lowest was observed at 6, 7, 8 and 9th SMWs (5) during *rabi,* 2016-17. Light trap catches of YSB population had a significant and positive correlation with minimum temperature (0.549) and evening relative humidity (0.687). In reverse, DHSB adult population established a significant and positive correlation with morning relative humidity (0.617) and significant and negative correlation with maximum temperature (-0.820).

In pheromone trap, YSB male moth catches were maximum at 42nd SMW (18), 7th and 9th SMW (8) during *kharif* and *rabi,* 2016-17, respectively. Pheromone trap catches of YSB moths showed a significant and negative correlation with morning relative humidity (-0.638) during *kharif,* 2016-17.

Among the stem borer species, YSB egg mass was parasitized by, *Telenomus spp, Trichogramma spp,* and *Tetrastichus spp,* between 34th to 51th SMW. *Telenomus spp* (42.1 per cent and 37.4 per cent) effected maximum egg parasitism followed by *Tetrasticus Spp* (0.2 per cent and 3.3 per cent) and *Trichogramma spp* (0.00 per cent and 7.5 per cent) during kharif and rabi 2.16-17. However, the DHSB was parasitized only by *Trichogramma spp*. alone between 47th to 51th SMW (27.92 to 51.66 per cent).

ENTOMOLOGY

Author	:	**SUNEEL KUMAR, G.V.**
Title of the Thesis	:	**DEVELOPMENT OF LIFE TABLES FOR STEM BORER, *CHILO PARTELLUS* (SWINHOE) ON PROMISING GENOTYPES OF MAIZE AND ITS MANAGEMENT WITH BIORATIONAL INSECTICIDES**
Chairperson	:	**Dr. T. MADHUMATHI**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number		**D5416**

ABSTRACT

Investigations on life tables, seasonal incidence, crop loss estimation and management of maize stem borer, *Chilo partellus* (Swinhoe) with biorational insecticides were carried out at Agricultural Research Station, Darsi, Prakasam district during *kharif* and *rabi* 2014-15 and 2015-16.

Total life cycle of *C. partellus* (egg to adult emergence) was completed in 54.5, 54.0, 51.5, 51.4, 55.0 and 48.6 days in *kharif* and 58.7, 59.5, 56.8, 57.5, 58.8 and 53.3 days in *rabi* on DHM 117, DHM 121, Madhuri, Priya, Amber and 30V92, respectively.

Forty eight life-tables were constructed for *C. partellus* on six maize cultivars *viz*., DHM 117, DHM 121, Madhuri sweet corn, Priya sweet corn, Amber pop corn and 30V92. In each season of *kharif* and *rabi* 2014-15 and 2015-16 two generations of the pest were studied. The survivorship curves drawn for all the generations in each year indicated that the mortality rate was higher at the small larval stage. Generation survival declined from first generation in first crop during *kharif* 2014 to second generation in fourth crop during *rabi* 2015-16 in all maize cultivars. The trend index was positive (more than one) and varied in all generations. Key factor analysis revealed major mortality factors influencing population fluctuation included larval parasitoid particularly *Cotesia flavipes* and unknown causes during small and medium larval stage. Density dependant related mortality was observed in the life cycle of *C. partellus*. The lowest mean total K value (0.45) was observed on 30V92 maize cultivar. Correspondingly, the highest mean values of generation survival (0.38) and the trend index (40.2) were obtained on 30V92 cultivar indicate more susceptibility to *C. partellus*. The high mean total K (0.59) and lowest generation survival (0.27) and the trend index values (25.2) were observed on Amber pop corn.

C. partellus larval population, per cent infestation and per cent larval parasitism differed between years and seasons on maize. Natural enemies were recorded in more numbers when pest population was high. Larval population and plant infestation by *C. partellus* exhibited significant negative correlation with minimum temperature on average basis of two years during *kharif*. Maximum temperature had significant positive correlation with plant infestation on average basis of both study years in *rabi* season. Morning and evening relative humidity showed significant positive correlation with plant infestation on cumulative basis of both *kharif* 2014 and 2015, while evening relative humidity showed significant negative correlation during *rabi* 2014-15 and 2015-16 pooled analysis. Cumulative basis of two study years in *kharif*, parasitism by *C. flavipes* showed a significant positive correlation with larval population and plant infestation, whereas pooled average of *rabi* 2014-15 and 2015-16, larval parasitoid had significant positive correlation with larval population only and non-significant positive correlation with plant infestation.

Natural infestation of *C. partellus* resulted in the yield loss of 56.69 and 3.19 in grain yield and 100-grain weight, respectively across the different dates of sowing. The unprotected plot recorded significantly higher dead heart incidence (9.30 and 2.38%), larval population (1.89 and 0.65 per plant), foliage damage (43.08 and 22.24%), stem tunneling (11.72 and 3.30%) and exit holes (2.55 and 0.84) as compared to protected ones. The per cent grain yield loss increased with increase in larval density. The maximum loss in grain yield (45.68%) and 100-grain weight (19.25%) occurred in the treatment with 8 larvae per plant. The economic injury level was worked out at 2.74 larvae per plant.

Among the botanical pesticides, entomogenous microbes, insect growth regulators and natural insecticides in the management of *C. partellus* in maize, foliar application of

chlorantraniliprole 18.5% SC, spinosad 45% SC and whorl application of chlorantraniliprole 0.4% GR significantly reduced the damage of *C. partellus* and larval population over untreated control. The marginal increase in maize grain yield was in the order of 108.1, 99.8 and 88.4 per cent, respectively for the treatments chlorantraniliprole 18.5% SC, spinosad 45% SC and chlorantraniliprole 0.4% GR over untreated check. The population of natural enemies *viz*., *C. transversalis*, *C. sexmaculata* and predatory spiders remain unaffected by these biorationals. The incremental cost benefit ratio was 12.28 in chlorantraniliprole 18.5% SC which was next best to monocrotophos 36% SL (19.52).

ENTOMOLOGY

Author	:	**SWAROOPA, KANAPARTHI.**
Title of the Thesis	:	**STUDIES ON THE INCIDENCE OF MAJOR INSECT PESTS AND THEIR NATURAL ENEMIES IN GROUNDNUT (*ARACHIS HYPOGAEA* L.) – COWPEA [*VIGNA UNGUICULATA* (L.) WALP.] INTERCROPPING SYSTEM**
Chairperson	:	**Dr. C. SANDHYA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5420**

ABSTRACT

A field experiment entitled **"Studies on the incidence of major insect pests and their natural enemies in groundnut (*Arachis hypogaea* L.) – cowpea [*Vigna unguiculata* (L.) Walp.] intercropping system"** was conducted at Agricultural College Farm, Bapatla during *kharif,* 2016. Groundnut and cowpea were raised in different ratios *i.e*., 3:1, 7:1 and 11:1 ratios of groundnut + cowpea intercropping systems along with groundnut and cowpea sole crops, to study the incidence of different pests and natural enemies in both groundnut and cowpea crops among all intercropping systems compared with sole crops.

Among all intercropping ratios, the 7:1 ratio of groundnut + cowpea intercropping system showed lower mean population of almost all the pests. The lower mean population of thrips (2.90 and 3.10 thrips/plant) was recorded in both groundnut and cowpea crops, respectively in 7:1 ratio as compared to the groundnut (4.29 thrips/plant) and cowpea (4.08 thrips/plant) sole crops. The 7:1 and 11:1 ratios of intercropping systems recorded lower mean population of leaf hoppers in groundnut (4.08 and 4.50 leaf hoppers/ plant, respectively) and cowpea (7.83 and 6.75 leaf hoppers/ plant, respectively) when compared to the groundnut (5.58 leaf hopper/plant) and cowpea (10.64 leaf hoppers/plant) sole crops. The lower mean aphid population in cowpea was recorded in 7:1 ratio (14.22 aphids/ plant on leaves and 18.71 aphids/ plant on shoots) when compared to cowpea sole crop (23.20 aphids/ plant on leaves and 34.01 aphids/plant on shoots). The 7:1 ratio recorded lower mean population of looper *i.e.,* 0.49 and 0.38 larvae/ plant in groundnut and cowpea crops, respectively when compared to the

groundnut (1.53 larvae/plant) and cowpea (0.33 larvae/plant) sole crops. The least per cent damage of looper was recorded in 7:1 ratio (12.10 and 10.20 per cent damages in groundnut and cowpea crops, respectively). The 7:1 ratio recorded lower mean population (0.39 larvae/plant) and per cent damage (5.20 %) of *Spodoptera litura* when compared to the groundnut sole crop recorded 0.72 larvae/ plant and 9.19 per cent damage. The cowpea sole crop observed highest mean population of *Helicoverpa armigera i.e.,* 1.50 larvae/ plant and 12.68 per cent damage when compared to the 11:1 (0.69 larvae/plant and 3.62%) and 7:1 (0.80 larvae/plant and 4.50%). Significantly lesser larval population, least number of webs and least per cent damage of *Maruca vitrata* was observed in 11:1 and 7:1 ratios of intercropping systems *i.e*., 1.22 and 1.58 larvae/ plant, 1.64 and 1.87 webs/ plant and 19.1 and 18.5 per cent damages, respectively when compared to the cowpea sole crop which recorded 3.08 larvae/ plant with 3.23 webs/ plant and 33.8 per cent damage.

The 3:1 ratio of groundnut+ cowpea intercropping system recorded comparatively lower mean larval population of *Aproaerema modicella* (0.54 larvae/ plant) and leaf damage (7.70%) when compared to the groundnut sole crop where the highest mean larval population (1.74 larvae/ plant) and per cent damage (14.57 %) recorded. In cowpea, significantly lower stemfly population was recorded in 11:1 (1.60 flies/plant) ratio followed by 7:1 (1.68 flies/plant) ratios when compared to cowpea sole crop (3.46 flies/ plant). The moderate per cent damage on leaves due to stemfly recorded in 7:1 (76.75 %) and 11:1 (77.98 %) ratios and its least per cent plant damages were recorded in 7:1 (21.18%) and 11:1 (15.87%) ratios of intercropping. Significantly, higher mean larval population of leaf roller was observed in cowpea sole crop which recorded 0.52 larvae/ plant when compared to the 7:1 (0.20 larvae/plant) and 11:1 (0.27 larvae/plant).

The coccinellid population was observed to be very less in groundnut sole crop which recorded 0.09 coccinellids/plant when compared to the 3:1 (1.63 coccinellids/plant) and 7:1 (1.20 coccinellids/plant) ratios where the cowpea sole crop also recorded higher population of coccinellids (2.34 coccinellids/ plant). The lower population of spiders was recorded in groundnut sole crop (0.62 spiders/ plant) and significantly highest population recorded in groundnut at 3:1 (1.48 spiders/ plant) and 7:1(1.34 spiders/ plant) ratios where the cowpea sole crop also recorded high population of spiders (2.04 spiders/ plant).

Thus 7:1 ratio can be considered as recommendable ratio of intercrop for groundnut, because of the higher net returns (Rs 63988) and B: C ratio (1:3.10).

The presence of parasitoids in groundnut + cowpea intercropping system was confirmed by the collection of parasitoids belonging to the families *viz.,* Eulophidae, Encyrtidae (*Ooencyrtus* sp. Ashmead*, Aenacius* sp. Walker, *Copidosoma* sp. Ratzeburg), Eurytomidae, Platygasteridae, Trichogrammatidae, Mymaridae (*Anagrus* sp. Haliday*, Erythmelus* sp. Enock *, Omyomymar* sp. Schauff*, Mymar* sp. Curtis*, Gonatocerus* sp. Nees), Bethylidae, Ceraphronidae, Braconidae and Ichneumonidae by using yellow open pan trap.

Correlation studies between weather parameters and pests and the natural enemies of groundnut and cowpea crops revealed that the maximum temperature showed non significant positive correlation with almost all the pests but, the stemfly showed significant positive correlation with maximum temperature and rainfall and the regression relationship between weather parameters and pests and the natural enemies of both crops revealed that only maximum and minimum temperature exerted influence on maximum population of pests and natural enemies.

ENTOMOLOGY

Author	:	**VAMSI CHANDRASEKHAR REDDY, DAGGUMATI**
Title of the Thesis	:	**STUDIES ON PHYSICO-CHEMICAL POD CHARACTERS OF PIGEONPEA AGAINST PODFLY, *Melanagromyza obtusa* (Malloch) AND ITS MANAGEMENT**
Chairperson	:	**Dr. M. SREEKANTH**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5419**

ABSTRACT

A field experiment entitled "Studies on physico-chemical pod characters of pigeonpea against podfly, *Melanagromyza obtusa* (Malloch) and its management" was conducted at Regional Agricultural Research Station, Lam, Guntur during *Kharif,* 2016-17.

Fourteen pigeonpea genotypes were screened and their morphological and biochemical parameters were studied to know the influence on podfly infestation. Similarly, the time of application of insecticide for the management of podfly was also studied.

Among fourteen pigeonpea genotypes, WRP 1, ICPHaRL 4985-11, ICPHaRL 4985-10, ICPHaRL 4989-7, LRG 52, CO 6, ICP 11957 and BRG 10-2 were found to be resistant as they recorded lowest mean pod and grain damage ranging from 9.33 to 23.67 per cent and 4.78 to 13.00 per cent, respectively with pest susceptibility rating ranging from 1 to 5. The per cent weight loss in grains due to podfly ranged between 54.70 (ICPHaRL 4985-10) to 71.30 (ICPL 87119) with a mean weight loss of 61.38 per cent. The mean number of maggots and pupae per pod ranged from 0.04 (WRP 1) to 0.51 (GRG 2013) and 0.10 (LRG 52) to 0.54 (GRG 2013) in different genotypes, respectively. The genotype, ICPHaRL 4985-10 recorded maximum yield (1761.34 kg ha^{-1}) followed by BRG 10-2 (1640.74 kg ha^{-1}), ICPHaRL 4989-7 (1638.66 kg ha^{-1}), WRP 1 (1533.56 kg ha^{-1}), ICPHaRL 4985-11 (1475.23 kg ha^{-1}) and LRG 41 (1459.33 kg ha^{-1}).

Among the various morphological and biochemical parameters, pod wall thickness, trichome length, trichome density, pod wall phenols and seed phenols showed a significant negative correlation, whereas, seed length, seed width, number of seeds damaged per pod and seed protein content showed a significant positive correlation with podfly infestation, indicating that genotypes having thick pod walls, long and more trichomes, small seeds, with high phenol and low protein content offered resistance to podfly.

Scrutiny results on management of podfly revealed that the insecticide dimethoate 30 EC @ 2 ml l^{-1} applied at 2, 3, 4 and 5 weeks after 50% flowering was found most effective in reducing pod and grain damage due to podfly with more yield. However, the same insecticide

applied twice at 3 and 4 weeks after 50% flowering was most promising and can be recommended, as it registered more ICBR.

ENTOMOLOGY

Author	:	**VENKATARAMANAIAH, P.**
Title of the Thesis	:	**EFFECTIVE MONITORING STRATEGY FOR SOUTH AMERICAN TOMATO LEAF MINER, *Tuta absoluta* (Meyrick) (LEPIDOPTERA : GELECHIIDAE) THROUGH PHEROMONE TRAPS**
Chairperson	:	**Dr. S.R. KOTESWARA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5513**

ABSTRACT

The present studies on assessing of efficacy of pheromone trap type and height of erection, effective concentration and changing interval of pheromone lure, seasonal incidence and spatial distribution of South American tomato leaf miner, *Tuta absoluta* (Meyrick) were carried out during *rabi*, 2016 in farmer's field at Piler and Kalikiri in Chittoor district (Andhra Pradesh).

The delta, sleeve and wota T traps were installed in tomato crop (Sweakar-448) at Piler to assess the efficacy of trap type and height of erection. The highest moth catches were observed during 44th standard week (204.00 moths/trap) and lowest moth catches were during 3rd standard week (8.00 moths/trap). The delta trap (58.94 moths/trap) installed at crop canopy level caught highest moth catches of *T. absoluta* followed by sleeve trap (48.94 moths/trap) installed at crop level and lowest moth catches were recorded in wota T (3.92 moths/trap) trap installed at 60 cm above the crop canopy level.

Studies on evaluation of different pheromone lure concentrations and replacement period of lures reported that highest and lowest moth catches were recorded during 44th and 4th standard week with 154.00 and 6.00 moths/trap, respectively. The higher moth catches were recorded in two mg pheromone lure replaced for every 15 and 30 days (41.36 and 35.22 moths/trap) and lowest moth catches were recorded in one mg pheromone lure replaced for every 45 days (21.22 moths/trap).

The correlation studies between weather parameters and pheromone trap catches revealed that maximum temperature, minimum temperature and morning relative humidity showed non-significant positive association with pheromone trap catches. The pheromone trap catches showed significant negative association with evening relative humidity and rainfall. The sunshine hours showed non-significant positive association and wind velocity showed non-significant negative association with trap catches of *T. absoluta*. Maximum and minimum temperature showed significant positive association while evening relative humidity showed

significant negative association with fruit infestation. The pheromone trap catches exhibited significant positive association with leaf infestation while non-significant positive association with fruit infestation.

The highest per cent leaf and fruit infestation of South American tomato leaf miner, *T. absoluta* was observed during 11th and 14th standard weeks, respectively. The larval infestation mostly confined to top canopy level when compared to bottom canopy of tomato crop.

Studies on spatial distribution of tomato pinworm, *T. absoluta* studied during *rabi*, 2016 in farmer's field. The selected descriptive statistical indices *viz.,* Mean, Variance, Variance mean ratio, David and Moore's index, Lloyd's index of mean crowding, Lloyd's index of patchiness, Lexis index and Charlier coefficient showed aggregated or clumped distribution throughout the crop period.

ENVIRONMENTAL SCIENCE

Author	:	**JAYA, K.**
Title of the Thesis	:	**STUDIES ON SEWAGE WATER OF GUNTUR MUNICIPAL CORPORATION ON SOIL PROPERTIES AND QUALITY OF FODDER GRASS**
Chairperson	:	**Dr. G. RAMACHANDRA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5540**

ABSTRACT

The present study entitled "Studies on sewage water of Guntur Municipal Corporation on soil properties and quality of fodder grass" was undertaken at Department of Environmental Science, Advanced Post Graduate Centre, Guntur during 2016-17 to assess the impact of municipal sewage on soil, water and fodder grass. The samples were collected from eight locations from Guntur municipal sewage flow area and analysed for physico-chemical and chemical characteristics. Sample points include Reddypalem, Ring road, Autonagar, Nandivelugu, Manasa Sarovaram, Ponnur road, Lakshmipuram and Collector office road. The pH of soils irrigated with sewage water was neutral in reaction ranging from 7.1 to 8.5. The variation in pH values were due to contamination with sewage water. The electrical conductivity of sewage water irrigated soil was 0.71 to 2.12 of dSm^{-1}. The soils were saline in nature. Organic carbon content of sewage irrigated soils was high with a range from 0.5 to 0.9 per cent which indicates medium range of organic matter in soils. Nutrient status was assessed with respect to macronutrients (N,P,K,S), micro nutrients (Zn, Cu, Fe, Mn) and heavy metals (Pb, Ni, Cr).

The available nitrogen, phosphorus, potassium and sulphur content in sewage irrigated soils were varied from 188 to 502, 9.85 to 22.10, 739 to 1301 and 3.92 to 9.17 kg ha^{-1} respectively. Available nutrients were moderately high to high in sewage irrigated soils. The micronutrients viz., zinc, iron, manganese and copper were in the range of 0.33 to 1.60, 5.08 to 14.32, 2.12 to 6.85 and 1.59 to 5.49 ppm respectively. Soil samples analysed for Zn was below the permissible limits whereas Fe, Mn and Cu were above the permissible limits. The concentration of total heavy metals like Cr, Ni and Pb were in the range of 0.3 to 0.9, 5.1 to 18.7 and 2.4 to 11.46 ppm respectively. The total heavy metals levels in soil were below toxic levels considering threshold metal levels.

The pH, EC, BOD, COD, SAR and RSC of the sewage waters were within permissible limits. The mean concentration of calcium, magnesium, sodium and potassium contents in sewage water were 4.4, 3.8, 5.61 and 1.06 me L^{-1} respectively which were in safe limits for irrigation. The mean anions concentration in sewage water was 6.9, 7.5, 1.63 me L^{-1} and 62.1 mgL^{-1} for bicarbonate, chloride, sulphate and nitrates respectively. The carbonates were not detectable in sewage water. All anions except chloride and nitrates were in the safe limits. Chloride content was more than 4 meL^{-1} whereas, nitrate content was more than 40 mg L^{-1} which may pose slight restriction for irrigation purpose.

Nitrogen, phosphorus, potassium and sulphur content in fodder grass irrigated with sewage water ranged from 0.84 to 1.68, 0.07 to 0.18, 1.5 to 1.7 and 0.24 to 0.56 percent respectively. The concentration of micronutrients viz., zinc, iron, manganese and copper in sewage irrigated fodder grass were in the range of 24.28 to 57.20, 598 to 975, 34.2 to 58.9 and 24.6 to 46.2 ppm respectively. All the micronutrients were found below toxic level. Chromium, nickel and lead concentration in sewage irrigated fodder grass were in the range of 2.2 to 5.1, 0.7 to 2.0 and 1 to 2.7 ppm respectively indicating that all metals were below toxic limit. The yield of fodder grass ranged from 9730 to 19380 kg ha^{-1}. Fodder samples collected from sewage irrigated soil had higher levels of nitrogen, phosphorus, potassium and sulphur contents as compared to the fodder unirrigated with sewage water. The micronutrients and heavy metal contents were also higher in sewage water irrigated fodder but were not high enough to be categorized under toxic level. Quality of fodder grass was not affected by application of sewage water.

GENETICS AND PLANT BREEDING

Author	:	**ANAMIKA ROY**
Title of the Thesis	:	**GENETIC DIVERSITY ANALYSIS AND IDENTIFICATION OF SSR MARKERS LINKED TO LATE LEAF SPOT AND RUST DISEASES IN GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. M. LAL AHAMED**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5430**

ABSTRACT

The present investigation was carried out during *kharif* 2016 to study the variability, heritability, genetic advance as per cent of mean, character association, path coefficient analysis and genetic divergence among 33 genotypes of groundnut for eleven characters *viz.,* days to 50 % flowering, SCMR 40 DAS, SCMR 50 DAS, SCMR 60 DAS, SCMR 70 DAS, days to maturity, harvest index, shelling percentage, 100 kernel weight (g), kernel yield per plant (g) and oil content (%) and these genotypes were screened for resistance to late leaf spot and rust diseases of groundnut during *rabi* 2016-17 at RARS, Tirupati. Thirty SSR markers were used for analyzing molecular diversity and their association with LLS and rust.

Screening for LLS and rust revealed that seven genotypes were moderately resistant to LLS and five genotypes were moderately resistant to rust. Susceptible reaction to LLS was conferred by twenty two genotypes whereas twenty four genotypes conferred susceptible reaction against rust. The genotype, TMV-2, was highly susceptible to both LLS and rust. Thus, four genotypes *viz.*, ICG 1710, ICG 1707, ICG 6475 and ICG 1079 showing moderate resistant reaction to both the diseases can be selected as donor parents in hybridization programmes.

Analysis of variance revealed significant differences among the genotypes for all the characters studied indicating a high level of variability in the material. High PCV and moderate GCV were observed for kernel yield per plant. The estimates of heritability and genetic advance as per cent of mean were high for the characters, days to 50 % flowering, SCMR 70 DAS, harvest index and kernel yield per plant indicating these are traits are under the control of additive gene action and selection may be effective for the improvement of these traits.

Phenotypic correlations in general were higher than the genotypic correlations indicating presence of environmental influence on the expression of the traits. Significant positive association with kernel yield per plant was recorded for the traits, SCMR 60 DAS, harvest index, shelling percentage, 100 kernel weight and oil content at both genotypic and

phenotypic levels. Thus, selection for any of these traits will lead to simultaneous improvement of correlated trait and in turn kernel yield per plant.

Path coefficient analysis revealed strong positive correlation and direct effect of harvest index, shelling percentage and 100 kernel weight on kernel yield per plant. Therefore, these traits serve as good indicators for selection in any breeding programme.

Genetic diversity studies using Mahalanobis's D^2 statistic grouped the genotypes into six clusters. The maximum contribution towards genetic divergence was recorded from the traits, 100 kernel weight followed by days to 50 % flowering and harvest index. Based upon the inter-cluster distance, most divergent clusters were clusters V and VI and genotypes from these two clusters can be included in hybridization programme in order to get more heterotic combinations.

Molecular diversity analysis with thirty SSR markers grouped the genotypes into three major clusters. The genotypes were grouped irrespective of their disease reaction to LLS and rust. Out of the thirty SSR markers, IPAHM103 and PM 375 exhibited association with disease resistance where IPAHM103 co-segregated with LLS and rust phenotype and PM 375 showed general resistance to a wide variety of biotic stresses. Thus, these two markers can be successfully used for identification and transfer of positive alleles in molecular breeding programme.

GENETICS AND PLANT BREEDING

Author	:	**APARNA, P.**
Title of the Thesis	:	**EVALUATION OF MINICORE COLLECTION OF GROUNDNUT UNDER ORGANIC AND INORGANIC FERTILIZER MANAGEMENTS**
Chairperson	:	**Dr. M. SHANTHI PRIYA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5515**

ABSTRACT

The present investigation was undertaken to generate information on variability and genetic parameters, character association and path analysis in 168 genotypes and five checks of groundnut under organic and inorganic fertilizer managements separately. The experiment was conducted at dryland farm of S.V. Agricultural college, Tirupati, during *kharif* 2016.

Analysis of variance in respect of 14 characters revealed the existence of significant differences among the entries for all the characters under both organic and conventional fertilizer managements except for number of primary branches per plant, shelling percentage

and harvest index which were non-significant under organic fertilizer management and significant under inorganic fertilizer management indicating the presence of considerable amounts of genetic variation for different traits in the present material. Based on mean performance the genotypes viz., ICG-13099, ICG-13942, ICG-13723, ICG-10384 and ICG-11687 under organic management whereas under inorganic fertilizer management the genotypes viz., ICG-434, ICG-13942, ICG-11651, ICG-12879 and ICG-332 were found promising for yield and its contributing characters.

The high estimates of GCV and PCV were recorded for number of immature pods per plant, kernel yield per plant, pod yield per plant, number of mature pods per plant, number of pegs per plant, total number of pods per plant under both the managements; for 100 seed weight and plant height under organic management and for number of primary branches per plant under inorganic fertilizer management indicated the presence of genetic variability for these traits and less influence of environment.

High heritability coupled with high genetic advance as per cent of mean was observed for the characters days to 50% flowering, 100 kernel weight, plant height, number of mature pods per plant, number of immature pods per plant and total number of pods per plant under both the fertilizer managements. Similarly high heritability coupled with high genetic advance as per cent of mean was observed for pod yield per plant under organic management and for number of primary branches per plant and shelling percentage under inorganic fertilizer management. This indicated the preponderance of additive gene action and selection may be rewarding for improvement of these traits. Further, moderate heritability coupled with high genetic advance as per cent of mean was observed for number of pegs per plant, kernel yield per plant and sound mature kernel percentage under both the fertilizer managements, while the traits viz., harvest index and pod yield per plant also recorded moderate heritability coupled with high genetic advance as per cent of mean under inorganic fertilizer management. Improvement can be brought about in these traits through simple pedigree method of breeding and phenotypic selection would be effective.

The character association analysis revealed that significant positive association of harvest index, 100 seed weight, number of mature pods per plant, total number of pods per plant, shelling percentage, number of pegs per plant and kernel yield per plant with pod yield per plant under both the fertilizer managements, indicating the possibility for simultaneous selection of these characters would result in improvement of pod yield in the genotypes under both organic and inorganic fertilizer managements.

Path analysis revealed that kernel yield per plant under organic management and kernel yield per plant and total number of pods per plant under inorganic fertilizer management recorded high positive direct effects on pod yield per plant. Thus, emphasis could be given for these characters during selection in order to improve pod yield under both organic and inorganic fertilizer managements.

GENETICS AND PLANT BREEDING

Author	:	**BHEEMESH, S.J.**
Title of the Thesis	:	**STUDIES ON GENETIC DIVERGENCE AND CHARACTER ASSOCIATION FOR YIELD AND DROUGHT RELATED TRAITS IN FOXTAIL MILLET (Setaria italica L.).**
Chairperson	:	**Dr. M. SUBBA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5516**

ABSTRACT

The present investigation was undertaken in Foxtail millet during *kharif,* 2016 to study genetic variability, genetic divergence, character association and path analysis in sixty germplasm lines including seven checks for different morpho-physiological characters related to drought tolerance along with yield and yield components.

The genotypes SiA 3636, Sri Lakshmi, Narasimharaya, SiA 3598 and SiA 3604 recorded superiority for most of the traits. Five genotypes *viz.,* Prasad, SiA 3580, SiA 3604, SiA 3618 and SiA 3623 showed the highest thermo tolerance in terms of 75 to100 per cent seedlings survival with minimal reduction in root and shoot growth. From the experiment using polyethylene glycol (PEG) induced drought stress technique, Suryanandi, Prasad, SiA 3551 and SiA 3615 showed the highest germination per cent, lower reduction of plumule and radicle length. These varieties are able to survive even when they were exposed to high drought conditions.

Higher GCV, PCV, heritability and genetic advance as per cent mean were recorded for test weight, membrane injury at 30 DAS, fodder yield, ear bearing tillers per hill and grains per ear head indicating that simple selection could be practiced for improving these traits under rainfed condition.

All the genotypes were grouped into 13 clusters based on D^2 analysis. The inter-cluster distance was maximum between cluster IX and IV followed by cluster II and I. Selection of parents from such clusters for hybridization programmes would result in novel recombinants. Relative membrane injury contributed maximum towards genetic divergence.

Fodder yield per plant, number of grains per ear head, test weight, ear bearing tillers per hill, days to maturity, SPAD chlorophyll meter reading and relative water content exhibited highly significant positive association with grain yield per plant. Fodder yield per

plant, test weight, number of grains/ ear head, SPAD chlorophyll meter reading and relative water content exerted maximum positive direct effect on grain yield besides other traits. Hence, emphasis should be made on these traits in the selection programme to evolve high yielding genotypes in foxtail millet under rainfed condition.

GENETICS AND PLANT BREEDING

Author	:	**CHAITANYA NIRUJOGI**
Title of the Thesis	:	**GENETIC DIVERGENCE FOR YIELD AND YIELD COMPONENTS AND PHENOTYPING AGAINST LEAF BLIGHT IN MAIZE (*Zea mays* L.) INBREDS**
Chairperson	:	**Dr. D. RATNA BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5438**

ABSTRACT

Present investigation was carried out during *kharif* 2014-15 at Agricultural College Farm, Bapatla with the prime objective of grouping the 50 genotypes of maize (*Zea mays* L.) into distinct classes based on their genetic diversity. Other genetic parameters like mean, genetic variability, heritability, genetic advance as per cent of mean, character association and the magnitude of direct and indirect effects of yield component traits on kernel yield were also studied. Further, phenotyping against Northern Corn Leaf Blight (NCLB) was also carried out.

Analysis of variance indicated significant differences except for days to 50% silking among 50 genotypes for all the characters studied. High PCV and GCV were recorded for kernel yield per plant and kernels per row while moderate PCV and GCV were recorded for test weight, cob length, plant height andkernel rows per cob indicating that there is considerable amount of variability for majority of the characters studied.

The estimates of high heritability coupled with low genetic advance as per cent of mean were recorded by days to 50% tasseling and days to 50% silking indicating the operation of both additive and non-additive gene actions. Days to maturity exhibited moderate heritability and low genetic advance as per cent of mean indicating the predominance of non additive gene action in controlling this trait. While the remaining six traits *viz.,* plant height, cob length, kernel rows per cob, kernels per row, test weight and kernel yield per plant recorded high heritability and high genetic advance as per cent of mean indicating the predominance of additive gene action and hence direct phenotypic selection is useful with respect to these traits.

The traits, cob length, kernel rows per cob, kernels per row, test weight and plant height were found to possess significant positive association with kernel yield per plant at both genotypic and phenotypic levels. Further, path analysis studies revealed that test weight, kernels per row, kernel rows per cob and plant height showed true relationship with kernel yield per plant by establishing significant positive association and high positive direct effect at both genotypic and phenotypic levels. Considering the nature and magnitude of character associations and their direct and indirect effects, it can be inferred that test weight, kernels per row, kernel rows per cob and plant height could serve as important traits in any selection programme for developing high yielding varieties in maize.

The phenotyping against Northern Corn Leaf Blight (NCLB) revealed that nine genotypes *viz.,* BM-96, BM-128-1, BM-201, BM-261, RNBL-4141, RNBL-4211, BLSB-4, CM-119 and Ra-36 are resistant to NCLB. These genotype could be utilized as donars for transfer of disease resistance into superior inbreds. These genotypes as well can be utilized in hybridization programmes under different breeding methods particularly for production of heterotic hybrids provided they are divergent enough genetically and having good *per se* for kernel yield and yield contributing characters.

The results of multivariate analysis revealed considerable genetic divergence among the 50 genotypes studied. Both D^2analysis and Ward's method grouped the 50 maize genotypes into eight clusters. However, the clusters are different in different methods with respect to total number as well as the genotypes included in each cluster.PCA revealed that the first four principal components contributed 84.87 per cent towards the total variability. The 2D and 3D plots obtained by PCA showed that the genotypes Ra-15-2, BLSB-12, BM-121 and BM-66-1 were scattered relatively away from other genotypes confirming the Tocher's clustering pattern and signifying their usefulness in maize breeding to develop heterotic hybrids.

Taking both methods of clustering into consideration, it can be concluded that crosses *viz.*, BLSB-4 x RNBL-4201, BLSB-4 x Ra-36, BM-261 x RNBL-4201 and BM-261 x Ra-36 are having good chance of producing heterotic hybrids or good transgressive segregants with resistance to northern corn leaf blight. Further, both the methods of clustering had similar conclusion that the geographical divergence and genetic divergence are least correlated.

GENETICS AND PLANT BREEDING

Author	:	**DADA AZMI, SHAIK.**
Title of the Thesis	:	**GENETIC DIVERGENCE STUDIES IN COTTON (*Gossypium hirsutum* L.) FOR YIELD AND YIELD COMPONENTS**
Chairperson	:	**Dr. B. GOVINDA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5429**

ABSTRACT

The present investigation was carried out during *kharif,* 2016-17 at Regional Agricultural Research Station, Lam farm, Guntur, Andhra Pradesh to characterize 40 genotypes of cotton (*Gossypium hirsutum* L.), to study the variability, heritability, genetic advance as per cent of mean, genetic divergence, character association and the magnitude of direct and indirect effects of fifteen yield component traits with seed cotton yield per plant *viz.,* plant height (cm), days to 50% flowering, number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), ginning out-turn (%), seed index (g), lint index (g), 2.5% span length (mm), micronaire (10^{-6}g/in), bundle strength (g/tex), uniformity ratio, seed cotton yield per plant (g) and lint yield per plant (g).

The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the masking effect of the environment. High heritability coupled with moderate genetic advance was observed in case of micronaire, 2.5% span length and bundle strength revealing the role of additive and non additive gene action. The other traits viz., number of monopodia per plant, number of sympodia per plant, number of bolls per plant and boll weight showed moderate heritability and moderate genetic advance. This indicates the presence of additive and non-additive gene action and further improvement of these traits would be possible through heterosis breeding rather than simple selection.

Correlation study indicated that plant height, days to 50% flowering, number of sympodia per plant, number of bolls per plant, boll weight, ginning out turn, seed index, lint index, micronaire, bundle strength, uniformity ratio and lint yield per plant had positive significant association with seed cotton yield per plant.

Path coefficient analysis revealed that days to 50% flowering, bundle strength, number of bolls per plant, number of sympodia per plant, plant height and number of monopodia per plant exerted highest positive direct effect on seed cotton yield per plant followed by, ginning out-turn, seed index, lint index and micronaire. Direct selection based on these attributes may be helpful in evolving high yielding varieties of upland cotton.

The results of multivariate analysis indicated the presence of considerable genetic divergence among the 40 genotypes studied. The 40 genotypes were grouped into seven clusters by using *Tocher's* method in D^2 analysis which indicated that the genetic diversity and geographical diversity were not related.

By Mahalanobis' D^2 statistic, it could be inferred that seed index, days to 50% flowering, boll weight, 2.5% span length and micronaire contributed maximum towards genetic divergence. Based on intra-and inter-cluster distance among the groups, it is suggested to make crosses between the genotypes of cluster VI (ARBH 1402) and cluster VII (HYPS 152), between genotypes of cluster I (SSGR 105) and cluster VIII (L 788), between the genotypes of cluster I (SSGR 105) and cluster IV (L 799), between the genotypes of cluster V (GJHV 497) and cluster VIII (L 788) after confirming their general combining ability.

Principal component analysis identified six principal components (PCs) which contributed 81.99 per cent of cumulative variance. The significant factors loaded in PC_1 towards maximum genetic divergence were seed cotton yield per plant, bundle strength, lint

index, micronaire, number of bolls per plant, number of sympodia per plant, plant height and uniformity ratio. The 2D and 3D graphs showed wide divergence among the F-2522, TCH-1716, ARBH-1501, HS-296, CPD-1502 and GJHV-517 signifying their usefulness in cotton breeding to develop high heterotic hybrids.

The fore mentioned six genotypes showed maximum inter-cluster distance in Mahalanobis'D^2 analysis, principal component analysis and cluster analysis and also for better performance for number sympodia per plant, number of bolls per plant, boll weight, seed index, lint index and quality characters. So they could be exploited for the development of heterotic hybrids in future breeding programmes.

GENETICS AND PLANT BREEDING

Author	:	**DIVYA, VAKA .**
Title of the Thesis	:	**GENETIC DIVERGENCE IN RABI SORGHUM (*Sorghum bicolor* (L.) Moench)**
Chairperson	:	**Dr. J. DAYAL PRASAD BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5434**

ABSTRACT

The present investigation was carried out during *rabi* 2016-2017 at Agricultural college farm, Bapatla with 50 genotypes of *rabi* Sorghum to elicit information on the nature and extent of the genetic variability, heritability, genetic advance, character association and the magnitude of direct and indirect effects of yield component traits with grain yield per plant through path coefficient analysis and genetic divergence. The observations were recorded on ten characters *viz.,* days to 50% flowering, plant height (cm), total no. of leaves, leaf length (cm), leaf width (cm), ear head length (cm), ear head width (cm), 100 grain weight (g), harvest index (%) and grain yield per plant (g).

Analysis of variance revealed significant differences among the genotypes for all the characters studied indicating that the data generated from the above diverse material shall represent wide variability. The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the masking effects of the environment. High PCV coupled with high GCV observed for ear head length and grain yield per plant indicate the presence of wider variability for these traits in the population studied. High heritability coupled with high genetic advance as per cent of mean was recorded for plant height, leaf length, ear head length, ear head width, 100 grain weight, grain yield per plant and harvest index indicate operation of additive gene action in the

inheritance of these traits and improvement in these characters is possible through simple selection.

Correlation study indicated that plant height, leaf length, ear head length, ear head width and harvest index had significant positive association with grain yield per plant at both genotypic and phenotypic levels and simultaneous improvement of these traits along with grain yield per plant is possible.

The path analysis indicated that ear head length, ear head width exerted high direct positive effect on grain yield per plant. As direct effects of these parameters are high, direct selection through these characters for improvement in grain yield per plant should be rewarding.

Thus, the present study revealed that the major emphasis should be laid on selection process by direct selection for improvement through component yield traits such as plant height, leaf length, ear head length, ear head width and harvest index directly contributed for increased realisation.

From the studies of genetic divergence, suggestions were made to attempt crosses after confirming good general combiner between genotypes of cluster VII (EC 489088) and cluster VIII (EC 489372) followed by cluster cluster VII (EC 489088) and IV (EC 489101) to obtain better and desirable segregants.

GENETICS AND PLANT BREEDING

Author	:	**JAISHANKAR BABU, BURIDI.**
Title of the Thesis	:	**HETEROSIS AND COMBINING ABILITY IN INTRA-SPECIFIC HYBRIDS OF UPLAND COTTON (*Gossypium hirsutum* L.)**
Chairperson	:	**Dr. Y.SATISH**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5427**

ABSTRACT

The present investigation was carried out during *kharif*, 2016-17 at Regional Agricultural Research Station, Lam Farm, Guntur to study the variability, heritability, genetic advance as per cent of mean, combining ability, heterosis, character association and path coefficient analysis in 53 genotypes (40 F_1's + 13 parents) along with one standard check of cotton for the characters *viz.,* days to 50 % flowering, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight

(g), seed index (g), lint index (g), ginning outturn (%), 2.5% span length (mm), micronaire value (10^{-6} g/inch), bundle strength (g/tex), uniformity ratio, and seed cotton yield per plant (g).

Analysis of variance revealed significant differences among the genotypes for all the characters studied indicating high degree of variability in the material. Wider variability was observed for number of monopodia per plant, number of bolls per plant and seed cotton yield per plant. High heritability coupled with high genetic advance as per cent of mean was observed for number of bolls per plant, micronaire value and seed cotton yield per plant.

The character association analysis revealed that plant height, number of sympodia per plant, number of bolls per plant, boll weight, seed index and bundle strength have significant positive association with seed cotton yield per plant both at phenotypic and genotypic levels indicating their importance in direct selection.

The path analysis indicated that number of monopodia per plant, number of sympodia per plant, seed index, micronaire value and uniformity ratio showed direct positive effects and significant correlation with seed cotton yield per plant. Direct selection based on these attributes may be helpful in evolving high yielding genotypes of upland cotton.

The analysis of variance for combining ability revealed that lines, crosses and line × tester effects had significant amount of variability with in each of them for majority of the traits studied. The per cent contribution towards the total variance was maximum due to the interaction of lines and testers for the traits, days to 50% flowering, number of bolls per plant, seed index, lint index, ginning outturn, 2.5% span length, micronaire value, bundle strength, uniformity ratio and seed cotton yield per plant.

The estimates of GCA and SCA variances revealed the predominance of non-additive gene action in the inheritance of plant height, number of bolls per plant, boll weight, lint index, 2.5% span length, ginning out turn, micronaire value, bundle strength, uniformity ratio and seed cotton yield per plant. Whereas, additive gene action was observed for number of sympodia per plant.

The *gca* effects of the parents revealed that none of the parent recorded significant *gca* effects for all the characters. The line, L 1384, and the tester, GTHV 13/32, recorded significant general combining ability effects in desirable direction for seed cotton yield per plant and its components. These parents may be utilized as good general combiners in future hybridization programmes aims at improving seed cotton yield along with fibre quality. The hybrids, LH 2220 × GTHV 13/32, L 1060 × GTHV 13/32 and L 1384 × HYPS 152 registered high *sca* effects along with high *per se* performance for seed cotton yield per plant and its contributing traits. The crosses with high × low, low × low and high × high general combiners resulted into hybrids with high *sca* effects. Indicating the importance of including low general combiners along with good general combiners in hybridization programmes.

Based on overall performance (*per se* performance, *sca* effects and standard heterosis) the crosses *viz.,* LH 2220 × GTHV 13/32 and L 1384 × HYPS 152 were found to be promising for seed cotton yield per plant and its components along with few fibre quality traits. These hybrids may be tested over large number of environments for their stability before their release for commercial cultivation.

GENETICS AND PLANT BREEDING

Author	:	**KUSUMA KUMARI, B.**
Title of the Thesis	:	**EVALUATION OF RICE BREEDING LINES FOR BROWN PLANTHOPPER RESISTANCE USING SSR MARKERS AND PHENOTYPIC METHODS**
Chairperson	:	**Dr. J. DAYAL PRASAD BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5425**

ABSTRACT

The present investigation was carried out during *kharif*, 2016 at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, Andhra Pradesh with 119 breeding lines along with two high yielding local checks of rice (*Oryza sativa* L.) to obtain information on variability, heritability and genetic advance for yield and its attributing characters and screening for BPH resistance. Breeding lines which have shown resistance in both field and laboratory screening were used along with resistant and susceptible checks for honeydew test and molecular diversity analysis using BPH linked markers.

The analysis of variance revealed significant differences among the lines for all the characters studied *viz*., days to 50% flowering, days to maturity, plant height (cm), number of Ear bearing tillers per plant, panicle length (cm), number of grains per panicle, spikelet fertility (%), grain yield per plant (g), test weight (g) and BPH resistance score using SES of IRRI, 2014 indicating the presence of sufficient genetic variability in the material under study which provides sufficient basis for selection.

High PCV and GCV were observed for number of grains per panicle (22.92% and 22.45%) and grain yield per plant (31.33% and 30.61%) and difference between PCV and GCV was very low indicating little environmental influence on these characters. High heritability coupled with high genetic advance as percent of mean was recorded for test weight (98.66% and 23.14), number of grains per panicle (95.94% and 45.30) and grain yield per plant (96.66% and 61.99) indicating the operation of additive gene action in the inheritance of these traits and improvement of these characters is possible through direct phenotypic simple selection.

The results of phenotypic screening for brown planthopper resistance revealed that out of 123 lines (including resistant and susceptible checks), 33 lines were found to be resistant, 44 lines were moderately resistant, 44 lines were moderately susceptible and remaining two lines were susceptible in standard seed box screening whereas in field screening 71 lines were resistant, 50 lines were moderately resistant and two lines were

susceptible. Honeydew experiment was conducted for 25 breeding lines which exhibited resistance in both field and lab

screening tests along with three BPH susceptible and resistance checks. Among these lines resistant check PTB 33 recorded lowest honeydew excreted area of 12.67 mm^2 followed by MTU 2399-24-1-1-1(13.67 mm^2), resistant check Rathu Heenathi (13.67 mm^2), MTU 2489-14-2-1-2 (14.00 mm^2), resistant check BM 71 (15.67 mm^2), MTU 2263-50-1-1-1 (17.67 mm^2), MTU 2330-183-2-2-1 (18.00 mm^2), MTU 2386-18-1-2-1 (18.67 mm^2), MTU 2398-4-5-1-1 (18.67 mm^2) and MTU 2324A-152-1-2-1 (19.00 mm^2) indicating that these lines were less preferred by BPH.

Molecular cluster analysis with 20 polymorphic BPH linked SSR markers (out of 33 markers used) using UPGMA clustering algorithm grouped 31 lines into three clusters in Darwin analysis and two clusters in NTSYS. In both the cluster analysis, susceptible check TN 1 and MTU 3626 are included under the same branch indicating MTU 3626 is highly susceptible and five breeding lines *viz*., MTU 2263-50-1-1-1, MTU 2399-24-1-1-1, MTU 2324A-152-1-2-1, MTU 2330-183-2-2-1 and MTU 2386-18-1-2-1 which have shown resistance in the above three screening tests were grouped with the resistant checks BM 71 and PTB 33 revealing that these five lines may have BPH resistance genes or QTLs in BM 71 and PTB 33.

Conclusively the breeding lines MTU 2491-70-1-1-1 (51.50 g), MTU 2489-14-2-1-1 (49.20 g), MTU 2491-69-1-1-1 (46.10 g), MTU 2491-57-1-1-1 (35.70 g), MTU 2399-24-1-1-1 (33.00 g) and MTU 2489-14-2-1-2 (32.90 g) were found to be promising lines due to higher grain yield coupled with resistance to BPH and may serve as potential parental genotypes for future breeding programmes or can be released for commercial cultivation after testing in yield trials.

GENETICS AND PLANT BREEDING

Author	:	**MAHITHA, S.**
Title of the Thesis	:	**GENETIC STUDIES IN EIGHT SEGREGATING POPULATIONS OF GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. R. P. VASANTHI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5517**

ABSTRACT

The experimental material consisted of two F_3 populations derived from TCGS 1157 × TCGS 1043 and TCGS 1157 × TCGS 1073 and F_2 populations of six three - way crosses derived from Kadiri 6 × (TCGS 1157 × TCGS 1043), Kadiri 6 × (TCGS 1157 × TCGS 1073), JL 24 × (TCGS 1157 × TCGS 1043), JL 24 × (TCGS 1157 × TCGS 1073), TAG 24 × (TCGS 1157 × TCGS 1043) and TAG 24 × (TCGS 1157 × TCGS 1073) and six parents involved *viz.*, TCGS 1157, TCGS 1043, TCGS 1073, Kadiri 6, JL 24 and TAG 24. The crop was grown unreplicated during *kharif,* 2016 at dryland farm of Regional Agricultural Research Station (RARS), Tirupati.

Estimates of genetic parameters, genotypic co-efficient of variation, heritability and genetic advance as percentage of mean were moderate to high in both single and three way crosses for most of the characters *viz.,* , number of secondary branches per plant, number of pegs per plant, total biomass per plant, shoot weight per plant, number of mature pods per plant, number of immature pods per plant, harvest index, mature pod weight per plant, kernel weight per plant, SLA and SLW indicating that these are predominantly governed by additive genetic variance. In these crosses, parents are more diverse with respect to almost all the characters studied. Hence, simple phenotypic selection would be effective in early generations in these crosses. From low to moderate genetic parameters, for traits, SCMR and pegs/pod, it is inferred that they are under control of non additive gene action. Selection for shelling out-turn in early generation would be moderately effective as it is controlled by both additive and non-additive gene action.

From descriptive statistics, skewness and kurtosis in F_3 populations, for the traits, SCMR at 30 DAS, negative skewness in both the crosses indicates the role of non-additive gene interactions, dominance and epistasis while for SCMR at 60 DAS in the two crosses, distribution was continuous indicating that it is a quantitative trait. For SLA and SLW skewness was positive which is almost opposite to that of SCMR. Because of the contribution of non-additive allelic interactions, the distributions were skewed negatively or positively for different characters in these two crosses.

Transgressive individuals with values exceeding the better parent were observed in all the crosses for primary branches per plant, plant height per plant, mature pod weight, kernel weight, SCMR 60 DAS and SLA. Transgressive segregants indicates that the parents possess different alleles and genes governing respective characters from which it could be inferred that there is a lot of scope to bring in beneficial alleles into a single genotype through rigorous selection and handling of these segregants, evaluating the segregants for different characters along with selection for yield to arrive at a desirable plant type through selection in later generations.

Among the F_3 and F_2 populations studied, mature pod weight per plant showed significant positive association with primary branches per plant, pegs per plant, total biomass, shoot weight, number of mature pods per plant, number of immature pods per plant, harvest index, shelling out-turn and kernel weight per plant indicating these should be considered while selecting for yield. Non- significant correlation of SCMR with yield clearly shows that SCMR, a correlated trait to WUE can be manipulated along with yield. Number of secondary branches per plant had shown significant positive correlation only in three, while in other crosses it was not significant indicating it is also important trait to be considered as selection criteria for yield in segregating generation in some of the crosses.

Based on the overall path analysis, kernel yield in all eight crosses; total biomass in JL 24 × (TCGS 1157 × TCGS 1043) and JL 24 × (TCGS 1157 × TCGS 1073); harvest index in TAG 24 × (TCGS 1157 × TCGS 1043) exhibited high positive direct effects, hence importance should be given in selection process for respective characters in respective crosses in order to improve pod yield.

GENETICS AND PLANT BREEDING

Author	:	**MOUNIKA, K.**
Title of the Thesis	:	**GENETIC DIVERGENCE FOR YIELD AND YIELD COMPONENTS IN MAIZE (*Zea mays* L.)**
Chairperson	:	**Dr. M. LAL AHAMED**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5431**

ABSTRACT

The present investigation was carried out during *rabi* 2016-17 at Agricultural College Farm, Bapatla with the prime objective of grouping 47 genotypes of maize (*Zea mays* L.) into distinct classes based on their genetic diversity. Other parameters like mean, genetic variability, heritability, genetic advance as per cent of mean, character association and the magnitude of direct and indirect effects of yield component traits on grain yield were also studied to know the variability and associations among the characters for the improvement of the traits in the material.

The analysis of variance revealed significant differences among 47 genotypes for all the characters studied. High PCV and GCV were recorded for ear height, 100-seed weight, number of kernels per row and grain yield per plant while low PCV coupled with low GCV was recorded for days to 50% tasseling, days to 50% silking and days to maturity indicating the presence of considerable amount of variability for majority of the characters studied.

The estimates of heritability and genetic advance as per cent of mean were high for plant height, ear length, ear height, 100-seed weight, number of kernels per row and grain yield per plant indicating the predominance of additive gene action and use of direct selection for the improvement of these traits whereas days to 50% tasseling showed moderate heritability coupled with low genetic advance indicating the action of non-additive genetic components along with additive gene action in the expression of these traits.

Genotypic correlations in general were higher than phenotypic correlations indicating apparent associations are largely due to genetic reasons. The traits, 100-seed weight, number of kernels per row, kernel rows per ear, ear height and plant height had significant positive association with grain yield per plant at both phenotypic and genotypic levels.

Further, path analysis also revealed that plant height, 100-seed weight, kernel rows per ear and number of kernels per row had true relationship with grain yield per plant by establishing significant positive association and positive direct effect.

Considering the nature and magnitude of character associations and their direct and indirect effects, it can be inferred that 100-seed weight, kernel rows per ear, number of kernels per row and plant height could serve as important traits in any selection programme for selecting high yielding genotypes in maize.

The results of multivariate analysis revealed considerable genetic divergence among the 47 genotypes studied. In principal component analysis, four principal components all together explained 80.35 % of the total variability. 2D and 3D scatter diagrams of principal component analysis clearly demonstrated that highly divergent genotypes like CDM-320 AND CDM-342, C-2703-1, PDM-4251K and CDM-306, were present away from other genotypes signifying their usefulness in breeding programmes to develop highly heterotic hybrids.

Both, D^2 analysis and cluster analysis, grouped the 47 maize genotypes into seven clusters. However, the clusters are different with respect to total number of genotypes and the genotypes included in each cluster. In D^2 analysis, cluster I is the largest with 12 genotypes and cluster VI is the smallest with 2 genotypes. In Wards method, cluster II was the largest containing 10 genotypes and cluster VII was solitary cluster having only 1 genotype.

In Mahalanobis D^2 analysis, maximum intercluster distance was observed between the clusters V (PDM-4251K, CDM-342, C-2703-1) and VII (CM-138A-2, PDM-4351, PDM-96-1, CDM-309, CDM-311, C-2730-1, CDM-110 and CDM-119) while in Agglomerative cluster analysis it was seen between the clusters IV (PDM-4611, CM-1388, PDM-4591, PDM-6571, CDM-115, PDM-84, CDM-116, CDM-107, CM-138A-2) and VII (CDM-306) indicating the exploitation of these genotypes in hybridization programme for heterotic hybrids.

Thus, the genotypes *i.e.,* CDM-306, CDM-320, CDM-342, C-2703-1, PDM-4251K and CM-138A-2 can be exploited in the future breeding programmes as they showed maximum diversity in the genetic diversity analysis and they also have high *per se* performance with regard to yield.

GENETICS AND PLANT BREEDING

Author	:	**RADHIKA RAMYA, A.**
Title of the Thesis	:	**STUDIES ON DEFINING HETEROTIC GENE POOLS USING MOLECULAR MARKERS IN PEARL MILLET [*Pennisetum glaucum* (L.) R. Br.]**
Chairperson	:	**Dr. M. LAL AHAMED**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5426**

ABSTRACT

Pearl millet inbred lines comprising of 161 B- and 182 R- lines were molecularly profiled using 88 polymorphic SSR markers to study genetic diversity and to define heterotic groups based on genetic distance. Inbred lines were also evaluated using 12 quantitative characters *viz*., days to 50 per cent flowering, plant height, ear length, ear diameter, productive tillers per plant, head yield per plant, grain yield per plant, panicle harvest index, fresh stover yield per plant, dry matter yield per plant, 1000 grain weight and grain harvest index to study phenotypic diversity and to compare genetic and morphological diversity patterns. The selected inbred lines from heterotic groups were crossed in a line × tester design during *Summer*, 2015 at RM01B field, ICRISAT, Patancheru. Evaluation of 122 genotypes (9 lines, 11 testers and 99 hybrids with three checks *viz*., HHB 67 Improved, ICMH 356 and HHB 146-672 was done based on 12 quantitative characters during *Kharif*, 2015 over two locations *viz*., RP 01B field, ICRISAT, Patancheru and Agricultural Research Station, Vizianagaram and at one location during *Rabi*, 2015 at Agricultural College Farm, Naira to study gene action, combining ability, heterosis for yield and its component traits and to identify the association between genetic distance with F_1 mean, heterosis and specific combining ability for grain yield.

The SSR markers detected a total of 532 alleles with an average of 6.05 alleles per locus. Of these, 443 and 476 alleles were contributed by B- and R-lines respectively. Of 532 alleles, 60, 276 and 157 were rare, common and most frequent alleles respectively. Thirty nine unique alleles which were specific to a particular accession and useful for germplasm identification were also detected. SSR loci in the present study identified an average gene diversity of 0.55 and mean PIC of 0.50. Of 88 SSR markers, 5 markers Xipes0203, Xipes0098, Xipes0027, Xipes0233 and Xpsmp2070 were found to be highly informative with high average number of alleles, greatest average gene diversity and high average PIC. The unweighted neighbor-joining tree based on simple matching dissimilarity matrix of 347 (one control-Tift $23D_2B_1P1$-P5, repeated 5 times) inbred lines of pearl millet classified into three major clusters *viz*., B_I, R_I, R_{II} and one undetermined cluster which corresponded well with the pedigree information with minor deviations. The major clusters B_I, R_I and R_{II} divided into 10 ($1B_I$, $2B_I$, $3B_I$, $4B_I$, $5B_I$, $6B_I$, $8B_I$, $9B_I$ and $10B_I$), 9 ($2R_I$, $3R_I$, $4R_I$, $5R_I$, $6R_I$, $7R_I$, $8R_I$ and $9R_I$)

and 2 ($10R_{II}$ and $11R_{II}$) sub-clusters, respectively. The representative entries from heterotic groups (10B, 11R-clusters and one undetermined cluster) defined based on genetic distance were selected for crossing program to assess the degree of heterosis and hybrid performance for yield in the resulting crosses. Mantel test showed positive and significant but low correlation between phenotypic and molecular dissimilarity matrix for both B- and R-lines.

Pooled analysis of variance for combining ability of nine lines selected from sub-clusters, $1B_I$ (L1), $2B_I$ (L2), $3B_I$ (L3), $4B_I$ (L4), $5B_I$ (L5), $6B_I$ (L6), $8B_I$ (L8), $9B_I$ (L9) and $10B_I$ (L10), 11 testers selected from sub-clusters, $2R_I$ (T10), $3R_I$ (T11), $4R_I$ (T12), $5R_I$(T13), $6R_I$ (T14), $7R_I$ (T15), $8R_I$ (T16), $9R_I$ (T17), $10R_{II}$ (T18), $11R_{II}$ (T19) and undetermined cluster (T20) and 99 F_1s with 3 checks, revealed significant differences among the genotypes for most of the characters studied, indicating a high degree of variability in the material. Based on pooled mean performance, of 9 crosses generated from cross between each line with 11 testers, L1T11, L2T12, L3T13, L4T20, L5T19, L6T11, L7T12, L8T15 and L9T13 had shown higher grain yield per plant compared to their counterparts.

Based on pooled data, L9 among lines and T11, T12 and T13 among testers were found as good general combiners for grain yield per plant. Significant positive specific combining ability (*sca*) effects were observed among seven hybrids *viz*., L2T12, L3T13, L3T14, L4T20, L5T19, L8T17 and L9T13 for grain yield per plant. Based on *per se* performance, high *sca* effects and standard heterosis in pooled analysis, two cross combinations *viz*., L9T13 and L3T13 were found promising over the best check HHB 146-672 for grain yield per plant.

The correlation between genetic distance and F_1 performance, SCA and heterosis for grain yield per plant was negative and non-significant. Therefore, the study inferred that genetic distance alone cannot predict heterotic performance of hybrids. However, utilization of markers specific to yield or QTLs of yield related traits would be helpful in development of promising hybrids for grain and stover characters.

The F_1s generated from cross between representative entries of cluster $3B_I$, $10B_I$ with representative entry of cluster $5R_I$ resulted in best heterotic combinations for grain yield per plant. Moreover, the cross combination resulted from cluster $10B_I$ and cluster $5R_I$ resulted in best heterotic combinations for most of the characters under study *viz*., ear length, productive tillers per plant, head yield per plant, grain yield per plant, fresh stover yield per plant and dry matter yield per plant.

GENETICS AND PLANT BREEDING

Author	:	**RAJU NAIK, S.**
Title of the Thesis	:	**REJUVENATION AND EVALUATION OF SUGARCANE VARIETIES THROUGH MICROPROPAGATION**
Chairperson	:	**Dr. M. HEMANTH KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5518**

ABSTRACT

An experiment was carried out at the Agricultural Research Station, Perumallapalle for rejuvenating four sugarcane varieties (87A298, Co86032, CoT8201 and 2003V46) by using shoot tip, leaf roll and apical meristem explants through micropropagation technique to evaluate the response of explants of each variety to standard tissue culture protolcols. The micropropagated plants were evaluated for yield and quality characters against respective controls (single bud setts) to study their performance in nucleus seed plots.

Callus induction frequency in the leaf roll of Co86032 and 2003V46 was higher (76.66% and 63.55%, respectively) and took more number of days (6.9 days and 5.8 days, respectively) than apical meristem culture. However reverse was true with respect to 87A298 (63% and 12.8 days, respectively) and CoT8201 (45.67% and 17.2 days, respectively). In general, shoot regeneration frequency was higher in shoot tip explants of the varieties (87A298-86.6%, CoT8201-61.1% and in 2003V46-82.2% respectively) with an exception to Co86032 where in leaf roll explant exhibited higher shoot regeneration frequency (76.6%) than the other explants. The time taken for shoot initiation was more in shoot tip derived explants (87A298-34.5, Co86032-34.8, CoT8201-48.1 and 2003V46-38.5 than the other explants of respective varieties except Co86032 apical meristem (41.7 days, respectively). Leaf roll explants of all the varieties took less time (87A298-28.8, Co86032-34.6, CoT8201-36.2 and 24.7 days, respectively) for shoot initiation. Similarly leaf roll explants produced more number of shoots per explant (87A298-20, Co86032-18.5 and 2003V46-18.6, respectively) except CoT8201 shoot tip (13.6).

Apical meristem of 87A298 and Co86032 took more time (13.1 days and 12.4 days, respectively) for root induction with high root induction frequency (87.50% and 69.32%, respectively). Where as in shoot tip explant of CoT8201 and leaf roll explant of 2003V46 recorded higher root induction frequency (54.17% and 85.06%, respectively) than the other explants of the respective varieties and took more time for root induction (9.3 days and 14.1 days, respectively).

Seedlings obtained from leaf roll explants of 87A298 and Co86032 survived better (72.2% and 65.4%, respectively) than the other explants. Where as in CoT8201 shoot tip

derived explants and in 2003V46 apical meristem derived explants recorded higher survival per cent (56.4% and 64.2%, respectively) than the other explants.

Though the establishment of control treatment of 87A298 was good (87%), tissue cultured seedlings of all the three explants performed better for yield attributes. Leaf roll explants of 87A298 showed consistent performance all through this growth commencing from establishment of seedlings. All the three explants produced higher cane yield (87A298 shoot tip-112.7 t/ha, 87A298 leaf roll-113.9 t/ha and 87A298 apical meristem-77.3 t/ha, respectively) than control (69.1 t/ha). Yield traits of Co86032 (control) were better than its explants except apical meristem derived plants where number of millable canes per hectare contributed more (65.3) towards improvement in cane yield per hectare. Similarly the performance of control in CoT8201 was superior to all its explants with respect to yield traits including cane yield. All the treatments of 2003V46 recorded higher values than control (76.3 t/ha) for cane yield and yield traits (shoot tip-118 t/ha, leaf roll-85.9 t/ha and apical meristem-104.7 t/ha respectively). Shoot tip derived plants were superior to other treatments with respect to cane yield, cane length, number of internodes and single cane weight. Hence direct supply of tissue culture seedlings of Co86032 and CoT8201 is not advisable for commercial cultivation. Performance of tissue culture seedlings of early varieties *viz.,* 87A298 and 2003V46 was superior to the performance of mid late varieties; Co86032 and CoT8201.

Generalized conclusions could not be made for quality traits. However with regards to CCS yield/ha the trend of superiority of tissue culture seedlings over controls of each varieties; 87A298 (shoot tip-13.37 t/ha, leaf roll-13.80 t/ha, apical meristem-9.25 t/ha and control-8.32 t/ha) and 2003V46 (shoot tip-14.78 t/ha, leaf roll-10.24 t/ha, apical meristem-12.44 t/ha and control-9.31 t/ha) inferiority of tissue cultured seedlings over controls of mid late varieties; Co86032 and CoT8201 remained similar to cane yield/ha.

Apical meristem derived plants were free from sugarcane streak mosaic virus which indicated that disease free seed material could not be obtained from other explants *viz.,* leaf roll and shoot tip. Therefore apical meristem alone has to be used as explant to produce disease free seed material. Direct supply of tissue cultured seedlings for commercial cultivation cannot be recommended as some of the varieties like Co86032 and CoT8201 produce inferior plants in the first generation. Their performance in the next generation may be tested and vegetative material may be given for commercial cultivation rather than their tissue cultured seedlings.

GENETICS AND PLANT BREEDING

Author	:	**RAM PRABHU NAIK, P.**
Title of the Thesis	:	**GENETICS OF FERTILITY RESTORATION IN RICE (*ORYZA SATIVA* L.)**
Chairperson	:	**Dr. B.N.V.S.R. RAVI KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5439**

ABSTRACT

The present investigation was carried out during *kharif*, 2016 at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, Andhra Pradesh for studying the genetics of fertility restoration in rice (*Oryza sativa* L.). Data on days to 50% flowering, days to maturity, plant height (cm), number of ear bearing tillers per plant, panicle length (cm), pollen sterility (%), number of filled grains per plant, number of unfilled grains per plant, spikelet fertility (%) and single plant yield (g) was observed in 52 restorers and 100 F_2 plants in each of two crosses studied.

Two crosses in F_2 generation were used to study the genetics of fertility restoration *viz.,* APMS 8A × RM 141-91-11-2-1-1 and APMS 6A × RM 71-42-2-1-1. The segregation ratio for pollen sterility was 3 fertile: 1 sterile (Chi square analysis), representing a typical case of dominant monogenic inheritance.

Parental polymorphism studies between parents of both the crosses was done using 21 *Rf3 & Rf4* gene linked SSR markers. Five *Rf3* gene linked markers *viz.,* RM 10287, RM 10305, DRRM *Rf3-5*, DRRM *Rf3-10* and RMS-SF21-1 showed polymorphism between parents of cross APMS 6A × RM 71-42-2-1-1 and *Rf4* gene linked marker RM 6100 showed polymorphism in F_2 cross APMS 8A × RM141-91-11-2-1-1. Five *Rf3* gene linked markers showed polymorphism between parents of the cross APMS 6A × RM 71-42-2-1-1 indicating the presence of *Rf3* gene in RM 71-42-2-1-1, while one *Rf4* gene linked marker showed polymorphism between the parents of F_2 cross APMS 8A × RM 141-91-11-2-1-1 indicating the presence of *Rf4* gene in RM 141-91-11-2-1-1. Fertile parents and fertile bulks and sterile parents and sterile bulks have not shown co-segregation of banding pattern in bulk segregant analysis clearly indicating that neither of *Rf3* or *Rf4* genes is contributing for fertility restoration and polymorphic markers used were not tightly linked to *Rf* genes in the two restorers under study. Further screening for presence of fertility restoration genes other than *Rf3* and *Rf4* has to be done for confirming the genes linked to fertility restoration in both the restorers under study. Variability and character association for the traits *viz.,* days to fifty per cent flowering, days to maturity, number of ear bearing tillers per plant, panicle length, pollen sterility, number of filled grains per panicle, number of unfilled grains per panicle, spikelet fertility and single plant yield.

The analysis of variance revealed that significant differences are existing among the characters under study. Of 52 restorers, the study of genetic parameters, high PCV and GCV were observed for number of unfilled grains per panicle (59.42% and 55.38%), pollen sterility (38.87% and 37.64%) and single plant yield (41.66% and 40.22%) indicating high variability among the restorers under study for these traits.

High heritability coupled with high genetic advance as per cent of mean was observed for plant height (91% and 22.01%), number of ear bearing tillers per plant (62% and 26.22%), pollen sterility (93% and 74.72%), number of filled grains per panicle (64% and 30.35%), number of unfilled grains per panicle (61% and 82.60%) and single plant yield (93% and 79.98%) indicating the importance of additive gene action in governing the inheritance of these traits. Hence, direct phenotypic selection is useful with respect to these traits.

The study on character association revealed that *viz.,* plant height (0.2799**/0.2694**), number of filled grains per panicle (0.2791**/0.02715**) at both genotypic and phenotypic levels and number of ear bearing tillers per plant (0.2606**) only at genotypic level showed significant positive association with grain yield per plant indicating that direct selection can be practiced for these characters for improving single plant yield.

Path coefficient analysis revealed that high positive direct effects were recorded for the traits *viz.,* number of filled grains per panicle (0.4530/0.9451) both at phenotypic and genotypic levels where as days to maturity (0.5790) recorded high direct effect only at genotypic level. Moderate positive direct effects were recorded for the traits *viz.,* number of ear bearing tillers per plant (0.1585 /0.2222) and plant height (0.1714 / 0.1276) at both the levels. While the trait, panicle length (0.1285) showed low direct effect at phenotypic level. The traits *viz.,* plant height, number of ear bearing tillers per plant, panicle length and number of filled grains per panicle are having direct positive effects and positive correlation with single plant yield and therefore, simultaneous improvement of grain yield is possible through direct selection of these traits.

In the present investigation residual effect is high (phenotypic (0.88) and genotypic (0.76)) indicating that some other characters which were not included in this study need to be included for completely studying the traits contributing to grain yield.

GENETICS AND PLANT BREEDING

Author	:	**RAVIKANTH, BENDI.**
Title of the Thesis	:	**GENETIC STUDIES ON PHYSIOLOGICAL AND AGRONOMIC TRAITS SUITABLE FOR DIRECT SEEDING IN RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. P.V. SATYANARAYANA**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5436**

ABSTRACT

Rice is commonly grown by transplanting seedlings into puddled soil. Puddling and transplanting require huge amounts of water and labour, both of which are becoming increasingly scarce and expensive, making its production less profitable. Under the situation of water and labour scarcity, farmers are changing their crop establishment method transplanting to direct seeding. This rambles the need of varietal improvement for traits *viz.,* early seedling vigour for weed competitiveness; anaerobic germination and tolerance of early submergence; dense root system for drought resistance and culm thickness for lodging resistance, which are highly essential for good crop establishment in direct seeding conditions.

Present investigation was aimed to characterize the elite rice cultivars for the traits related to direct seeding and yield; to work out the genetics of the traits related to direct seeding by using established molecular markers.

The genetic variability studies revealed that significant differences among the genotypes for all the 19 characters studied indicating the existence of high degree of variability in the material. The estimates of heritability and genetic advance as per cent of mean were high for the characters *viz.,* days to 50% flowering, plant height, leaf area index, number of productive tillers per plant, total number of tillers per m^2, test weight, grain yield per plant, biological yield per plant, seedling root length, seedling shoot length, seedling vigour index and basal culm diamter.

Genetic diversity among 48 elite rice cultivars for direct seeding traits was determined using 10 SSR markers (two each for the five direct seeding traits *viz*., Anaerobic germination, seedling root length, seedling shoot length, rate of germination, culm diameter) and estimated magnitude of genetic diversity for 19 agronomic and physiological traits *viz.,* days to 50% flowering, plant height (cm), leaf area index, number of productive tillers per plant, total number of tillers per m^2, panicle length (cm) number of filled grains per panicle, number of total grains per panicle, spikelet fertility (%), test weight (g), grain yield per plant (g),

biological yield per plant (g), seedling root length (mm), seedling shoot length (mm), vigour index and basal culm diameter (mm) with D^2 analysis. All the ten SSR loci were polymorphic and produced 36 alleles. The number of alleles per locus generated by each marker varied from 2 to 5 alleles with an average of 3.6 alleles per locus. Polymorphic information content (PIC) of these markers ranged from 0.305 to 0.797 with an average of 0.628 indicated potentialities of these markers for assessing genetic diversity. Based on molecular diversity and D^2 analysis seven parents (MTU 3626, MTU 1010, MTU 1121, MTU 1140, PS-140-1, AC39416A) were selected and crossed in Griffing's diallel fashion (Method-2, model-I) during *Rabi*, 2014-15 to generate 21 F_1s.

Evaluation of the 21 F_1s along with parents was done in *kharif*, 2015-16. The ANOVA for combining ability revealed that parents and crosses had significant amount of variability for all the characters. The component of variance due to both *gca* and *sca* were significant for all the characters studied indicating the role of both additive and non-additive gene actions in governing the inheritance of these traits. Among the seven parents studied for their combining ability pertaining to nineteen different characters, the line, PS-140-1 recorded significant *gca* effects in desirable direction for majority of the characters followed by AC39416 A, MTU 1121, MTU 1140 and MTU 1156. Heterosis studies revealed that 15 out of 21 crosses registered significant positive heterosis over both mid and better parents for grain yield per plant. The best heterotic combination identified were MTU 3626 × PS-140-1 for important yield contributing traits; MTU 1140 × AC39416 and MTU 1140 × PS-140-1 for direct seeding traits.

In the present study, an effort was also made to generate genotyping data of two F_2 populations *viz.,* MTU 3626 × PS-140-1 and MTU 1121 × PS-140-1 (100 individuals each) using the 10 SSR markers which were used earlier for screening of genotypes for direct seeding traits. The markers that linked to anaerobic germination (RM341, RM206); seedling root length (RM201, RM234); seedling shoot length (RM17, RM263): rate of germination (RM231) and culm diameter (RM20557, RM5509) were segregated in expected genetic ratio *i.e.,* 1: 2: 1 for which the χ^2 values were non significant against table value. The marker RM7, linked to rate of germination showed segregation distortion for the cross MTU 3626 × PS-140-1 progeny by not segregating in the expected genetic ratio 1:2:1 and showed high, significant χ^2 value. The results revealed the usefulness of the studied SSR makers in marker assisted selection of direct seeding traits.

GENETICS AND PLANT BREEDING

Author	:	**SANTHOSH KUMAR, M.**
Title of the Thesis	:	**ASSOCIATION STUDIES AMONG GRAIN PROPERTIES AND GLYCEMIC INDEX IN RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. P.V. SATYANARAYANA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5428**

ABSTRACT

The present investigation is carried out during *kharif* 2016 at Andra Pradesh Rice Research Institute and Regional Agriculture Research Station, Maruteru in order to evaluate 36 rice genotypes for yield, quality, texture properties and glycemic index and to study associations among these parameters and to know magnitude of direct and indirect effects of above parameters on G.I. Data were recorded on days to 50% flowering, plant height (cm), number of panicles per plant, panicle length (cm), grain yield per plant (g), test weight (g), kernel length (mm), kernel breadth (mm), L/B ratio, volume expansion ratio, elongation ratio, alkali spreading value, gel consistency (mm), amylose content (%), hardness, resilience and glycemic index.

The analysis of variance revealed highly significant differences among the genotypes for all the characters indicating the presence of sufficient genetic variability in the studied material.

Estimation of glycemic index showed that there is a lot of variation for the traits among the genotypes studied that ranged from 49.16 to 84.64 with a mean value of 61.36. Among the genotypes MTU-2716 exhibited lowest GI value of 49.16 and MTU-1001 exhibited highest GI value of 74.16. There were 8 genotypes which comes under low GI category namely MTU-2716 (49.16), MTU-1061 (49.3), MTU-1140 (49.36), MTU-2077 (49.8), MTU-1184 (50.95), BPT-2270 (51.14), MTU-1075 (54.5) and BPT-5204 (54.79).

Study of correlation between grain properties and glycemic index revealed that the glycemic index had significant positive association with the traits *viz.,* grain yield (0.410**, 0.253*), alkali spreading value (0.526**, 0.535**) and gel consistency (0.312**, 0.283**) at both genotypic and phenotypic levels. Further, glycemic index exhibited significant negative correlation with amylose content (-0.346**,-0269*) at both genotypic and phenotypic levels.

Path analysis studies revealed that GI had shown positive correlation and direct effect for the characters *viz.,* L/B ratio (0.2281, 0.0145), volume expansion ratio (0.1367, 0.571),

alkali spreading value (0.5259, 0.571) and gel consistency (0.3119, 0.3548); similarly negative correlation along with positive direct effects was observed in the characters, namely panicle length (-0.0129, 0.2723), test weight (-0.0609, 0.6307) and hardness (-0.0187, 0.64871). Positive association with negative direct effects as been observed for the characters kernel length (0.0458, -0.2486), plant height (0.0011, -0.7430), grain yield per plant (0.4253,-0.513), where as negative association with negative direct effect was also observed for the characters no of productive tillers per plant (-0.2567, -0.7430), kernel breadth (-0.2025, -0.5879), elongation ratio (-0.1198, -0.6199), amylose content (-0.03457, -0.3083) and resilience (-0.2253, -0.6520).

In the present investigation high residual effect (0.699 and 0.689) at both genotypic level and for phenotypic level, indicated that some other factors which have not been considered in the present study need to be included in the analysis to account fully for the variation.

The genotypes such as MTU-2716 (49.16), MTU-1061 (49.3), MTU-1140 (49.36), MTU-2077 (49.8), MTU-1184 (50.95), BPT-2270 (51.14), MTU-1075 (54.5) and BPT-5204 (54.79) recorded lower G.I. value. Among these varieties MTU-2716, MTU-1140, MTU-2077, BPT-2270 and BPT-5204 had recorded intermediate desirable values for alkali spreading value, gel consistency and amylose content, and hence posses good quality along with the low glycemic index which are recommended for diabetic patients and people who are looking for better quality with low glycemic index. Hence we are concluding that MTU-2716, MTU-1140, MTU-2077, BPT-2270 and BPT-5204 have low GI along with good quality.

GENETICS AND PLANT BREEDING

Author	:	**SINDHU, S.**
Title of the Thesis	:	**GENETIC STUDIES IN F_3 GENERATION OF THREE CROSSES IN GREEN GRAM (*Vigna radiata* (L.) Wilczek)**
Chairperson	:	**Dr. M. SHANTHI PRIYA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5519**

ABSTRACT

The present investigation entitled "Genetic studies in F_3 generation of three crosses in green gram (*Vigna radiata* (L.) Wilczek)" was carried out during *kharif*, 2016 to study the variability, heritability, genetic advance as per cent of mean, character association for different yield related characters and their direct and indirect effects on seed yield and

transgressive segregants for yield, harvest index and water use efficiency related traits. The experimental material used in this study consists of four parents *viz*., MGG-347, MGG-351, LGG-460 and LGG-528 and three F_3 populations of MGG-347 x MGG-351, MGG-351 x LGG-460 and LGG-460 x LGG-528. The experiment was laid out in compact family block design with three replications at dry land farm, S.V. Agricultural College, Tirupati.

The analysis of variance between families revealed that the mean squares due to crosses were significant for the characters *viz.,* number of pods per plant, specific leaf area at 35 DAS, specific leaf area at 50 DAS and SCMR at 50 DAS. The analysis of variance among progenies within each family indicated significant differences among progeny means for all the characters studied in all the crosses except for number of primary branches per plant, number of pods per plant, number of pods per cluster, harvest index and seeds per pod in cross MGG-347 x MGG-351; number of primary branches per plant and harvest index in cross LGG-460 x LGG-528 and hundred seed weight in all the three crosses *viz.,* MGG-347 x MGG-351, MGG-351 x LGG-460 and LGG-460 x LGG-528.

Estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters. High GCV estimates and high heritability coupled with high genetic advance as per cent of mean were observed for number of clusters per plant, number of pods per plant, specific leaf area at 35 DAS, pod yield and seed yield in the two crosses, MGG-351 x LGG-460 and LGG-460 x LGG-528 suggesting the involvement of additive gene action for these characters in these crosses. Hence, direct selection for these traits in these crosses would result in further improvement of seed yield along with water use efficiency in green gram. High heritability and genetic advance as per cent of mean were observed for SLA at 35 DAS and 50 DAS in all the three crosses, suggesting that these characters were governed by additive gene action and simple selections can be utilized to improve water use efficiency in these crosses.

Based on association analysis, plant height, number of cluster per plant, number of pods per plant, number of pods per cluster, number of seeds per pod, harvest index and pod yield might be selected for improvement in seed yield in positive direction in all the three crosses. Path analysis revealed that in all the three crosses, highest positive direct effect on seed yield was exerted by pod yield followed by harvest index. Hence, these traits might be considered as selection criteria for breeding high yielding lines.

A good number of transgressive segregants over better parent were propelled for number of primary branches per plant, number of pods per plant and SCMR at 35 DAS in the cross MGG-347 x MGG-351; plant height, number of pods per cluster, number of seeds per pod, hundred seed weight and SLA at 35 DAS in the cross MGG-351 x LGG-460; number of clusters per plant, pod length, SLA at 50 DAS, SCMR at 50 DAS, harvest index, pod yield and seed yield in the cross LGG-460 x LGG-528. Hence, forwarding these transgressive segregants to further generation, contributes to the development of most promising genotype which is better than both the parents.

Among all the three crosses, LGG-460 x LGG-528 cross can be used to breed high yielding lines and MGG-347 x MGG-351 cross can be used to breed high water use efficiency lines.

GENETICS AND PLANT BREEDING

Author	:	**SRI LAKSHMI, M.**
Title of the Thesis	:	**HETEROSIS AND COMBINING ABILITY FOR SALINITY TOLERANCE IN RICE (*Oryza sativa* L.).**
Chairperson	:	**Dr. Y. SUNEETHA**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5433**

ABSTRACT

The present investigation entitled "Heterosis and combining ability for salinity tolerance in rice (*Oryza sativa* L)" was undertaken at Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, West Godavari district of Andhra Pradesh during 2016-17 with the objective of identifying suitable salinity tolerant restorers and to study their heterosis and combining ability for yield and yield components towards identification of potential salinity tolerant hybrids.

Screening of the 60 identified restorers for salinity tolerance at seedling stage was taken up during *Kharif* 2016. The results revealed 12 genotypes to be highly tolerant, six genotypes to be tolerant, and 12 genotypes to be moderately tolerant based on final SES score.

Fourteen salinity tolerant restorers identified from the salinity screening trial and three male sterile lines were hybridized in a 3 x 14 Line x Tester mating design during *Kharif* 2016. The resultant 42 hybrids along with their parents and check, KRH-2 were evaluated for information on mean performance, heterosis and combining ability for yield and yield attributes in a Randomized Block Design with three replications during *Rabi 2016-17*. The analysis of variance (ANOVA) for yield and yield component characters revealed the presence of significant differences among genotypes for all the characters studied. The hybrids, in general were observed to be high yielding with early duration and greater panicle length, compared to the parents. Among the lines, APMS 12A and among the testers, MTU 1121, MTU 1210, MTU 1229, MTU 1032, MCM 223, MTU 1031, MCM 48 and MTU 1213 had recorded higher grain yield per plant and were found promising.

A perusal of the results on heterosis revealed APMS 12A x MTU 1153 and APMS 12A x MTU 1156 to be promising and high yielding with significant and positive relative heterosis, heterobeltiosis and standard heterosis more than 10 per cent for grain yield per plant. These hybrids had also recorded desirable levels of heterobeltiosis and standard heterosis for days to 50 per cent flowering, days to maturity, plant height and ill-filled grains per panicle. Positive and significant relative heterosis and heterobeltiosis for these hybrids was also observed for filled grains per panicle.

ANOVA for combining ability revealed pre-ponderant non-additive gene action for grain yield per plant and majority of the yield components studied. A perusal of the results on general combining ability effects for grain yield per plant revealed APMS 12 A to be a good combiner for grain yield per plant, 100-seed weight, panicle length and filled grains per panicle. The testers, namely, MTU 1153, MTU 1156, MTU 1210, IR 64, MCM 48 and MCM 225 had recorded significant and positive *gca* effects for grain yield per plant and few other yield attributes, and hence, are identified as general good combiners for use in hybrid breeding programmes aimed at the development of high yielding salinity tolerant hybrids. A perusal of the results on *per se* performance, heterosis and specific combining ability revealed the superiority of APMS 12A x MTU 1153 and APMS 12A x MTU 1156 hybrids. Therefore, the hybrids are identified as promising heterotic combinations for further evaluation and commercial exploitation as potential salinity tolerant hybrids.

GENETICS AND PLANT BREEDING

Author	:	**SRI LAKSHMI, P.**
Title of the Thesis	:	**GENETIC STUDIES ON ANAEROBIC GERMINATION AND SEEDLING VIGOUR TRAITS IN RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. N. CHAMUNDESWARI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5437**

ABSTRACT

The present investigation, "Genetic studies on anaerobic germination and seedling vigour traits in rice (*Oryza sativa* L.)" was carried out during *kharif* 2016 and *rabi* 2016-17 to obtain information on the nature and extent of variability, heritability, genetic advance as per cent of mean and genetic diversity for yield and its contributing parameters, quality characters, direct seeded traits, seedling vigour and anaerobic germination related traits at Andhra Pradesh Rice Research Institute (APRRI) and Regional Agricultural Research Station (RARS), Maruteru, Andhra Pradesh. Fifty genotypes were collected from Department of Genetics and Plant Breeding, APRRI & RARS, Maruteru. Data was recorded on plant height at maturity (cm), days to 50% flowering, no. of panicles/plant, panicle length (cm), no. of grains/panicle, spikelet fertility (%), grain yield/plant (g), test weight (g), hulling (%), milling (%), HRR (%), kernel length (mm), kernel breadth (mm), kernel L/B Ratio, kernel elongation ratio, volume expansion ratio, culm diameter (mm), bending strength, leaf area index, harvest index, germination % on 10th day, germination % on 14th day (rate of germination), SSL on 10th day (cm), SSL on 14th day (cm), SRL on 10th day (cm), SRL on 14th day (cm), SFW on 14th day (mg), SDW (mg), SVI -1, SVI -2, AG % after 2 weeks of submergence, plant survival % after 2 weeks, AG % after 3 weeks of submergence and plant survival % after 3

weeks. In *rabi* 2016-17, selection of lines and testers was done based on seedling vigour and anaerobic germination related traits performance among 50 genotypes and crossing was done in Lx T fashion among selected genotypes. Data were recorded on F_1's along with parents for SV and AG traits under lab conditions and combining ability studies were performed. Molecular screening was also done for F_1's along with parents for AG and SV related traits with 24 trait linked SSR markers.

The analysis of variance revealed significant differences among the genotypes for all the characters indicating the presence of sufficient genetic variability in the studied material. High heritability coupled with high genetic advance as per cent of mean was observed for plant height at maturity (cm), days to 50% flowering, no. of panicles/plant, no. of grains/panicle, grain yield/plant, test weight, kernel L/B ratio, culm diameter (mm), bending strength, leaf area index, harvest index, germination % on 10th day, SSL on 10th day (cm), SSL on 14th day (cm), SRL on 10th day (cm), SRL on 14th day (cm), SFW on 14th day (mg), SDW (mg), SV I -1, SV I -2, AG % after 2 weeks of submergence, plant survival % after 2 weeks, AG % after 3 weeks of submergence, plant survival % after 3 weeks indicating the predominance of additive gene action and their amenability for further improvement through simple selection.

Genetic divergence was high and the 50 genotypes were distributed into eight clusters. Out of eight clusters, maximum number of genotypes (16) included in cluster II. Cluster I is the second largest with 14 genotypes followed by cluster VII and VIII each with 11 and 5 genotypes respectively. The clusters III, IV, V and VI were solitary clusters.

Survival % after 2 weeks, anaerobic germination % after 3 weeks of submergence, anaerobic germination % after 2 weeks of submergence, leaf area index, seedling shoot length on 10th day and seedling shoot length on 14th day together contributed 80% towards total divergence indicating that these characters should be taken into consideration while selecting parents for hybridization.

The analysis of variance for combining ability revealed significant differences among crosses for all the characters studied indicating high degree of variability in the material studied. While, line × tester effects were significant for majority of the characters except for seedling shoot length on 14th day (cm), seedling root length on 14th day (cm), seedling dry weight (mg) and survival % after 2 weeks. The analysis of variance for combining ability also revealed significant differences among the lines for the traits *viz*., seedling shoot length on 14th day (cm), seedling root length on 10th day (cm), Seedling fresh weight on 14th day (mg), seedling dry weight (mg), seedling vigour Index **I.** While, in testers significant difference was observed only for seedling shoot length on 14th day (cm), seedling fresh weight on 14th day (mg) and survival % after 2 weeks.

Among the eight parents evaluated, based on their gca effects and their per se performance, AC 39416A, N-22 were identified as good general combiners for seedling vigour traits. The genotypes AC 39397, MTU 1140 and AC 39416A were identified as good general combiners for the anaerobic germination.

The ratio of *gca* variance to *sca* variance was high indicating the predominance of additive gene action for seedling shoot length on 10th day (cm), seedling root length on 10th day (cm), seedling root length on 14th day (cm), seedling dry weight (mg) and seedling vigour index I. The traits governed by additive gene action may be improved by hybridization followed by simple selection procedures like pedigree breeding method. For the characters

viz., germination % on 10th day, germination % on 14th day, seedling shoot length on 14th day (cm), seedling fresh weight on 14th day (mg), seedling vigour index II, anaerobic germination % after 2 weeks of submergence, plant survival % after 2 weeks, anaerobic germination % after 3 weeks of submergence and plant survival % after 3 weeks, the ratio between *gca* variance and *sca* variance was low and indicated the role of non additive gene action. Non-additive gene action governing characters may be exploited through heterosis breeding.

Based on *sca* effects and *per se* performance, the crosses, Azucena x MTU 1010, AC 39416A x MTU 1010 , N 22 x MTU 1010, AC 39397 x MTU 1121, AC 39416A x MTU 1121, N 22 x MTU 1010 and MTU 1140 x MTU 1010 were identified as promising for seedling vigour and anaerobic germination traits.

Molecular screening was done for F_1's along with parents for anaerobic germination and seedling vigour traits with 24 specific trait linked SSR markers.The markers RM 478, RM 104, RM 341, RM 253 RM 520, RM 105, RM 210, RM 263 and RM 206 were associated with anaerobic germination. The markers RM 231 and RM 7 were associated with rate of germination, where as RM 201 and RM 234 were associated with root length. The markers RM 214, RM 5509, RM 20557, RM 306, RM 152 and RM 208 were associated with culm diameter, RM 17 associated with seedling height, RM 270 associated with seedling vigour. RM 10, RM 172 and RM 346 associated with culm strength. Among these markers 13 markers has shown polymorphism which were used for characterization of F_1 crosses.

GENETICS AND PLANT BREEDING

Author	:	**SRILAKSHMI CHAITANYA, M.**
Title of the Thesis	:	**VARIABILITY STUDIES FOR EARLY VIGOUR, ANAEROBIC GERMINATION, YIELD COMPONENTS IN RICE (*Oryza sativa* L.) GENOTYPES**
Chairperson	:	**Dr. B. KRISHNA VENI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5435**

ABSTRACT

The present investigation was carried out during *kharif,* 2016 at Agricultural College Farm, Bapatla, with 48 genotypes of Rice (*Oryza sativa* L.) to elicit information on the nature and extent of variability, heritability, genetic advance for early vigour & yield components and character association, the magnitude of direct and indirect effects of early vigour traits

under anaerobic conditions and molecular diversity at RRU, Bapatla and APRRI & RARS, Maruteru.

The analysis of variance results revealed significant differences among the genotypes for all the characters studied indicating that the data generated from the above diverse material shall represent wide variability. The results of genetic parameters among yield components revealed high heritability coupled with high genetic advance as percent of mean for plant height, number of ear bearing tillers, grain yield and test weight. Under field conditions, shoot length at 7& 14 days after sowing, root length at 7& 14 days after sowing, dry matter at 7& 14 days after sowing and vigour index manifested high heritability and coupled with high genetic advance as percent of mean. Germination percentage after 7 and 14 days of submergence and total soluble sugars also recorded high heritability and genetic advance as percent of mean indicating the operation of additive gene action in the inheritance of the trait. Hence good response to selection can be attained for improvement of these trait.

Among all genotypes studied NLR 4002, BPT 2673, NLR 33892, MTU 5182, MTU 1075, BPT 2740 and JGL 17004 recorded high grain yield under dry direct sowing. Among the genotypes studied, 28 exhibited resistance to anaerobic conditions upto one week of submergence suggesting their suitability for direct sowing and their tolerance to submergence for shorter period immediately after sowing. When we consider both grain yield per plant and anaerobic germination percentage the genotypes *viz.,* BPT 2740, MTU 5249, MTU 2716, IR 85961-23-1-2-1, MTU 1140, BPT 2595, BPT 2782, BPT 2411, BPT 2573 and MTU 1064 can be recommended for direct sowing under anaerobic conditions also. Under 14 days of submergence only 13 genotypes exhibited their resistance to anaerobic germination with > 75% germination. Hence these genotypes can be recommended for direct seeding or utilized as donors for incorporating this trait into other cultivars/varieties.

Under 21 days of submergence in 10cm depth, the genotype AC 39416A recorded 100% germination. Other genotypes *viz.,* AC 39416A, AC 39397, IR 85961-23-1-2-1, BPT 2411, MTU 5249, MTU 1140 and BPT 2595 also exhibited more than 50 % germination under 21 days of submergence The morphological adjustment enabled these cultivars to access oxygen at the water surface earlier which supported the growth of organs such as the primary leaf and root. also possess high amount of total soluble sugars and free amino acids. All these genotypes exhibited high values for shoot length, vigour index and anaerobic response index, root length, dry matter and number of leaves indicating the cumulative effect of all these traits which contributed for high anaerobic germination.

The character association studies among the yield components revealed that plant height, panicle length and test weight manifested non-significant and positive association with grain yield whereas number of ear bearing tillers showed significant positive association with grain yield. Likewise plant height also exhibited significant and positive correlation with panicle length, test weight, dry matter at 7 days after sowing and vigour index under field conditions indicating simultaneous improvement of these traits. The association studies among early vigour traits under field conditions revealed that dry matter 14 at days after sowing and germination percentage exhibited negative and significant association with grain yield. Shoot length at 7 DAS showed positive and significant association with shoot length at 14 days after sowing, dry matter at 7 and 14 days after sowing and vigour index. Similarly under anaerobic conditions also shoot length at 7 days of submergence manifested positive and significant association with shoot length after 14 days of submergence, root length after 7 days of submergence, dry matter after 7 days of submergence, anaerobic germination

percentage under 7 and 14 days of submergence, vigour index under 7 and 14 days of submergence and total soluble sugars suggesting that the genotypes possessing high shoot length, root length, vigour index, dry matter and total soluble sugars would lead to better crop establishment under anaerobic conditions. Free amino acids and total soluble sugars also exhibited positive association with grain yield.

Studies of path analysis among early vigour related traits under anaerobic conditions with grain yield revealed that the characters, shoot length after 7 days of submergence, root length after 14 days of submergence, vigour index after 14 days of submergence, free amino acids and total soluble sugars manifested positive correlation coefficient coupled with positive direct effect on grain yield. Hence simple selection of these traits would improve the grain yield.

Twelve reported microsatellite (SSR) markers for anaerobic germination in rice were used to study the molecular diversity among the 48 genotypes under study. Among these, 8 markers exhibited polymorphism for this trait. The number of alleles detected per primer ranged from 2 to 5 with a mean of 2.91. The cluster analysis studies by the SSR markers classified the genotypes into two major clusters at 62% similarity level. Cluster I comprised of 18 genotypes which were further sub-divided into 2 clusters. Most of the elite breeding lines were grouped in cluster II with 30 genotypes which was further sub grouped into 2 clusters. The results indicates the genotypes expressed divergence based on ancestry and place of origin of genotypes. Three genotypes *viz.,* BPT 2411, MTU 1064, RGL 1414with higher anaerobic germination percentage at 2 weeks and 3 weeks were grouped in cluster I. The genotype BPT 2411, manifested similar amplification pattern for qAG-2 linked alleles RM 6318. It clearly indicates gene/ QTL responsible for anaerobic germination are specific to genotypes which are to be identified by further QTL mapping.The present investigation is aimed at identifying varieties/cultivars tolerant to anaerobic conditions combining high grain yield which can be recommended for direct sowing in rainfed and irrigated lowland areas. Further studies are recommended to test the survival rate and establishment of seedlings after removal of water from direct sown paddy field and to estimate the growth parameters and yield potential also.

GENETICS AND PLANT BREEDING

Author	:	**SUDHAKAR REDDY, B.**
Title of the Thesis	:	**EVALUATION AND CHARACTERIZATION OF RICE NEAR ISOGENIC LINES FOR MAJOR ABIOTIC STRESSES OF COASTAL AREAS**
Chairperson	:	**Dr. M. GIRIJA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5432**

ABSTRACT

The present investigation was carried out during *kharif* and *rabi* 2016-17 at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, Andhra Pradesh to evaluate and characterize Near Isogenic Lines (NILs) for yield parameters and major abiotic stresses of coastal irrigated areas using DUS morphological and molecular markers, to assess genome recovery in comparison with recurring parent and to study character association for yield and lodging related parameters. The data were recorded on plant height, ear bearing tillers per plant, days to 50 % flowering, number of grains per panicle, spikelet fertility %, 1000 grain weight, panicle length, grain yield per plant, culm diameter, culm thickness, basal internodal length, per cent of lodging, culm strength, bending stress, anaerobic germination %, plant survival % at 34 days after sowing, plant survival % at 40 days after transplanting, flash flood + stagnant flood plant survival %, stagnant flooding plant survival % and salinity scoring.

The analysis of variance revealed significant differences among the entries for all the characters indicating the presence of sufficient genetic variability among the 24 entries studied. NILs expressed on par or better performance than the recurrent parent for the characters studied with expression of targeted trait. These results revealed that this improved version of popular varieties for submergence, lodging and salinity would be accepted by the farmers.

Agro morphological characterization was recorded on 54 morphological and quality characters. Out of 54 characters studied, 25 characters are found to be monomorphic, 21 were found to be dimorphic and remaining characters are polymorphic. Most of the agro morphological characters were found to be similar between Near Isogenic Lines and their respective recurrent parent.

Screening of 24 entries for major abiotic stress results in identification of NILs with multiple abiotic stresses such as *Sub1* NILs of Amara expressed moderate level of salinity tolerance, NILs of lodging expressed moderate anaerobic germination % and most of the NILs expressed lodging resistance.

NIL of Pushyami MTU 2336-70-46-25-44 for *Sub1* having highest genome recovery of 96.4 % showed dark green intensity of leaf colour, medium leaf senescence can be differentiated with recurrent parent Pushyami possessing light green intensity of leaf colour and early leaf senescence. Indentified best NIL of Amara MTU 2244-119-59-63-40 for *Sub1* having highest genome recovery of 96.3 % exhibited weak pubescence of blade surface, medium leaf senescence, medium gelatinizing temperature can be differentiated with recurrent parent Amara possessing medium pubescence of blade surface, early leaf senescence, low gelatinizing temperature.

Identified best NIL of Swarna MTU 2546A-34-1-9-1 for *SCM2* exhibited genome recovery of 94.1 % showed medium pubescence of blade surface, thick stem thickness, medium leaf senescence can be differentiated with recurrent parent Swarna for absence in pubescence of blade surface, thin stem thickness, early leaf senescence. NIL of popular variety Indra MTU 2547A-78-19-1-1 for *SCM2* showed highest genome recovery of 93.7 % exhibited no variation in all the agro morphological characters studied with the recurrent parent Indra.

NIL of Cottondora sannalu DST 8-162-4 for *saltol* exhibited highest genome recovery of 91.0 % showed strong pubescence of blade surface, thick stem thickness, long panicle length, medium panicle number per plant (>11) can be differentiated with recurrent parent Cottondora

sannalu possessing weak pubescence of blade surface, medium stem thickness, medium panicle length, low panicle number per plant (<11). NIL of Cottondora sannalu MTU 2251A-136-11-1 for *SCM2* possessing genome recovery of 93.8 % exhibited strong pubescence of blade surface, thick stem thickness can be differentiated with recurrent parent Cottondora sannalu showed weak pubescence of blade surface, medium stem thickness.

Results of molecular characterization showed genetic diversity among 24 entries studied. Markers with higher PIC value (RM 243, RM 212, RM 5919, and RM 2229) can be used to distinguish entries apart from marker linked introgressed region. The Jaccard's genetic similarity coefficient ranged from 0.212 to 1.000. Near Isogenic Lines MTU 2547A-78-19-1-1 and MTU 2547A-77-11-1 showed 100 % similarity. Lowest similarilty (0.212) is observed between MTU 2244-119-83-65 NIL of Amara and Swarna Sub1. The dendrogram showed two distinct clusters at similarity coefficient of 33 % among the 24 rice entries. Cluster I is sub divided into 2 clusters, cluster IA consists of 8 entries and cluster IB with 10 entries. Cluster II is sub divided into 2 clusters, cluster IIA consists of 5 entries and cluster IIB with only one entry. The above results revealed that grouping of cluster I using molecular markers is in accordance with parental ancestry and morphological traits.

Correlation analysis revealed that grain yield per plant has significant positive genotypic association with number of grains per panicle, days to 50% flowering and panicle length and negative association with 1000 grain weight, basal internodal length and per cent of lodging. Indirect selection for these traits inherited together positively would be rewarding for the development of high yield varieties. Per cent of lodging showed negative association with culm diameter, culm thickness and bending stress of lodging related traits indicating that careful selection for wider, thicker culms coupled with high yield would result in non lodging varieties.

The NILs studied expressed targeted traits with maximum recovery of recurrent parent without yield penalty with clear cut morphological, molecular distinguished characters. In this study we identified NILs expressing tolerance to multiple abiotic stresses apart from targeted trait. The NILs would serve as climate resilient varieties for enhancing rice productivity by withstanding adverse effects of climate changed conditions.

GENETICS AND PLANT BREEDING

Author	:	**SUDHEER, BONGI.**
Title of the Thesis	:	**GENETIC DIVERGENCE AND CHARACTER ASSOCIATION OF RICE (*ORYZA SATIVA* L.) GENOTYPES SUITABLE FOR EARLY *KHARIF* SEASON**
Chairperson	:	**Dr. P. RAMESH BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5440**

ABSTRACT

The present investigation was carried out during early *kharif* 2016 at Agricultural Research Station, Nellore, to study the variability, heritability, expected genetic advance, character association and path coefficient analysis involving 60 genotypes in rice for characters *viz*., days to 50 % flowering, days to maturity, plant height, number of ear bearing tillers per plant, panicle length, number of filled grains per panicle, number of ill-filled grains per panicle, 1000 grain weight, flag leaf length, flag leaf width, flag leaf area, SPAD chlorophyll meter reading, harvest index, grain length, grain width, grain L/B ratio and grain yield per plant.

Analysis of variance revealed significant differences among the genotypes for majority of the characters studied indicating a high degree of variability in the material.

The estimates of PCV and GCV were high for characters *viz*., Number of ill-filled grains per panicle. Moderate PCV and moderate GCV were observed for flag leaf length, ear bearing tillers per plant, grain yield per plant, 1000 grain weight, grain L/B ratio, flag leaf area and harvest index. While, low PCV and GCV were observed for days to 50 % flowering, days to maturity, plant height, panicle length, SCMR, grain length, and grain width.

The estimates of heritability coupled with genetic advance as per cent of mean were high for the characters *viz*., number of filled grains per panicle, number of ill-filled grains per panicle, 1000 grain weight, flag leaf length, flag leaf area and grain L/B ratio indicating the involvement of additive gene action in the inheritance of these traits.

The results of D^2 analysis indicated the presence of considerable genetic divergence among the 60 genotypes studied. The 60 genotypes were grouped into eight clusters. Out of 17 characters studied, flag leaf width, 1000 grain weight, days to maturity, flag leaf length and grain width contributed maximum towards divergence. Based upon the divergence studies, crosses may be made between genotypes of cluster III (IR 109A235) and VIII (JGL 11118) followed by cluster V (IR 11C208) and cluster VIII (JGL 11118) to obtain desirable transgressive recombinants suitable for *kharif* situation.

Correlation studies at phenotypic and genotypic level revealed that the traits panicle length, flag leaf width, number of ear bearing tillers per plant, number of filled grains per panicle, 1000 grain weight, SCMR, and harvest index were found to possess significant association in desirable direction with grain yield per plant.

Path analysis revealed that number of ear bearing tillers per plant, number of filled grains per panicle, 1000 grain weight and harvest index showed true relationship by establishing positive association and positive direct effect on grain yield per plant.

Considering the nature and magnitude of character association and their direct and indirect effects, it can be inferred that under early *kharif* situation simultaneous improvement of grain yield per plant is possible through number of ear bearing tillers per plant, number of filled grains per panicle, 1000 grain weight and harvest index.

GENETICS AND PLANT BREEDING

Author	:	**SURYANARAYANA, LIMMAKA.**
Title of the Thesis	:	**STUDIES ON HETEROSIS, GENE ACTION AND STABILITY OF F_1 HYBRIDS IN MAIZE (*Zea mays* L.) FOR YIELD AND YIELD COMPONENTS**
Chairperson	:	**Dr. M. REDDI SEKHAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5424**

ABSTRACT

The present investigation was undertaken to elicit information on combining ability, heterosis and stability of maize hybrids for yield and yield components of promising hybrids over six environments (seasons) and also to identify donor parents having favourable alleles for grain yield and its components for improving the target cross BML 6 × BML 7.

During *kharif* 2013, 30 maize inbred lines were evaluated for genetic divergence using Mahalanobis D^2, wards minimum variance and principal component analysis. The analysis of variance revealed the existence of significant differences among the 30 inbred lines for 21 characters indicating the presence of genetic variability in the breeding material. High heritability coupled with high genetic advance as per cent of mean recorded for plant height, ear height, ear length, number of kernels per row, 100 kernel weight, grain yield per plant, LAI at 30, 60 and 90 DAS, LAD at 30-60 and 60-90 DAS, SCMR and stover yield per plant indicated the operation of additive gene effects in the genetic variations of these traits.

Genetic divergence analysis through Mahalanobis D^2, wards minimum variance and principal component analysis classified 30 maize inbred lines in six divergent clusters. In D^2 analysis, grain yield per plant, stover yield per plant, number of kernels per row, LAI at 30 DAS, ear height, SCMR and days to 50% tasseling contributed maximum for the divergence. While in PCA the characters *viz.,* LAD at 60-90 DAS, days to maturity, plant height, number of kernel rows per ear, ear height and LAD at 30-60 DAS contributed more towards variability.

Forty crosses were generated by involving ten inbred lines and four testers in a Line × Tester fashion during *rabi* 2013. Divergent inbred lines from divergent clusters were selected as lines and testers for hybridization programme based on Mahalanobis D^2 statistics and principal component analysis. The evaluation of crosses for combining ability, heterosis and stability along with their parents and standard checks was done over six environments i.e., *kharif* 2014 (early *kharif, kharif* and late *kharif*) and *rabi,* 2014 (early *rabi, rabi* and late *rabi*) at Agricultural College Farm, Naira.

The pooled combining ability analysis of variance showed significant differences due to locations, parents, hybrids and various interactions indicating the existence of sufficient variation in the material under study. The ratio of general combining ability component of variance to specific combining ability component of variance revealed the presence of additive gene action for ear length and ear girth, the traits governed by additive gen action can be improved through hybridization followed by simple selection. Whereas, non-additive gene action was predominant for remaining characters

The estimates of *gca* effects among the lines MRC 185, MRC 139 and testers BML 10 and RSK was significant in desirable direction for grain yield and yield contributing traits and found to be good general combiners for grain yield per plant. The crosses involving good general combiners MRC 185 × BML 10, MRC 139 × BML 10 and MRC 185 × RSK 14 expressed high *per se* performance and *sca* effects for grain yield per plant and other yield contributing characters.

G × E interaction studies at six environments for yield and yield attributes by Eberhart and Russell model revealed the cross MRC 216 × BML 10 to be stable for grain yield per plant over environments. Whereas, in the AMMI model the crosses *viz.,* MRC 216 × RSK 14, MRC 126 × RSK 14, MRC 163 × MRC 202, MRC 139 × MRC 202, MRC 216 × BML 10 and MRC 186 × RSK 14 were found to be stable for grain yield per plant with mean higher than the grand mean and IPCA score nearer to zero.

The identification of unique favourable alleles in donor inbreds for improving the target cross, BML 6 × BML 7 revealed that, the donors, RSK 14, BML 10 and MRC 202 recorded the highest significant positive $\mu G'$ estimates indicating their worth in transferring favourable alleles in the target cross for ear length, number of kernel rows and grain yield per plant.

GENETICS AND PLANT BREEDING

Author	:	**SYAMALA, P.**
Title of the Thesis	:	**COMBINING ABILITY AND HETEROSIS STUDIES IN CGMS BASED HYBRIDS OF PIGEONPEA (*Cajanus cajan* (L.) Millsp)**
Chairperson	:	**Dr. N.V. NAIDU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5520**

ABSTRACT

The present investigation comprising of nine parents of pigeonpea (*Cajanus cajan* (L.) Millsp.) and 20 cross combinations developed through Line X Tester (5 X 4) crossing programme were evaluated for genetic parameters, heterosis, combining ability, character

association and path coefficient analysis during *kharif,* 2016. The experiment was laid out in Randomized Block Design with three replications at the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad and observations were recorded on 11 characters.

Analysis of variance indicated the existence of significant differences among the genotypes for all the characters. Among the parents, the lines ICPB-2047 and ICPB-2048, the testers ICPL-87119 and ICPL-20123 and among the crosses, ICPA-2092 x ICPL-20108, ICPA-2092 X ICPL-87119 and ICPA-2047 X ICPL-20108 showed high mean performance for secondary branches per plant, pods per plant, harvest index and seed yield per plant in parents and crosses indicating that simple selection may be practiced for improving these characters.

The magnitude of standard heterosis was high for secondary branches per plant, pods per plant, harvest index and seed yield per plant, whereas for seeds per pod and days to 75% maturity it was very low. Out of 20 crosses, the crosses *viz*., ICPA-2092 x ICPL-20108, ICPA-2047 x ICPL-20108, ICPA-2047 x ICPL-20116 and ICPA-2047 x ICPL-20123 had recorded significant and maximum heterosis for most of the characters.

The analysis of variance for combining ability indicated the predominance of non-additive gene action for all the traits due to higher *sca* variance than *gca* variance. Among the parents, ICPB-2078 and ICPB-2043 were the best general combiners for days to 50% flowering and days to 75% maturity, while ICPB-2047 for plant height, primary branches per plant, secondary branches per plant, seeds per pod, harvest index and seed yield per plant. ICPB-2092, ICPB-2078 and ICPB-20123 were the promising parents for pods per plant, 100-seed weight and seed protein. Based on *sca* effects, *per se* performance and heterosis, the crosses *viz*., ICPA-2092 x ICPL-87119 and ICPA-2092 x ICPL-20116 were identified as the best specific crosses for hybrid breeding programme while the crosses ICPA-2092 x ICPL-20123, ICPA-2048 x ICPL-20116, ICPA-2078 x ICPL-20108, ICPA-2043 x ICPL-87119, ICPA-2048 x ICPL-20108, ICPA-2092 x ICPL-20116, ICPA-2092 x ICPL-87119, ICPA-2078 x ICPL-87119, ICPA-2047 x ICPL-87119, ICPA-2043 x ICPL-20108 and ICPA-2047 x ICPL-20123 were identified for advancing through recombination breeding programme.

Character association studies revealed that selection based on all the characters except secondary branches per plant, seed protein, 100-seed weight in parents and seed protein, 100-seed weight in crosses will be effective for selection in improvement of seed yield as they had significant and positive correlation with seed yield per plant. Path analysis revealed high positive direct influence of pods per plant on seed yield and it also had positive indirect effects on seed yield *via* most of the characters in both parents and crosses. Hence, selection for pods per plant alone can be suggested for the improvement of seed yield per plant in pigeonpea.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author	:	**AJAY KUMAR, D.**
Title of the Thesis	:	**MOLECULAR TAGGING OF YELLOW STRIPE LIKE (OsYSL) PROTEIN FAMILY GENES FOR GRAIN Fe AND Zn CONTENT IN RICE (*Oryza sativa.* L)**
Chairperson	:	**Dr. A. SRIVIDHYA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5521**

ABSTRACT

Association mapping (AM) provides useful insights on the genetic architecture of traits using a large number of natural populations. However, candidate gene/family based association study provides precise mapping and prompt recovery of major loci associated with respective trait from the gene level, that help to achieve precision in plant breeding. Hence, in the current study the knowledge of functionally characterized genes that participate in the uptake, long distance transport and grain loading of micronutrients viz. Fe and Zn were used for identification of markers/genes that associate with respective traits using genic *Indel* and SSR markers from these known loci.

The grain Fe and Zn content of a total of 67 diverse rice genotypes were analysed with acid digestion method using Atomic Absorption Spectroscopy(AAS). The mean Fe content of the association panel was 55.07ppm, with a highest Fe content of 77.37ppm (BC_1F_3-75; a line derived from cross involving LND384 and INRC10192). The mean Zn content observed was 22.27ppm wherein the genotype (BC_1F_3 75 (LND384/INRC10192) showed highest Zn content of 47.63ppm.

When compared to the released biofortified rice varieties, a total of six genotypes viz. $BC_1F_3$75 (77.37ppm, 47.63ppm), Swarna (76.33ppm, 31.71ppm), MTU1061 (63.91ppm, 30.47ppm), LN388 (71.57ppm, 27.72ppm), JGL17004 (64.50ppm, 27.07ppm) and HKR47 (69.40ppm, 26.53ppm) that out performed for Fe (>60ppm) and Zn (>25ppm) content, respectively were identified. A very high significant positive correlation value (r^2 = 0.882**) was observed between grain Fe and Zn content measured among the genotypes, denotes that selection for grain Fe content simultaneously improves Zn content also.

Genotyping of the association panel was done by employing a total of 40 markers (*Indels* and SSRs) targeting 18 YSL genes and another 7 reported QTL linked markers. The annealing temperatures for the primers were ranged from 55ºC to 64ºC. Of 41 used, ten markers (24.39%) were polymorphic, suggesting the availability of potential variability for few of the selected loci. The genotyping of association panel resulted in the generation of allele size range of 80bp - 450bp for the markers RM17621 and vf0419060908, respectively.

Diversity study using YSL gene specific polymorphic markers in association panel revealed a total of 23 alleles, with an average of 3.8 alleles per loci. Highest number of alleles (6) was observed for YSL2 gene and lowest number of alleles was observed for YSL13 (2). The polymorphism information content (PIC) value for these primers ranged from a 0.59 (04g44300) to 0.88 (vf0509222520), followed by 0.88 (vf0226164382) with an average PIC value of 0.72.

Diversity study using four polymorphic QTL linked markers, total of 24 alleles were found with a range of 5 alleles (RM243 and RM3412) to 8 (RM17) and with mean allele value of 6. The polymorphism information content (PIC) value for these primers ranged from a 0.69 (RM3412) to 0.87 (RM17) with an average PIC value of 0.80

Marker – trait association study using TASSEL softw are revealed 6 YSL gene specific and 5 QTL linked associations, on four chromosomes. The associations at five loci namely, YSL2 (LOC_Os02g43370), YSL8 (LOC_Os02g02460), YSL13 (LOC_Os04g44300), qFe1.1 and (qZn12.1, qFe12.1) were commonly associated with both grain Fe and Zn content. Hence, these regions may governing grain loading of both Fe and Zn. The R^2 (%) values of most of the markers that associated with grain Fe and Zn are ≥15%. suggesting the major role of these loci/genes/QTLs in controlling the respective trait. Thus, these can be regarded as potential sources in the simultaneous development of grain Fe and Zn.

Among these genes, the potency of YSL2, YSL8 and YSL13 were proved through transgenic approaches also. Hence, our study has revealed the importance of usage of the knowledge about functionally characterized genes in unravelling the association of highly significant and major genomic loci, while highlighting their functional importance to use in targeted breeding programmes with high veracity.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author	:	**APARNA, ERAGAM.**
Title of the Thesis	:	**IDENTIFICATION OF DIFFERENTIALLY EXPRESSED GENES IN RESPONSE TO MID SEASON DROUGHT IN GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. Y. AMARAVATHI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5522**

ABSTRACT

Drought is one of the major constraints in groundnut and governed by many genes with small effects operating in a coordinating manner. The present investigation was aimed

for identification of differentially expressed transcripts in response to midseason drought in groundnut. To this end, a total of eleven genotypes viz., ICGV 07132, ICGV 07070, TCGS 1398, TCGS 1157, TCGS 1073, TCGS 1173, MLTG 4, Narayani, Tirupati 1, Kadiri 9 and Kadiri 6 were screened in pot culture for moisture stress tolerance. Among the eleven genotypes, TCGS 1157 and MLTG 4 genotypes showed early recovery after reaching the permanent wilting point and were grouped into moisture stress tolerant group. In contrast, Narayani and Kadiri 6 were highly sensitive to moisture stress.

The field experiments were carried out at the research farm of Regional Agricultural Research Station (RARS) and molecular analysis at Genomics lab, Institute of Frontier Technology (IFT), RARS, Tirupati. The contrasting genotypes for mid-season drought *viz.,* MLTG 4 and TCGS 1157 (tolerant) and Narayani and Kadiri 6 (susceptible) were further analyzed for morphological, physiological, biochemical and molecular parameters submitted to midseason moisture stress (50-80 DAS) in the field conditions.

SPAD Chlorophyll Meter Reading (SCMR) and Specific Leaf Area (SLA) were considered as surrogate traits for drought tolerance. The SPAD Chlorophyll Meter Reading values were increased as moisture stress period was increased upto 30 days in both drought tolerant and susceptible groundnut genotypes studied. SCMR can be used as non-destructive measure to estimate chlorophyll density while screening groundnut genotypes for drought tolerance. SLA decreased significantly in drought tolerant genotypes than in drought susceptible genotypes. Based on the SLA values, groundnut genotypes can be clearly distinguished from the drought susceptible genotypes.

The increased levels of proline under drought stress can be better considered as drought stress indicator in groundnut. The accumulation of proline was more as the moisture stress progressed up to 30 days in all groundnut genotypes under the study.

The total chlorophyll content under moisture stress imposed in groundnut genotypes initially was increased up to 70 DAS and declined at 80 DAS except for TCGS 1157. This was most probably due to prolonged vegetative growth phase in TCGS 1157 (120 days duration) when compared to MLTG 4, Narayani and Kadiri 6. To protect the cell from Reactive Oxygen Species generated in photorespiration, both catalase and peroxidase activities were increased in all the genotypes submitted to prolonged moisture stress.

To unravel the molecular mechanisms conditioning drought tolerance, transcriptome was analyzed in groundnut subjected to mid-season stress (50-80DAS). To identify differentially expressed transcripts, cDNA-RAPD analysis was carried out using total RNA collected from leaves under well watered (control) and moisture stress situations at 10 (60 Days After Sowing), 20 (70 Days After Sowing) and 30 (Days After Sowing) days.

Transcriptome was analyzed by cDNA-RAPD to identify differentially expressed transcripts in groundnut subjected to mid-season stress. cDNA-RAPD profiles with 35 RAPD markers resulted in a total of 823 reproducible differentially expressed transcripts in three regimes of moisture stresses. Among the 823 differentially expressed transcripts, 523 transcripts exhibited qualitative difference while 300 transcripts displayed quantitative differences in banding pattern of cDNA-RAPD profiles among all the four genotypes.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author	:	**ARPITHA SHANKAR, B.**
Title of the Thesis	:	**SELECTIVE LINE GENOTYPING FOR IDENTIFICATION OF MARKERS ASSOCIATED WITH HEAT-TOLERANCE IN RICE (*ORYZA SATIVA* L.)**
Chairperson	:	**Dr. N.P. ESWARA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5523**

ABSTRACT

Due to global warming and quickening industrialization environment is changing day by day and heat stress has become a major challenge for sustained production of rice. Rice is highly sensitive to heat stress during all growth stages, which will reduce the yield and create great losses. Production levels are decreasing gradually due to high temperature conditions. Hence, the present investigation was carried out to identify rice genotypes which can withstand high temperature conditions by employing Selective Line Genotyping approach.

A set of 74 genotypes were tested for heat tolerance under laboratory conditions employing Temperature Induction Response (TIR) technique with three temperature conditions *viz*. Control at room temperature, Sub-lethal gradual exposure to 38˚C -55˚C range and Lethal at 55˚C. Based on su rvival percentage (SP), relative root length, and relative shoot length measured under sub-lethal conditions over control, 14 genotypes were selected each under tolerant and sensitive classes. The genotypes under tolerant class fell between 80-100% survivability.

Of 14 tolerant genotypes, two genotypes *viz*. FR13A and Swarna Sub1A showed 100% survivability and were highly out performed to check genotypes in relative root length (62.53% and 47.56%, respectively) and shoot length (106.20% and 40.74%, respectively), in comparison to known tolerant genotypes. Next to survival percentage, root length plays an important role for selecting genotypes. In our study Maximum root length fell in the range of 4.8 cm - 10.74 cm and maximum RRL was observed for BPT1235 (82.54%). Also when it comes to shoot length, highest shoot length was recorded in BPT1235 which is about 11.75cm.

Based on the survival percentage (SP), RRL and RSL of genotypes, a total of 14 genotypes under each class *viz*. heat tolerant and heat sensitive classes were selected and used for molecular studies employing selective line genotyping approach (SLG). Under selective line genotyping approach, the selected tolerant and sensitive sets were genotyped with 51 SSR and genic markers. Out of all the 51 markers which were genotyped, the markers RM17270, RM16216, RM5687 and TTC/TTM gave polymorphic alleles, whereas 92% the

markers couldn't distinguish tolerant set from sensitive and as well among reported tolerant genotypes (N22, Dular and Nipponbare).

In our study, the alleles generated by different polymorphic markers were not clearly distinguished the tolerant set from sensitive set of genotypes. Among the reported genotypes also the allele sizes were varied except for the marker TTC/TTM, as they are from different sub groups of rice. N22 and Dular comes under *Aus* group, whereas Nipponbare comes under *japonica* group.

From the experiment, we have concluded that both heat stress tolerant genotypes FR13A and SwarnaSub1A can be used as donor sources for heat tolerance because these genotypes proved themselves to be good performers under sublethal conditions, also their amplification pattern with well reported loci RM17270 is similar to checks Dular and Nipponbare. Although, the other three markers are not much informative in the current study, to distinguish the tolerant group from sensitive group, they are reported to be linked to heat tolerance by different research groups. Thus, our study has unveiled valuable markers (regions) and genotypes in developing alternative donor sources in *indica* rice, rather original *aus* and *japonica* group, where they originally identified, to use them in heat tolerance breeding programmes for better yields.

Put together the involvement of small set of phenotyping panel and use of extremely core set of genotyping panel for SLG that generated most relevant association of potent markers along with identified donors comparable to QTL mapping results. Further, the diverse allele pattern exhibited by genotypes alike large association panel, additional knowhow of the degree of association of a locus makes the SLG technique to be challenged as greatly powerful.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author	:	**SURESH NAIK, E.**
Title of the Thesis	:	**GENE EXPRESSION AND SEQUENCE ANALYSIS OF KNOWN YIELD GENES IN HIGH YIELDING VARIETIES OF RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. V. LAKSHMI NARAYANA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5524**

ABSTRACT

Rice (*Oryza sative*. L) is one of the major food crops in the world. Half of the world's population depends on rice as their staple food. Rice yield is governed by mainly three major traits i.e., number of tillers per plant, grain number per panicle, grain size and are directly associated with rice grain productivity. Rice yield is a complexly inherited trait governed by many genes/QTLs. As of now more than 34 genes have been molecularly cloned and

characterized, however, using donors from China and Japan only. However, their gene expression and sequence variation needs to be validated before directly using them in the rice breeding programmes. In the present investigation, an attempt has been made to validate the gene expression and sequence variation of the important cloned genes governing yield traits in known India donor varieties.

In all, 21*indica* rice genotypes have been selected including 15 high yielding and 6 low yielding. The phenotypic data of the important yield and its component traits such as, plant height, culm height, number of tillers per plant, panicle length, number of grains per panicle, days to 50% flowering, filled grains, chaffy grains, spikelet fertility, grain weight, grain length, grain width, biological yield, harvest index, and economic yield have been recorded. The analysis of variance (ANOVA) for the 21 rice genotypes for all the agronomic traits revealed highly significant differences among the entries for all the characters except for panicle length, grain length, and grain width.

The expression analysis was carried out with gene specific primers designed from key yield genes from the flag leaf and young panicles. The semi qRT PCR gene expression analysis in the selected rice genotypes revealed differential expression of all yield genes. The *Gn1a* gene expression analysis revealed that the known Indian high grain number donor varieties with low or nil gene expression such as, NLR33892, Ranjit, BPT2601, BPT5204 and Rasi can be used as donors for. The gene expression analysis of *OsSPL14* revealed that the high grain number varieties with high gene expression can be used as donor varieties *viz.,* MTU1064, Dee-geo-woo-gen, Rasi, BPT5204, and MTU1010 from Indian rice germplasm. The *DEP1* gene expression revealed that the high expression varieties with high grain number could be value for marker assisted introgression of this trait into highly adaptable low grain number varieties. The *GIF1* gene expression analysis revealed that the high gene expression varieties with high grain weight such as, BPT 2678 and Basmati370 are the potential donors for grain weight/grain filling trait. The *GW8* gene expression analysis in all 21 rice genotypes revealed that the high grain weight varieties with high GW8 expression such as, MTU3626, IR-8, Dee-geo-woo-gen, MTU1010, MTU1001, and INRC10192 can be used as donors from Indian rice germplasm. The *Ghd7* expression analysis revealed that the high grain number, tall plant, and late flowering varieties with high *Ghd7* expression such as, NLR33892, BPT 2678, Ranjit are can be used a donors from Indian rice germplasm.

Besides gene expression analysis, the DNA sequence variation of most differentially expressed yield genes such as *Ghd7, DEP1* and *Gn1a* also analyzed in all high yielding and low yielding varieties. The whole genome DNA sequence of *Ghd7* gene (3918 bp) was resequenced in all 21 rice genotypes. In all, 104 SNPs and 141 indels were detected. It was found that certain nucleotide variations are unique to high grain number varieties such as, MTU1121, MTU1010, and Dee-Geo-Woo-Gen. It was found that certain nucleotide variations are unique to tall (>95cm) varieties such as, INRC10192, Tetep, and MTU1001. It was found certain nucleotide variations are unique to late flowering (>105 days) varieties such as, MTU7029 (G/A) at 1426, MTU1001 (T/C) at 1425 bp positions of the gene. However, there is no nucleotide variations were found for their specific traits in all the varieties. The whole genome DNA sequence of *DEP1* gene (4363 bp) was resequenced in all high yielding and low yielding rice genotypes. In all, 99 SNPs and 338 indels were detected in the 5732 base pair alignment and of these, three SNPs (IR-8) and 61 indels were detected in the promoter region of the gene. However, there are no nucleotide variations found specific to either low or high grain number varieties. The whole genomic DNA sequence of *Gn1a* gene (6476 base pair) was resequenced in all genotypes. In total, 97 SNPs and 121 indels were detected in the 4837 base pair alignment. Of these, one SNP (MTU1064) and 28 indels

were detected in the promoter region. It was found certain nucleotide variations are unique to high grain number varieties such as, NLR33892, MTU1064, MTU1010 (G/G) and Dee-geo-woo-gen (A/T) having SNPs at 1426 base pair position of the gene. However, there are no nucleotide variations in specific to either low or high grain number varieties were observed.

In short, an attempt was made to identify the Indian donor varieties comparison of important yield genes based on consistent gene expression and sequence analysis with reported donors. The shortlisted donors for the yield traits can be right away used in the rice breeding programmes.

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Author	:	**SWARAJYA LAKSHMI NAIDU, B.**
Title of the Thesis	:	**ALLELE MINING AND ALLELIC DIVERSITY OF GENES GOVERNING GRAIN SIZE RELATED TRAITS IN RICE (*Oryza sativa* L.)**
Chairperson	:	**Dr. V. LAKSHMI NARAYANA REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5525**

ABSTRACT

Mining elite alleles for grain size is one of the key aspects for the improvement of cultivated rice to suit diverse global consumer preferences. Thus with the goal of identification of novel and superior alleles from the genes governing the grain size related traits by exploring the natural variability present in the rice germplasm, the present study was conducted.

In all, 124 rice genotypes were evaluated for different grain traits such as grain length (GL), grain width (GW), grain length to width ratio (GL/GW), and 1000-grain weight (TGW). The germplasm of 124 rice genotypes presented substantial variation for grain size traits. Significant correlations were detected among the grain size traits. All the four traits exhibited normal distribution in the germplasm indicating quantitative inheritance of these traits.

In total, 32 molecular markers comprising of 8 grain size gene-specific markers and 24 SSR markers covering all 12 chromosomes were used in this study and all markers showed polymorphism and produced a total of 86 alleles among the 124 rice varieties. Number of alleles ranged from 2 to 4 with an average of 2.68 alleles per locus. The mean polymorphism information content (PIC) value was 0.34, with values ranging from 0.70 (RM 252) to 0.03 (RM 502).

The screening of the 124 rice genotypes with eight gene-specific markers *viz*., GS3 specific marker revealed two alleles, GS5INDEL1 revealed two alleles, *qSW*5 specific marker revealed four alleles, *qGRL*7.1 specific marker revealed two alleles, *GS*2 specific marker revealed two alleles, *qsgw*7 specific marker revealed two alleles, *SLG*7 specific marker revealed two alleles and *GLW*7 specific marker revealed two alleles with substantial variation in the germplasm.

For finding the allelic diversity a dendrogram consisting of 124 rice genotypes was drawn using unweighted pair group method using arithmetic averages (UPGMA) based on genotyping data using NTSY spc -2.02e software. The dendrogram revealed that 124 genotypes could be made into two groups, A and B. The group A exclusively includes the extra-long grain length basmati genotypes. However, the group B could be again divided into two groups *i.e.,* B1 and B2. The group B1 includes mostly long grain genotypes. The group B2 comprising of all classes of grain length and size genotypes.

Based on the population structure Q matrix data the 124 accessions are divided into four clusters/subpopulations, viz., from POP1 to POP4. POP1 subpopulation was grouped under extra-long grain type, POP2 was grouped under long grain type, POP3 and POP4 includes all the four grain size classes.

Eight marker-trait associations were identified by screening 124 genotypes with grain size specific primers for GL, GW, L/B and TGW traits. One *GS*3 gene-specific marker, GS3RGS1 was found to be associated with GL, GW, L/B and TGW traits with their PVE as 15.2%, 16.9%, 10.3% and 7.8%, respectively. Earlier results by Fan *et al.,* (2006), Lu *et al*., (2013) and Xu *et al*., (2016) also reported that the *GS*3 is the major gene governing the grain length and minor gene for grain width. Similarly, one SSR marker, RM505 was showed association with GL, GW, L/B and TGW traits with their PVE as 4.4%, 2.6%, 1.9% and 3.8%, respectively.

The present investigation reinforce the fact that grain size is a complex trait regulated by many genes located on different chromosomes. However, the gene specific markers, for GL, GW, TGW and L/B traits, such as GS3RGS1 and RM505 have potential to be used as foreground markers in marker-assisted breeding. Mining of complete gene sequences and other genes governing grain size traits is warranted further investigation adding some more germplasm. However, harmonious pyramiding of superior and novel alleles from diverse germplasm facilitates the designing of rice varieties suitable to diverse consumers in the world.

PLANT PATHOLOGY

Author	:	**AMULYA, G.**
Title of the Thesis	:	**PHYLOGENETIC VARIATION AND FUNGICIDAL MANAGEMENT OF CERCOSPORA ABELMOSCHI ELL. AND EV. INFECTING OKRA**
Chairperson	:	**Dr. V. PRASANNA KUMARI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5442**

ABSTRACT

The present study on phylogenetic variation and fungicidal management of *Cercospora abelmoschi* Ell. and Ev. infecting okra was taken up in the Agricultural College, Bapatla during 2016-2017.

Cercospora leaf spot was mainly observed on the lower surface of leaves in the form of sooty to dark olivaceous colour, indistinct or none, fruiting effuse, forming angular vein limited areas in dense patches of conidiophores and conidia.

Cercospora infected leaves were collected during *kharif* 2016 from eight different okra growing villages in Guntur district, Andhra Pradesh which were used for *in planta* isolation of fungal DNA using universal primers ITS 1 and ITS 4.

The 550 bp amplicon thus obtained was restricted with hexa cutters, EcoRI, BamHI and tetra cutter Taq1 to find variability among *Cercospora* isolates. EcoRI found two restriction sites in all isolates except the Yazali isolate while BamHI found single restriction site in all the isolates with length polymorphism in Yazali isolate. Taq1 restriction indicated a high degree of genetic diversity among the isolates and was represented by three different banding patterns while in three isolates there was no restriction sites.

Dendrogram constructed from similarity coefficients showed that Yazali isolate seperated into a group upon digestion with EcoRI and BamHI. Taq1 digestion of Yazali isolate clustered with Thimmareddipalem isolate. The results revealed that, polymorphism existed among the *Cercospora* isolates collected from Guntur district. The changes in single nucleotide resulted in variation in restriction sites for the different restriction enzymes used.

Among all the tested fungicides, trifloxystrobin + tebuconazole @ 0.1% showed significant reduction of the disease on both lower leaves (35.61%) and upper leaves (12.98%), leading to the significant increase in yield (101.75 q ha^{-1}). However, highest benefit cost ratio was recorded with propiconazole @ 0.1% (3.62).

Phenol content in lower leaves(1.58 mg g^{-1}) and upper leaves (1.52 mg g^{-1}), total protein content in lower (9.32 mg g^{-1}) and upper leaves (9.23 mg g^{-1}) were significantly higher in trifloxystrobin + tebuconazole @ 0.1% applied plants. Total sugar content in lower (12.33 mg g^{-1}) and upper leaves (10.08 mg g^{-1}) were low in trifloxystrobin + tebuconazole @ 0.1% treatment.

The reduction in Chlorophyll a and chlorophyll b was observed to be lowest in lower leaf (1.15 and 1.06 mg g^{-1} respectively) and upper leaf (1.28 and 1.02 mg g^{-1} respectively) in trifloxystrobin + tebuconazole @ 0.1% sprayed plants. The reduction in the total chlorophyll content was relatively less in trifloxystrobin + tebuconazole @ 0.1% as compared to other treatments due to reduced disease intensity and thus maintaining greenness of the leaves.

Significant negative correlation existed between disease severity and total phenols (-0.903), total proteins (-0.903), chlorophyll a (-0.901), chlorophyll b (-0.788), total chlorophyll (-0.856) while significant positive correlation existed between total sugars and disease severity (0.932).

Significantly high positive correlation existed between proteins and phenols (0.862), total chlorophyll (0.889), chlorophyll a (0.844), chlorophyll b (0.868). Similarly, significant high positive correlation existed between phenols and total chlorophyll (0.854), chlorophyll a (0.803), chlorophyll b (0.839). Significantly high negative correlation between total sugars and phenols (-0.924), proteins (-0.836), chlorophyll a (-0.919), chlorophyll b (-0.838), total chlorophyll (-0.897) existed.

PLANT PATHOLOGY

Author	:	**ARUNODHAYAM, K.**
Title of the Thesis	:	**STUDIES ON VARIABILITY OF *Fusarium udum* Butler, CAUSAL AGENT OF PIGEONPEA WILT [*Cajanus cajan* (L.) Millsp.] AND ITS MANAGEMENT**
Chairperson	:	**Dr. R. SARADA JAYALAKSHMI DEVI**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5528**

ABSTRACT

Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is the prominent drought tolerant pulse crop with multiple benefits *viz.,* source of dietary protein, protects soil from erosion and enriches it, medicinal properties, stover and fuel wood etc. Pigeonpea wilt caused by *Fusarium udum* is the most important soil borne disease. *F. udum* isolates from the same site or diverse geographical origins have been shown to exhibit high variability in cultural and pathogenic characteristics. Information on the variability of the pathogen among isolates

collected from different agro-ecological zones of Andhra Pradesh is lacking. Hence variability among 25 isolates of *F. udum* from Andhra Pradesh and Telangana were studied.

The laboratory experiments pertaining to the research work were conducted during the year 2013-2016 in the Department of Plant Pathology, S.V. Agricultural College and Institute of Frontier Technology, RARS, Tirupati, Chittoor district, Andhra Pradesh. Field experiments were conducted during *kharif* 2013 and *kharif* 2014 at Agricultural Research Station, Tandur, Rangareddy district, Telangana. Glass house experiments were conducted during 2014-15 in the Department of Legumes Pathology at International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Patancheru, Medak district, Telangana.

A total of 25 diseased specimens were collected from different pigeonpea growing areas of Andhra Pradesh and Telangana *viz.,* Chittoor, Kadapa, Anantapur, Warangal, Khammam, Kurnool, Guntur, Prakasam, Rangareddy, Medak and Mahaboobnagar during *kharif,* 2013. The pathogenic isolates were isolated and designated as FU-1 to FU-25. Pathogenicity test was conducted using root dip inoculation method. Cultural and morphological variability was studied and categorized 25 isolates into various groups based on radial growth, growth pattern, mycelial characters, mycelial colour, pigmentation, dry mycelial weight, septation of macro and micro conidia and size of micro and macro conidia. Molecular characterization was done using RAPD and found polymorphism with K1 primer at 450 bp in FU-25, with K2 primer at 620bp in FU-3, with K3 primer at 320 bp in FU-10, with K4 primer at 550 bp in FU-3 and with K5 primer at 750 bp in Fu-11. The polymorphic bands were used in developing SCAR markers for rapid detection of *F. udum* isolates. Based on wilt incidence and reaction on selected host differentials (ICP 2376, C 11, ICP 8863 and ICP 9174), 25 *F. udum* isolates were categorized into six races/variants *viz*., Variant 0, Variant I, Variant II, Variant III, Variant VIII and Variant IX. SCAR was developed successfully for FU-25 isolate with 450 bp band and for FU-3 with 620 bp. Screening of pigeonpea germplasm was done under sick plot conditions at Tandur and found TRG-59 as best genotype with lower wilt incidence of 17.42% and highest yield of 214.1 g per plant. Potential fungal antagonist T1, potential bacterial antagonist B2 and effective fungicide carbendazim were imposed as treatments in Integrated Disease Management program. Among seven treatments imposed in IDM T5 (Asha-red seed coat resistant check) was found best followed by T2 (Seed treatment with bacterial biocontrol agent).

PLANT PATHOLOGY

Author	:	**BHAVANI, BASAVALA.**
Title of the Thesis	:	**STUDIES ON THE MANAGEMENT OF FUNGAL FOLIAR DISEASES OF GROUNDNUT IN GUNTUR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. V. MANOJ KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5443**

ABSTRACT

Investigations on "Studies on the management of fungal foliar diseases of groundnut in Guntur district of Andhra Pradesh" was carried out in the Agricultural College Farm, Bapatla, Guntur district, Andhra Pradesh during late *kharif* 2016-17.

A survey was conducted during *rabi* 2016-17 in Guntur district of Andhra Pradesh. Fungal foliar disease severities were recorded in the surveyed villages of Karlapalem and Pittalavanipalem mandals of Guntur district at 30-35 and 55-60 DAS. Mean ELS PDI of Guntur district at 30-35 DAS was 12.86 %. Mean LLS PDI of Guntur district was 12.87 % at 30-35 DAS and 30.73 % at 55-60 DAS.

During late *kharif* 2016-17, ELS PDI of K-6 and Vemana showed significant positive correlation with mean minimum temperature (r = 0.556* and r = 0.604* respectively). Regression analyses for PDI of ELS and weather factors revealed that maximum temperature and minimum temperature have influenced the development of ELS on the genotypes RSB-87, Vemana, JCG-88, AVT-1666, AVT-1638 where as maximum temperature, minimum temperature and morning relative humidity influenced disease development on GG-2, Kisan, ALR-3, K-9, Abhaya, Narayani, ALR-1, Anantha and K-6.

Late leaf spot PDI of K-6 showed significant positive correlation with sunshine h (r = 0.592*) and negative correlation with minimum temperature (r = -0.819*), rainfall (r = -0.568*) and all other tested genotypes showed significant negative correlation with mean minimum temperature.

Rust PDI on all the test genotypes showed significant negative correlation with mean minimum temperature. Regression analyses with PDI of LLS and rust with weather factors revealed that maximum temperature and minimum temperature influenced the development of LLS and rust severity in all the genotypes.

Out of 14 genotypes (including check) evaluated for their resistance to fungal foliar diseases, RSB-87, Kisan, Vemana, GG-2, K-9, AVT-1638, Abhaya, Anantha, JCG-88, AVT-1666, ALR-1 and ALR-3 were moderately resistant and other two genotypes (K-6 and Narayani) were susceptible to LLS. The genotypes JCG-88, AVT 1666 and AVT-1638 were resistant, nine genotypes *viz*., RSB-87, Kisan, Vemana, GG-2, ALR-3, K-9, Abhaya, ALR-1, Anantha were moderately resistant. K-6 (check) and Narayani were susceptible to rust.

Studies on management of fungal foliar diseases with fungicides have revealed that three sprays of tebuconazole + trifloxystrobin 75 WG (50 %+ 25 % w/w) @ 0.09 % at the occurrence and at two weeks interval recorded the lowest severity of ELS (25.56 %), LLS (32.42 %) and rust (18.56 %) and improved dry pod weight, number of pods per plant and was the most economical.

PLANT PATHOLOGY

Author	:	**BHAVANI, G.**
Title of the Thesis	:	**STUDIES ON LEAF CRINKLE DISEASE OF *URDBEAN* [*Vigna mungo* (L.) Hepper]**
Chairperson	:	**Dr. V. MANOJ KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5441**

ABSTRACT

The investigation on the topic entitled "Studies on leaf crinkle disease of *urdbean* [*Vigna mungo* (L.) Hepper]" was carried out at Agricultural College, Bapatla, Guntur district, Andhra Pradesh during 2014-15.

Fixed survey conducted in Guntur district of Andhra Pradesh during *kharif* 2014 revealed the maximum overall per cent mean incidence of leaf crinkle (1.85%), followed by *mungbean* yellow mosaic disease (0.38%), leaf curl (0.08%) and mixed infections (0.03%).

Among four crop species belonging to Leguminosae tested for their reaction to *Urdbean leaf crinkle virus* (ULCV) by sap incoulation method, only *Vigna mungo* expressed the disease symptoms with crinkling and reduction of petiole length.

Seed treatment studies revealed significantly lower incidence (20.00%) of ULCV with hot water treatment (50 ^{0}C for ten minutes) than that with trisodium orthophosphate at the rate of 16% (35.00%) when compared to untreated control (38.33%).

Studies on aphid (*Aphis craccivora*) transmission of ULCV revealed maximum transmission of ULCV with pre-acquisition fasting period of 25-30 minutes (80.00%), acquisition access period of two minutes (86.67%), inoculation access period of 24 – 48 hours (80.00%) with ten aphids per plant (80.00%). Whitefly, *Bemisia tabaci* failed to transmit ULCV.

Out of 72 genotypes including susceptible check (LBG 623), screened for their reaction to ULCV, 23 genotypes were free from the disease, 46 genotypes exhibited resistant reaction, two genotypes exhibited moderately resistant reaction and only one genotype (LBG 623) exhibited susceptible reaction.

The leaf area (cm^{2} plant^{-1}), leaf thickness (µm) and stomatal frequency (no. of stomata/mm^{2}) of ULCV infected plants were found to be significant and positively correlated with disease incidence. The trichome density (5 mm dia leaf disc) of ULCV infected plants were found to be significant and negatively correlated with disease incidence. The genotypes

with purple pigmentation of petiole showed highly resistant or resistant reaction to ULCV with low disease incidence and petiole with light green pigmentation showed susceptible reaction.

Among the micronutrients tested, spraying of $ZnSO_4$ @ 0.2% recorded significantly lowest incidence (15.00%) of ULCV followed by combination of Borax @ 0.2% + $MgSO_4$ @ 0.2% + $MnSO_4$ @ 0.2% + $ZnSO_4$ @ 0.2% (26.67%) against unsprayed control (80.00%).

PLANT PATHOLOGY

Author	:	**GUNASRI , REDDI.**
Title of the Thesis	:	**STUDIES ON THE MANAGEMENT OF FUNGAL FOLIAR DISEASES OF BLACKGRAM [VIGNA MUNGO (L.) HEPPER] IN GUNTUR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. V. MANOJ KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5445**

ABSTRACT

Investigations on "Studies on the management of fungal foliar diseases of blackgram [*Vigna mungo* (L.) Hepper] in Guntur district of Andhra Pradesh" was carried out in the Agricultural College Farm, Bapatla, Guntur district, Andhra Pradesh during *rabi,* 2016-17.

A survey was conducted during *rabi,* 2016-17 in Guntur district of Andhra Pradesh to record the occurrence and severity of fungal foliar diseases at 30-35, 40-45 and 50-55 DAS. Two mandals were selected based on the preceding year blackgram cultivation statistics, in each mandal two villages and in each village two fields were surveyed. There was no record of any fungal foliar disease at 30-35 DAS. At 45-50 DAS, overall mean PDI of Corynespora leaf spot (*Corynespora cassiicola*) PDI was 31.89% and at 50-55 DAS it was 67.27%. The overall mean PDI of Cercospora leaf spot (*Cercospora canescens*) at 40-45 DAS was 28.88% and at 50-55 DAS it was 53.70%. The overall mean PDI of powdery mildew (*Erysiphe polygoni*) at 40-45 DAS was 22.85% and 63.22% at 50-55 DAS.

During *rabi,* 2016-17, Corynespora leaf spot PDI of six genotypes *viz.,* LBG 752 (r= -0.635), LBG 709 (r=-0.656), KU-15-6 (r= -0.637), LBG 20 (r= -0.640), LBG 791 (r= -0. 648) and LBG 685 (r= -0.654) showed a significant negative correlation with mean minimum temperature. Cercospora leaf spot PDI of three genotypes *viz.,* LBG 752 (r= -0.642), LBG 709 (r=-0.660) and T9 (r= -0.636) showed a significant negative correlation with mean minimum temperature. Powdery mildew PDI of six genotyes LBG 752 (r= -0.654), KU-15-3 (r=-0.655), LBG 709 (r=-0.664), KU-15-6 (r= -0.678), LBG 791 (r= -0.650) and PU 31 (r= -

0.633) showed significant negative correlation with minimum temperature. Regression analysis for PDI of Corynespora leaf spot, Cercospora leaf spot and powdery mildew revealed that maximum temperature and minimum temperature influenced the development of the disease in all the genotypes.

Out of 16 genotypes (including check) evaluated for their reaction to fungal foliar diseases, two genotypes T9 and LBG 645 were moderately resistant to Corynespora leaf spot. The genotype LBG 645 was rated as moderately resistant to Cercospora leaf spot. Ten genotypes *viz*., LBG 20, LBG 791, LBG 685, LBG 645, LBG 787, PU31, LBG 790, KU-15-13, LBG 792 and T9 were categorized as moderately resistant to powdery mildew.

Studies on the management of fugal foliar diseases with fungicides have revealed that two sprays of Azoxystrobin 23 SC @ 0.05% has recorded significantly lowest severity of Corynespora leaf spot (53.52%). Carbendazim 50 WP @ 0.05% has significantly reduced the Cercospora leaf spot severity (33.75%). Trifloxystrobin 25% WG + Tebuconazole 50% WG @ 0.05% has absolutely controlled (0%) the powdery mildew. Highest seed yield (9.33 q ha^{-1}), highest test weight (6.40 g), highest B:C ratio (1.72), lowest per cent seed discolouration and per cent shrivelled seed were recorded with Azoxystrobin 23 SC @ 0.05%.

PLANT PATHOLOGY

Author	:	**JYOTHSNA, V.**
Title of the Thesis	:	**CHARACTERIZATION AND MANAGEMENT OF *ALTERNARIA SESAMI* (KANUWARA) MOHANTY AND BEHARA ON *SESAMUM INDICUM* L.**
Chairperson	:	**Dr. V. PRASANNA KUMARI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5447**

ABSTRACT

The present study on the characterization and management of *Alternaria sesami* on *Sesamum indicum* was taken up at the Agricultural College, Bapatla during 2016-2017.

Alternaria leaf spot was mainly observed on the leaves in the form of minute brown spots that were round to irregular with concentric rings measuring up to one centimeter diameter. Disease prevalence and severity was less in young and vigorously growing plants, whereas in old and senescing plants it was more.

Among Elamanchili and Nakkapalli mandals of Visakhapatnam district surveyed for Alternaria leaf spot occurrence, Elamanchili mandal was found with low disease severity that

ranged from 9.57 to 15.62 % while in Nakkapalli mandal it varied between 22.07 and 60.80% with highest mean severity of 42.04 %.

Alternaria sesami isolates when cultured on potato dextrose agar were mostly in hues of grayish brown colour with fluffy centre. Radial growth among isolates after seven days of incubation varied from 4.08 to 5.28 cm, while sporulation varied between 5.33 x 10^4 and 71.67 x 10^4 ml^{-1}. Conidial dimensions of 12 isolates varied from 24.88-34.64 X 9.61-12.13 µm with beak length of 5.12-8.32 µm. Number of horizontal and vertical septa varied from 2.76 to 3.82 and 1.31 to 1.76 respectively.

EC of the halo primed solution was significantly high compared to other solutions used for priming (70.13 µS cm^{-1}). An increase in EC was observed after hydro (from 0.02 to 0.20 µS cm^{-1}) and bio priming (from 0.12 to 0.41 µS cm^{-1}) for 24 h.

Significantly high per cent germination was observed when hydro primed for 24 h (85.55 %) followed by hydro priming for 12 h (80.00 %) and 6 h hydro priming (73.33 %) and control (72.22 %). The highest per cent increase of 45.29 % over normal practice (mancozeb @ 0.25 % incubated for 6 h) was recorded when hydro primed for 24 h.

There was no significant difference in mean germination time (MGT) of sesame seed in any of the treatments after 24 h of incubation. After two days of incubation, minimum MGT was observed in the six hour bio primed and 24 hour hydro primed treatment (3.03 days). Minimum MGT was in 6 h bio primed seed (9 days) while it was maximum in 24 h halo primed seed (9.53 days) after three days of incubation.

Seedling vigour index was significantly high when hydro primed for 24 h (217.00) and least when bio primed for 12 h (62.54). Increase in seedling vigour index (108.77 %) was noticed over normal practice *i.e.,* seed treatment with mancozeb @ 0.25 % for 6 h.

In Alternaria leaf spot disease management, fungicidal treatment involving two sprays of propiconazole @ 0.1 % was found with significantly lowest PDI (53.89 %) with highest yield (463 kg ha^{-1}). However, among the botanicals, neem leaf extract @ 5 % sprayed twice was effective in reducing the disease (PDI of 65.00 %) with an yield of 441 kg ha^{-1} next to propiconazole and chlorothalonil @ 0.2 % was on a par with chemical fungicide mancozeb @ 0.25 % sprayed twice.

In yield economics, the highest net returns were registered in propiconazole treatment (Rs. 22,161 ha^{-1}) that was followed by neem leaf extract treatment (Rs. 20,445 ha^{-1}). Similarly, the highest benefit: cost ratio of 1.59 was obtained in propiconazole used treatment and was followed by neem leaf extract treatment (1.54).

PLANT PATHOLOGY

Author	:	**LALITHA, DULLA.**
Title of the Thesis	:	**STUDIES ON EARLY AND LATE LEAF SPOT DISEASES OF GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. V. MANOJ KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5446**

ABSTRACT

Investigations on "Studies on early and late leaf spot diseases of groundnut (*Arachis hypogaea* L.)" were carried out in the Agricultural College Farm, Bapatla, Guntur district, Andhra Pradesh during *kharif* and *rabi* 2014-15.

A fixed plot survey was conducted during *kharif* 2014 in Guntur district of Andhra Pradesh. Early leaf spot (ELS) and late leaf spot (LLS) incidence and severity were recorded in the surveyed villages of Karlapalem, Pittalavanipalem and Pedakakani mandals of Guntur district at 30, 60 and 90 DAS. The overall mean ELS incidence of Guntur district at 30 DAS was 9.11% and 0.79% at 60 DAS. Mean ELS PDI at 30 DAS was 12.10% and 11.29% at 60 DAS. The overall mean LLS incidence of Guntur district at 60 DAS was 61.85% and 100.00% at 90 DAS. The mean LLS PDI at 60 DAS was 25.80% and 61.28% at 90 DAS.

Early leaf spot symptoms were first appeared as pale areas on the upper surface of lower leaves about 30 to 40 DAS. The spots later turned yellow, and necrosed from the centre of the lesion, and later the entire spot became necrotic. The large, circular to irregular spots were characterized by a yellow halo. At maturity, the spots turned reddish brown to black colour. LLS symptoms appeared after 40 DAS. The spots on leaves were circular with bright yellow halo around matured spots, usually darker than early leaf spots. On the under surface of the leaves, the spots were deep black in colour with clusters of conidiophores bearing conidia, arranged in concentric manner.

During *kharif*, PDI of ELS showed a significant positive correlation with maximum temperature (r= 0.518) and non-significant correlation with other variables. LLS PDI showed a significant positive correlation with morning relative humidity (r= 0.549), significant negative correlation with maximum temperature (r= -0.758), minimum temperature (r= -0.830). Regression analysis for PDI of ELS and LLS revealed that maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and wind speed would influence the development of ELS upto 51% and maximum temperature and minimum temperature would influence the development of LLS upto 73.5%.

During *rabi*, PDI of ELS showed a significant positive correlation with morning relative humidity (r= 0.534). LLS PDI had a significant positive correlation with maximum temperature (r= 0.907), minimum temperature (r= 0.897), and evening relative humidity (r= 0.557). It showed a significant negative correlation with morning relative humidity (r= -0.728). Regression analysis for PDI of ELS and LLS revealed that maximum, minimum temperature and morning relative humidity would influenc the development of ELS upto 38.6% and maximum temperature and minimum temperature would influence the development of LLS upto 88.3%.

Out of 11 genotypes (including check) evaluated for their resistance to ELS, LLS and rust, all the 11 genotypes showed resistant reaction to ELS. K-1789 was moderately resistant, other nine genotypes (K-4, K-5, Anantha, K-9, K-1468, K-1535, K-1501 and K-1577, Kadiri Harithandra) were susceptible and check (K-6) was highly susceptible to LLS. Four were moderately resistant *viz*., K-1501, K-1577, Kadiri Harithandra and K-1789; six were susceptible *viz*., K-5, Anantha, K-4, K-9, K-1535 and K-1468 and K-6 (Check) was highly susceptible to rust disease.

Correlation studies with morphological characters on ELS, LLS and rust of different genotypes revealed that ELS PDI showed a significant negative correlation with number of stomata on lower side (r= -0.643), LLS PDI showed a significant negative correlation with stomata on upper side (r= -0.907), epidermal cell wall thickness (r= -0.821), canopy spread (r= -0.813), trichome density (r= -0.797) and stomata on lower side (r= -0.757) and rust PDI showed a significant negative correlation with stomata on upper side (r= -0.923), trichome density (r= -0.862), canopy spread (r= -0.817), epidermal cell wall thickness (r= -0.804),) and stomata on lower side (r= -0.783).

Regression analysis for PDI of ELS, LLS and rust revealed that plant height, number of branches, canopy spread, stomata on upper side and stomata on lower side showed 68.5% role for ELS severity. Plant height, number of branches and canopy spread showed 76.1% and 74.7% role for LLS and rust severity respectively.

Studies on ELS and LLS management with fungicides revealed that sprayings of tebuconazole 25 EC @ 0.1% and chlorothalonil 75 WP @ 0.25% at 35 (30.01.2015) and 70 DAS (05.03.2015) found superior as they recorded the lowest severity of ELS (11.47% and 11.73%) and LLS (29.25% and 30.79%) respectively. Significant increase in number of flowers per plant, number of gynophores per plant, number of pods and pod yield was recorded with sprayings of tebuconazole 25 EC @ 0.1% followed by chlorothalonil 75 WP @ 0.25% at 35 (31.01.2015) and 70 DAS (07.03.2015).

PLANT PATHOLOGY

Author	:	**MAHENDRA, M.**
Title of the Thesis	:	**EFFICACY OF COMBINED BIOFORMULATION OF *Pseudomonas fluorescens* AND *Trichoderma* spp. IN THE MANAGEMENT OF DRY ROOT ROT AND STEM ROT OF GROUNDNUT**
Chairperson	:	**Dr. M. REDDI KUMAR**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5526**

ABSTRACT

In the present investigation, six native rhizosphere isolates of *Trichoderma* spp. and five native rhizosphere isolates of *P. fluorescens* were isolated, screened for their biocontrol potential against *M. phaseolina* and *S. rolfsii* incitants of dry root rot and stem rot of groundnut, respectively under *in vitro* condition. The potential isolates were formulated in solid and liquid carrier materials and assessed for their viability periodically at 30, 60 and 90 days after storage at 4°C and at room temperature (30°C), the potential isolates were further assessed *in vivo* in pot culture against groundnut dry root rot and stem rot respectively.

The groundnut dry root rot pathogen was isolated from the infected plants showing typical symptoms *viz.,* withering and drying of plants, presence of dark tap root, shredding of bark coming out in the form of flakes and devoid of lateral and finer roots, purified by single hyphal tip method and identified as *M. phaseolina*.

The groundnut stem rot pathogen was isolated from the infected plants showing typical symptoms such as drying of leaves and wilting of either individual branches (or) the whole plant and presence of whitish mycelium on soil surface near stem. When such infected plants were pulled out showed profuse whitish mycelium along with sclerotial bodies on stems and roots at collar region. The pathogen was purified by single hyphal tip method and identified as *S. rolfsii*.

Cultural and morphological variability studies among four isolates of *M. phaseolina* revealed that, the isolates SgMp and TpMp were categorized as fast growing isolates among all isolates, the isolate SmMp produced bigger size (94.30 µm) microsclerotia when compared to other isolates. The isolate SmMp produced blackish mycelium while others produced greyish mycelium.

Cultural and morphological variability studies among four isolates of *S. rolfsii* revealed that, the isolates DmSr and SgSr were categorized as fast growing isolates, the isolate SgSr produced maximum number (186) of sclerotia per Petri plate after ten d of incubation with bigger sclerotia measuring 0.90 mm diam compared to other isolates. The isolate TpSr produced highly fluffy mycelium while others produced partially fluffy mycelium.

Based on morphological features, the six rhizosphere *Trichoderma* isolates were identified as *T. harzianum* (designated as GRT1, GRT3, GRT4 and GRT6) and *T. viride* (designated as GRT2 and GRT5). The five *P. fluorescens* isolates obtained on fluorescent *Pseudomonas* selective medium were designated as PF1 to PF5.

Based on radial growth on PDA, *Trichoderma* Iiolates GRT1, GRT2 and GRT6 were considered as fast growing isolates while, GRT4 and GRT5 as medium growing isolates and GRT3 as slow growing isolate.

Among six *Trichoderma* isolates tested against each four isolates of *M. phaseolina* and *S. rolfsii*, the isolates GRT1, GRT2, GRT4 and GRT5 were found effective in inhibiting the growth of both the pathogens *in vitro*.

Among five *P. fluorescens* isolates tested against each four isolates of *M. phaseolina* and *S. rolfsii*, the isolates PF3 and PF4 were found effective in inhibiting the growth of both the pathogens *in vitro*.

Results from the compatibility studies between potential *Trichoderma* and *P. fluorescens* isolates revealed that, the *Trichoderma* isolate GRT4 (*T. harzianum*) and *P. fluorescens* isolate PF4 were highly compatible with minimum per cent inhibition (21.48%) compared with other combinations, used for developing formulations.

Results from the shelf life studies of *Trichoderma* formulations revealed that, talc based formulations maintained higher inoculum density even after 90 d of storage both at room temperature (30°C) and at 4°C when compared to other formulations.

Results from the shelf life studies of *P. fluorescens* formulations revealed that, talc, glycerol based formulations maintained higher inoculum density even after 90 d of storage both at room temperature (30°C) and at 4°C, respectively when compared to other formulations Pot culture studies revealed that among the twelve treatments imposed in managing groundnut dry root rot and stem rot diseases, treatment T_{10} i.e. seed treatment with *P. fluorescens* @ 10 g + *Trichoderma* spp. @ 8 g kg^{-1} of seed along with soil treatment with combined bioformulation @ 2 L + 80 kg of FYM + 5 kg of neem cake acre^{-1} was found to be superior as it recorded the highest germination percentage, highest initial, highest final population of groundnut, least PDI, maximum shoot, root lengths and maximum fresh and dry weights.

PLANT PATHOLOGY

Author	:	**MOHAN VENKATA SIVA PRASAD, BANDI.**
Title of the Thesis	:	**EPIDEMIOLOGY AND MANAGEMENT OF ALTERNARIA LEAF SPOT IN COTTON**
Chairperson	:	**Dr. B. SREE LAKSHMI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5444**

ABSTRACT

Alternaria leaf spot/blight of cotton caused by *Alternaria macrospora* Zimmermann is the most commonly occurring disease in Andhra Pradesh. *A. macrospora* is found to be an aggressive pathogen which can attack all crop growth stages starting from seedling stage to harvesting manifesting in seed rot, damping off, seedling blight, mummification of bolls *etc*. Under severe conditions it causes severe defoliation, cracking, breaking of stems and reduction in boll formation. Epidemiological studies indicated that irrespective of different dates of sowing, Alternaria leaf spot occurred at its first peak intensities (17.5%, 18.25% and 18.33%) in 44th meteorological week (Oct 29-Nov 4) and its second maximum intensities (39.25%, 33% and 33.5%) in 1st standard meteorological week (Jan1- Jan7). Among the weather parameters sunshine significantly influenced the disease progress in susceptible Jadoo BG II hybrid.

Fungicides *viz*., mancozeb, carbendazim, hexaconazole, propiconazole and carbendazim 12% + mancozeb 63%; botanicals *viz*., neem leaf, garlic clove extracts and biocontrol agents *T. harzianum* strain 1, *P. fluorescens* strain 1 and *B. subtilis* significantly inhibited the growth of *A. macrospora in vitro*. Interactions with all the *Trichoderma* strains in dual culture revealed lysis of *A. macrospora* with evidence of protoplast aggregation, wrinkling of mycelium and germination of *Trichoderma* conidia on *Alternaria* mycelia.

Field evaluation of seed treatment and foliar spray of selected fungicides, botanicals and biocontrol agents against Alternaria leaf spot of cotton showed that ST with carboxin + thiram (vitavax power) at 2 g kg^{-1} of seed and 0.1% carbendazim + mancozeb sprays, three times, at 15 days interval recorded the lowest per cent disease index (6.8), the highest yield (1571.4 kg ha^{-1}) and the highest benefit cost ratio (1.61) compared to per cent disease index (35), yield (1013 kg ha^{-1}) and benefit cost ratio (0.69) in control.

PLANT PATHOLOGY

Author	:	**SANDHYA, YERRAGURAVAGARI.**
Title of the Thesis	:	**EFFECTOFAGROCHEMICALSAND BIOCONTROL AGENTS ON THE VIABILTY OF SCLEROTIA OF RICE SHEATH BLIGHT PATHOGEN , *Rhizoctonia solani* Kuhn.**
Chairperson	:	**Dr. C.P.D. RAJAN**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5527**

ABSTRACT

The present investigation was carried out to study the effect of agro chemicals and biocontrol agents on the viability of sclerotia of *Rhizoctonia solani* Kuhn. Rice sheath blight pathogen *R. solani* was isolated from the diseased samples obtained from Agricultural Research Station, Nellore. Its pathogenicity was proved by using detached leaf technique.

The herbicides viz., Glyphosate, 2,4-D Sodium salt, Butachlor, Pretilachlor, Oxadiargyl, Pyrazosulfuron ethyl, Bensulfuron methyl 0.6% + Pretilachlor 6%, Cyhalofop-butyl, Bispyribac sodium and Ethoxy sulfuron were tested at recommended concentrations were significantly superior over control in checking the mycelial growth of *R. solani*. Glyphosate, Butachlor, Pretilachlor showed 100 per cent inhibition.

Among the ten herbicides tested against sclerotial viability, only two, viz., Butachlor and Pretilachlor were found to be effective in inhibiting the sclerotial germination even at lower incubation period of 5 min. both in soil application and *in vitro*. Glyphosate inhibited sclerotial germination at higher incubation periods *i.e.,* 18 h and 24 h. Rest of the herbicides tested were ineffective in inhibiting the sclerotial germination even though they were effective in inhibiting mycelial growth.

Pseudomonas fluorescens isolates NLR-B1, NLR-B2, NLR-B3 were tested in dual culture against *R. solani* among which NLR-B3 isolate was found to be more antagonistic *in vitro* against *R. solani* than other two isolates.

Sclerotial germination was tested after incubating in NLR-B3 bacterial suspension in the concentrations from 10^{-4} to 10^{-8} CFU/ml, there was no inhibition in sclerotial germination at 10 min incubation at all concentrations of bacterial suspension, where as at 20 min incubation, inhibition of sclerotial germination was 73.33 per cent at 10^{-4} concentration, 43.33 per cent at 10^{-5} concentration, 30 per cent at 10^{-6} concentration and there was no inhibition of sclerotial germination at 10^{-7} and 10^{-8} concentrations. At the incubation period of 30 min. inhibition in sclerotial germination was 53.33 per cent at 10^{-4} concentration, 36.67 per cent at 10^{-5} concentration, 30 per cent at 10^{-6} concentration. Similar inhibition of 13.33

per cent was observed both at 10^{-7} and at 10^{-8} concentration. Per cent inhibition increased with increase in concentration of bacterial suspension at 20 and 30 min incubation periods.

The bacterial suspensions at the earlier concentrations were added to the soil and incubated for 10 days after which the sclerotia were retrieved and tested for their viability, the inhibition of sclerotial germination was 56.67 per cent at 10^{-4} concentration, 36.66 per cent at 10^{-5} concentration and 16.66 per cent at 10^{-6} concentration. However at lower concentration of 10^{-7} and 10^{-8} there was no inhibition of sclerotial germination. There was a significant increase in per cent inhibition of sclerotial germination with increase in concentration of the bacterial suspension.

The efficacy of seed treatment with different fungicides viz., Carbendazim, Propiconazole, Hexaconazole, validamycin, Tebuconazole, Thifluzamide, Azoxysrtrobin, Difenoconazole, Tebuconazole 50% + Trifloxystrobin 25% (Nativo) on the viability of sclerotia admixtured with the seed was tested, in which all the tested fungicides showed 100 per cent inhibition of sclerotial germination in both wet and dry seed treatments.

The seed admixtured with sclerotia was treated with different fungicides given above, and the effect of sclerotia on germination and seedling growth was tested by paper towel and pot culture methods. All the seed was germinated in both paper towel and pot culture methods. The efficacy of fungicides on seedling growth varied in both wet and dry seed treatments. All the tested fungicides showed increased seedling growth (root length and shoot length) except Carbendazim and Tebuconazole 50% + Trifloxystrobin 25% (Nativo) when compared to control in both paper towel and pot culture methods.

Effect of *Trichoderma* silver nano particles on mycelial growth of *R. solani* at three different concentrations *i.e.,* 75, 100 and 125 ppm were tested. Among the three concentrations, the highest inhibition (88.19 %) was observed at 125 ppm followed by 100 ppm (52.93 %). The effect of *Trichoderma* silver nano particles were also tested on sclerotial viability of *R. solani in vitro*. Among the four tested concentrations (50, 75, 100 and 125 ppm) the highest per cent inhibition was observed at 125 ppm (85 %) followed by 100 ppm (47.50 %).

SEED SCIENCE AND TECHNOLOGY

Author	:	**GAYATRI, V.**
Title of the Thesis	:	**INFLUENCE OF DRY-DRESSING WITH BOTANICAL ONSTORABILITYOF BLACKGRAM SEED INDIFFERENT PACKAGING MATERIALS**
Chairperson	:	**Dr. K. RADHIKA**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5544**

ABSTRACT

The present investigation was carried out to understand the effect of dry-dressing with botanicals, recommended fungicide and packaging material on storability of seed of blackgram variety, LBG-752. The seed was dry-dressed with fenugreek seed powder @ 3 g kg^{-1} (T_2), neem seed kernel powder @ 10 g kg^{-1} (T_3), neem leaf powder @ 10 g kg^{-1} (T_4), custard apple leaf powder @ 4 g kg^{-1} (T_5), turmeric powder @ 20 g kg^{-1} (T_6), curry leaf powder @ 50 g kg^{-1} (T_7), soap nut powder @ 10 g kg^{-1} (T_8), moringa leaf powder @ 4 g kg^{-1} (T_9) and thiram 75% WDP @ 2.5 g kg^{-1} (T_{10}). The treated seed along with untreated seed (control - T_1) stored in jute bag (P_1), cloth bag (P_2) and HDPE bag (700 gauge) (P_3) under ambient conditions of Guntur for a period of 10 months were evaluated for germination and seedling quality parameters, moisture content and electrical conductivity of seed leachates at monthly intervals. The data were analyzed statistically by adopting Factorial Completely Randomised Design (FCRD) with three replications.

The results of analysis of variance indicated that the influence of seed treatments, packaging material and their interaction on storability and seed quality was significantly different at different periods of storage.

The significant effect of seed treatments was observed on moisture content and electrical conductivity from first month, seedling length from fourth month, seedling dry weight, co-efficient of velocity of germination and seedling vigour index-I from fifth month, germination and seedling vigour index-II from sixth month, speed of germination from seventh month of storage.

The significant influence of packaging material was noticed on moisture content and electrical conductivity from first month, co-efficient of velocity of germination and mean daily germination from fifth month, seedling dry weight and seed viability from sixth month and germination and speed of germination from seventh month of storage.

The significant effect of interaction of seed treatments and packaging material was registered on electrical conductivity from first month, co-efficient of velocity of germination from fifth month, speed of germination, moisture content and dry weight of seedlings from seventh month and germination and fresh weight of seedlings from ninth month of storage.

The results revealed that with the advancement of storage period, there was a decline in germination, speed of germination, co-efficient of velocity of germination, mean daily germination, seedling length, seedling fresh and dry weights and seedling vigour along with an increase in moisture content and electrical conductivity of seed leachates irrespective of seed treatments, packaging material and their interaction. The germination was maintained above minimum seed certification standards and the moisture content of the seed was with in the safe storage limits till the end of the storage period in all the treatments, packaging material and their interaction.

Among the seed treatments, neem leaf powder treated seed exhibited superior performance with highest germination, speed of germination, co-efficient of velocity of germination, seedling length, seedling dry weight and seedling vigour and low moisture content and electrical conductivity through out the storage period.

HDPE (700 gauge) bag was found to be the best packaging material for storing blackgram seed as evidenced by recording more germination, speed of germination, co-efficient of velocity of germination, mean daily germination and seedling dry weight along with minimum fluctuations in moisture content and electrical conductivity of seed leachates compared to cloth bag and jute bag during the storage period.

After ten months of storage period, though neem seed kernel powder treated seed stored in HDPE bag and the curry leaf powder treated seed stored in HDPE bag showed higher germination and speed of germination, respectively, neem leaf powder treated seed stored in HDPE bag maintained better seed quality with higher co-efficient of velocity of germination, fresh and dry weights of seedlings along with less moisture content and electrical conductivity of seed leachates among all the interactions.

Correlation coefficient analysis carried out at the end of the storage period showed that the germination and other seed quality parameters *viz*., speed of germination, co-efficient of velocity of germination, mean daily germination, seedling length, seedling fresh and dry weights and seedling vigour indices exhibited positive association with germination and negative correlation with seed moisture content and electrical conductivity of seed leachates.

These storability studies clearly revealed that for better storage of seed of blakgram variety, LBG-752, it is preferable to treat the seed with neem leaf powder and store in moisture and vapour proof packaging material (HDPE) to enhance the quality and longevity of the seed.

SEED SCIENCE AND TECHNOLOGY

Author	:	**LEELAVATHI, M.**
Title of the Thesis	:	**EFFECT OF SEED INVIGORATION TREATMENTS ON FIELD PERFORMANCE AND STORABILITY OF AGED SEED OF GREENGRAM [*Vigna radiata* (L.) Wilczek]**
Chairperson	:	**Dr. V. PADMA**
Degree	:	**M.Sc (Ag.)**
College	:	**ADVANCED POST GRADUATE CENTRE, GUNTUR**
Accession Number	:	**D5545**

ABSTRACT

The present investigation entitled "Effect of seed invigoration treatments on field performance and storability of aged seed of greengram [*Vigna radiata* (L.) Wilczek]" was carried out at Agricultural Research Station (ARS), Jangamaheswarapuram, Guntur (field studies) and Department of Seed Science and Technology, Advanced Post Graduate Centre, Lam, Guntur (storability studies) during 2016-17.

The seed of greengram cv. LGG-460 were invigorated by the hydration treatments *viz*., $CaCl_2$ (2%), hydropriming, moringa leaf extract (5%), KNO_3 (1.5%), hydroprimed and dry dressing with thiram (0.25%). Seed were also invigorated by dry dressing with bleaching powder (2g/kg of seed) and red chilli powder (1g/kg of seed). The invigorated seed along with the untreated seed (control) (aged and fresh seed) were used for both storability and field studies.

Among the invigoration treatments hydroprimed and dry dressed with thiram exhibited the highest germination (93.7%) and field emergence (92.0%). Seed treated with red chilli powder and bleaching powder exhibited more plant height.

Leaf area, number of leaves, number of branches were found to be superior in seed treated with bleaching powder, red chilli powder and hydro primed and dry dressed with thiram. However, days to 50% flowering was not influenced by the invigoration treatments.

Treating of aged seed with bleaching powder, red chilli powder and hydroprimed and dry dressed with thiram increased the number of pods per plant, number of seed per plant, seed yield per plant and 100 seed weight. Shelling percent and harvest index were also high in hydroprimed and dry dressed with thiram treatment.

Even during storage, among all the invigoration treatments, hydroprimed and dry dressed with thiram treatment performed well with respect to the seed quality parameters like germination, seedling length, seedling dry weight and seedling vigour index over the control.

Though the hydroprimed and dry dressed with thiram treatment performed well in storage in first four months, the dry dressing treatment *viz*., bleaching powder and red chilli powder treatments gave good results compared to hydration treatments in maintaining germination percentage after six month of storage, where the germination percentage was on par with fresh seed.

Correlation studies exhibited positive and significant association with seed yield for all parameters except germination and plant height.

The present study proved that seed invigoration with bleaching powder @ 2 g/kg of seed, red chilli powder @ 1 g/ kg of seed and hydroprimed and dry dresssed with thiram @ 0.25% of seed may be suggested for improvement of field performance and storability of greengram seed.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**DEEPIKA, JANGAM.**
Title of the Thesis	:	**NITROGEN DYNAMICS AND NITROGEN USE EFFICIENCY WITH NEEM COATED UREA IN RICE CULTIVATION**
Chairperson	:	**Dr. Y. SUDHA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5452**

ABSTRACT

A field experiment entitled "Nitrogen dynamics and nitrogen use efficiency with neem coated urea in rice cultivation" was conducted at Agricultural College Farm, Bapatla during *kharif*, 2016. The experimental soil was clay in texture, slightly alkaline in reaction and non-saline. The soil was medium in organic carbon and available nitrogen, high in available phosphorus and potassium and sufficient in sulphur. The soil was high in zinc, copper, manganese and iron.

The experiment was laid out in RBD with nine treatments replicated thrice.The treatments comprised of**T_1**- Control, **T_2**-100% RDN throughurea in 3 split doses, **T_3** - 75% RDN through neem coated urea in 3 split doses, **T_4** - 100% RDN throughneem coated urea in 3 split doses, **T_5**-125% RDN throughneem coated urea in 3 split doses, **T_6**-100% RDN throughurea in 2 split doses, **T_7**-75% RDN throughneem coated urea in 2 split doses, **T_8**-100% RDN throughneem coated urea in 2 split doses, **T_9**-125% RDN throughneem coated urea in 2 split doses.

Well decomposed farmyard manure @ 10 t $ha^{-1}$was applied to the field as per recommended doseten days before transplanting. The inorganic nitrogen through urea and neem coated urea was applied in 3 splits (as basal and at tillering and panicle initiation stages) to four treatments *i.e*T_2 to T_5 and applied in 2 splits (as basal and in between tilleringand panicle initiation stages) to four treatments *i.e*T_6 to T_9. Entire quantity of P_2O_5 in the form of SSP and K_2O in the form of MOP were applied to all the treatments as basal dose at the time of transplanting. (Recommended dose of fertilizers was 120-60-40 kg NPK kg ha^{-1}).

The influence of various treatments on growth parameters, yield attributes, yield, soil properties (physical, physico-chemical properties and available nutrients), nutrient contents and uptake at different stages and forms of nitrogen at every three days and one week after application of fertilizers were determined by standard procedures.

All growth parameters, productive tillers m^{-2}, filled grains per panicle, grain and straw yield were markedly influenced by the application of neem coated urea. Maximum grain

yield was recorded with 125%RDN through neem coated urea in three split, which is on par with 100%RDN and 75%RDN through neem coated urea. The maximum nitrogen use efficiency and apparent N recovery was recorded in treatment 75% RDN through neem coated urea in 3 splits, while grain yield is on par with 125% RDN through neem coated urea.

The soil properties *viz*., bulk density, pH, EC and organic carbon and micronutrients were not markedly influenced by the imposed treatments. There was a significant influence of the treatments on available nitrogen and phosphorus, but not on potassium. The available nitrogen and phosphorus contents were markedly influenced by the application of neem coated urea at all the crop growth stages.

The nitrogen content of rice plants at all growth stages was markedly influenced by the treatments with highest N recorded in treatment supplied with 125% RDN through neem coated urea in three spits. The effect of treatments on other nutrients in plants was non-significant.

The uptake of N, P, K, Sand micro nutrients at all growth stages was markedly influenced by the treatments with higher values recorded with 125% recommended dose of neem coated urea in three spits which was at par with 100%RDN through urea applied in three and two splits.

Application of neem coated urea showed significant influence on forms of nitrogen.Neem coated urea proved to be more efficient in maintaining the maximum amount of ammoniacal – N, total nitrogen and mineralizable – N and lower amount of nitrate – N than urea and control where no nitrogen was applied.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**HARISH, V.**
Title of the Thesis	:	**BORON AVAILABILITY AND RESPONSE OF BLACKGRAM TO BORON IN CALAREOUS SOILS**
Chairperson	:	**Dr. P. R. K. PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5449**

ABSTRACT

The present investigation entitled “Boron availability and response of blackgram to boron in calcareous soils” was conducted for assessing the boron availability status of calcareous soils as it is one of the important factors controlling yield of the crops.

Representative surface soil samples (50) were collected from different locations of Sattenapalli mandal in Guntur district by following random sampling technique. The major soil textural classes identified in the soils of the mandal were sandy clay and clay. Out of which, clay was the dominant texture. The soils were slight to strongly calcareous in nature. The investigation revealed that content of the clay was significantly and positively correlated with $CaCO_3$ content (r= 0.29*) and exchangeable Ca^{2+} (r=0.56**). Whereas, organic carbon content showed a negative correlation (r= -0.37*) with $CaCO_3$ content. The soils of the study area were neutral to moderately alkaline in reaction. Negative correlation was observed between pH and soil available B (r= -0.32*). Bulk density and water holding capacity of soils varied from 1.23 - 1.55 Mg m^{-3} and 45.23 - 58.89 per cent, respectively in the mandal. The cation exchange capacity was in between 32.61 and 52.17 cmol (p+) kg^{-1} with high base saturation varying from 86.66 to 98.73 per cent. The exchangeable bases on the exchange complex followed a trend of $Ca^{2+} > Mg^{2+} > Na^{2+} > K^{+}$.

The soil nutrient index in respect of organic carbon, nitrogen and phosphorus was low and was high with potassium. Calcareousness of soils adversely affected the nutrient availability in the sampled locations. $CaCO_3$ content was negatively correlated with available N and available P_2O_5 (r = -0.34*). Whereas, available K content of soils showed a positive correlation with $CaCO_3$ content (r = 0.30*). Soils in the mandal were deficient in boron (64%) and sufficiently rich in iron (90%), manganese and copper. Calcareousness of soils was highly negative in correlation with soil available boron (r = -0.593**). Micronutrients *viz*. Fe, Zn and Cu also showed a negative trend with $CaCO_3$ content.

Soil samples of different calcareous levels up to 15 cm depth were collected in bulk from five selected locations of the mandal based upon preliminary investigation carried out. A pot culture experiment was conducted in the green house at Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla during 2015-16 to find out the response of blackgram to different levels of boron in calcareous soils. The treatment combinations were taken based on different levels of boron *viz*. 0.0, 0.25, 0.50 and 0.75 mg kg^{-1} at different levels of $CaCO_3$ (1.02, 5.25, 10.37, 16.20, 17.75 %) and replicated thrice in completely randomized block design.

Irrespective of the soil calcareousness, increasing doses of boron enhanced the biomass production, seed yield, nutrient content and uptake by blackgram. Whereas, decrease in biomass, seed yield and nutrient uptake was noticed with increasing levels of $CaCO_3$. Application of B @ 0.25 mg kg^{-1} (B_1) in soils containing 1.08% $CaCO_3$ was found sufficient to produce optimum yield of blackgram although maximum yield obtained with application of B @ 0.50 mg kg^{-1} soil (B_2) was on par with B_1 level. For all other soils having more than 1.08% $CaCO_3$ content, the yields increased with increase in B doses.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**JAGADISH, J.**
Title of the Thesis	:	**NUTRIENT MAPPING OF NAGARI MANDAL IN CHITTOOR DISTRICT OF ANDHRA PRADESH USING REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM (GIS)**
Chairperson	:	**Dr. P. VENKATA RAM MUNI REDDY**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5529**

ABSTRACT

A study was undertaken to assess the soil fertility status, delineate the spatial variability of soil fertility status in order to suggest fertilizer recommendations, for Nagari Mandal in Chittoor district of Andhra Pradesh state using remote sensing and GIS techniques.

Composite surface soil samples (0-15 cm) were collected across the Nagari mandal using Arc map software with the grid size of 10ha. The GPS data at each sample location was collected. Ground truth analysis indicated that soils of the study area are moderately to highly alkaline and with safe EC ranges. The available nitrogen content of the soils varied from 43.9 to 181.81 kg ha^{-1}, with a mean value of 77.20 kg ha^{-1} and standard deviation of 31.7 with CV of 41.08 per cent, the available phosphorus status in soils was low to high range and ranged from 2.08 to 133.13 kg ha^{-1}, with a mean value of 29.36 kg ha^{-1} and standard deviation of 17.7 with CV of 60.29 per cent and the available potassium content in soils of Nagari mandal ranged from 64.6 to 753.17 kg ha^{-1}, with a mean value of 217.56 kg ha^{-1} with standard deviation of 119.5 and CV of 54.93 per cent The available copper, nitrogen, phosphorous and potassium content showed much variation with high coefficient of variation. Soils vary across fields and within the fields. Hence to prove this fact, studies were done at village level taking Tadaku village of Nagari Mandal where much variability was observed. The data revealed that CV was high for EC content (83.32%), all other nutrients also observed high values of CV confirming the existence of spatial variability within field.

It can be inferred that when average content of micronutrients is analyzed, soils exhibit sufficient status of micronutrients but the coefficient of variation for available Fe, Cu, Zn and Mn is 52.4, 92.39, 45.23, 40.32 per cent respectively. The larger CV depicts that within a village there is much variation in the micronutrient status, proving that soil fertility is not homogeneous. Spatial variability of soil properties was studied and maps were generated using geo-statistics. In the present study the variability is observed in case of all the nutrients under study with more variation in copper followed by phosphorous, potassium, iron, nitrogen, zinc, manganese, and copper.

The soil site suitability maps for rice and sugarcane delineate the areas in to suitable and not suitable which could be utilized for selecting the proper cropping pattern at local level. Suitability analysis of rice crop in study area indicated 585.6 ha is highly suitable (S1), 1156.8 ha is moderately suitable (S2) and 244.8 ha is marginally suitable (S3). the remaining area 412.8 ha is having severe limitations that preclude the growing of rice making it not suitable (N), suitability analysis of sugarcane crop in Nagari mandal indicated that about 295.2 ha is highly suitable (S1), 1188 ha is moderately suitable (S2) and 628.8 ha is marginally suitable (S3). The remaining area 288 ha comes under suitability class of not suitable (N).

Site specific fertilizer recommendations for rice and sugarcane in Nagari mandal are made utilizing the thematic maps of spatial variability of N, P and K status. The recommended doses of nitrogen for rice crop is 91 and 101 kg ha^{-1}, recommended doses of phosphorus are 50, 61, 71, 82 and 93 kg ha^{-1} and the recommended doses of potassium are 5, 15, 25, 35, 45 and 55 kg ha^{-1}. The recommended doses of nitrogen for sugarcane crop is 276, 244, 212 and 180 kg ha^{-1}, recommended doses of phosphorus are 76, 55, 33 and 12 kg ha^{-1} and the recommended doses of potassium are 148, 135, 121,108, 94, 81 and 67 kg ha^{-1}. The application of N, P, and K as per the above recommendation in different spatial zones arrived reveals that there is a significant reduction in fertilizer application when compared to the general recommendations

In conclusion, it can be summarized that new technologies of remote sensing, GIS and GPS have opened a new era in generating natural resource database to integrate and assess their potential on spatial basis. Integration of GIS with various models in the present study was highly useful in generating the soil suitability assessment, fertilizer recommendation maps, soil quality assessment and preparation of customized fertilizer formulations. These studies can be made up to village level for micro level management of crop fields which help in attaining sustainability by catering the actual requirement of soil and crop within spatially variable fields. Further, the results provide actual estimates of fertilizer requirement for the study area for the important crops grown, thereby saving budget on nutrients at both planning and farmers level.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**KIRANMAI, JIRRA.**
Title of the Thesis	:	**ASSESSMENT OF GROUND WATER QUALITY USED FOR IRRIGATION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. P. MOHANA RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5454**

ABSTRACT

Present study entitled, "Assessment of groundwater quality used for irrigation in West Godavari district of Andhra Pradesh" was under taken in West Godavari district. A total number of 860 groundwater samples from 46 mandals of West Godavari district were collected during pre and post monsoon periods.

Water reaction (pH), EC, SAR and RSC in irrigation waters of study area varied from 6.5-8.6 and 6.5-8.8, EC ranged from 0.2-26.0 dS m^{-1} and 0.2-26.0 dS m^{-1}, SAR ranged from 0.1-63.1 and 0.1-29.2, RSC ranged from -74.6 to 20.5 me L^{-1} and -68.1 to 20.8 me L^{-1} during pre and post-monsoon seasons respectively. Dominant cation was sodium followed by calcium, magnesium and potassium, the trend was $Na^+ > Ca^{2+} > Mg^{2+} > K^+$. Likewise, in case of anions, chloride was the dominant anion followed by bicarbonate, sulphate and boron. The trend was $Cl^- > HCO_3^- > SO_4^{2-} > B$ during pre-monsoon. Similarly, during the post-monsoon water was $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ type waters and $Cl^- > HCO_3^- > SO_4^{2-} > CO_3^{2-}$ type water in respect of anions.

In both pre and post monsoon seasons in all mandals of West Godavari district majority of the underground water samples had pH between 6.5 to 7.5 and majority of the samples recorded under neutral class. Based on EC, maximum number of underground water samples had EC between 0.75 to 2.25 dS m^{-1} (C_3) *i.e.* high salinity. Based on SAR classification, during the pre-monsoon season 89.8, 8.8, 1.2 and 0.2 per cent samples recorded under S_1, S_2, S_3, and S_4 class, whereas, in post-monsoon season 90, 8.8, 0.9 and 0.2 per cent samples recorded under S_1, S_2, S_3, and S_4 class respectively. In both pre and post monsoon seasons majority of the samples were found under S_1 class *i.e.* low sodium hazard. Based on RSC classification, during the pre-monsoon season 65.1, 10.7 and 24.2 per cent samples recorded under A_1, A_2 and A_3 classes, whereas in post-monsoon season 66.7, 13.0 and 20.2 per cent samples recorded under A_1, A_2 and A_3 classes, respectively. In both pre and post monsoon seasons majority of the samples found under A_1 class *i.e.* RSC<1.25 me L^{-1}.

As per CSSRI classification 60.7, 8.8, 2.3, 5.3, 9.1, 8.4 and 5.3 per cent of water samples in west Godavari district during pre-monsoon season were classified under good, marginally saline, saline, high SAR saline, marginally alkali, alkali and high alkali categories, respectively. Likewise during the post-monsoon 64.2, 9.8, 2.3, 4.7, 6.5, 7.2 and 5.3 per cent of waters were classified under good, marginally saline, saline, high SAR saline, marginally alkali, alkali and high alkali categories, respectively. In both pre and post monsoon seasons majority of the samples were recorded under good category. As per USSL (1954) classification 22.6, 40.9, 12.1, 12.3, 5.9 and 6.5 per cent of waters in West Godavari district during pre-monsoon season were classified under C_2-S_1, C_3-S_1, C_3-S_2, C_4-S_2, C_4-S_3 and C_4-S_4 categories, respectively. Likewise during the post-monsoon 25.3, 45.1, 11.2, 10.0, 3.7 and 4.7 per cent of water samples were classified under C_2-S_1, C_3-S_1, C_3-S_2, C_4-S_2, C_4-S_3 and C_4-S_4 categories, respectively. In both pre and post monsoon seasons majority of the samples recorded under C_3-S_1 category *i.e.* high salinity-low sodium hazard class.

The yield of rice crop was negatively correlated with pH, K^+, HCO_3^- and SO_4^{-2} but not at significant level whereas, it was negatively correlated with EC, Na^+, Ca^{2+}, Cl^- and Boron at one per cent level of significance.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**MANIMALIKA, M.**
Title of the Thesis	:	**CHARACTERIZATION OF SALT AFFECTED SOILS AND YIELD OF CROPS GROWN IN SRIKALAHASTHI DIVISION OF CHITTOOR DISTRICT OF ANDHRA PRADESH**
Chairperson	:	**Dr. A. PRASANTHI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5530**

ABSTRACT

The present investigation was carried out to characterize the salt affected soils in Srikalahasthi division of Chittoor district of Andhra Pradesh. For this purpose, 152 surface soil samples and irrigation water samples were collected from five mandals of Srikalahasthi division *viz.,* Srikalahasthi, Yerpedu, B.N.Kandriga, Thotembedu and K.V.B.Puram. Soil samples were analyzed for physical, physico-chemical and chemical properties and irrigation water analyzed for its quality.

Per cent clay, silt and sand content ranged from 6.92 to 62.57, 2.28 to 28.95 and 30.31 to 85.08, respectively. The study area was dominated by medium textured soils (71.05 per cent) followed by coarse textured (18.43 per cent) and fine textured soils(10.42 per cent). Out of 152 soil samples collected from the study area 81 (53.28 per cent) soil samples were found to be strongly alkaline, while 47 (30.92 per cent) and 24 (15.78 per cent) soil samples were found to be mildly and moderately alkaline in reaction, respectively. Out of 152 soil samples collected from the study area, 61 (40.13 per cent), 57 (37.5 per cent), 21 (13.81 per cent), 9 (5.92 per cent) and 4 (2.63 per cent) were non saline, slightly saline, moderately saline, strongly saline and very strongly saline, respectively. The organic carbon status of 78.29 per cent of soil samples was low. Majority of soils in the study area were moderately calcareous (69.73 per cent) followed by strongly calcareous (17.10 per cent) whereas 13.16 per cent soil samples were said to be non calcareous. CEC of soils varied from 30.92 to 72.52 cmol(p^+)$kg^{-1}$with a mean value of 50.53 cmol(p^+)kg^{-1}. Per cent base saturation of soils ranged from 59.17 to 99.36 with a mean value of 70.11. The ESP > 15 was noticed in 59.86 per cent soil samples.

Soils of Srikalahasthi division were deficient in available nitrogen (87.5 per cent). Out of 152 soil samples studied for available phosphorous, 36, 54 and 62 soil samples were low, medium and high, respectively. The status of potassium in 18, 81 and 53 soil samples were high, medium and low respectively. 77.63 per cent of soil samples showed sufficient in

available sulphur content while only 22.37 per cent soil samples showed deficient in available sulphur content. The exchangeable cations of soils of Srikalahasthi division were found in the order of Ca^{2+}> Na^{+}> Mg $^{2+}$> K^{+}. But the soluble cations of the saturation extract was in the order of Na^{+}>Ca^{2+}>Mg^{2+}>K^{+}. In the saturation extract of the soils, chloride was the dominant anion followed by sulphates, bicarbonates and carbonates indicating chloride-sulphate type of soil salinity. Among the 152 soil samples collected from Srikalahasthi division, 65.14 per cent samples have SAR <13 and the remaining 34.86 soil samples have SAR>13.

The cationic composition of irrigation water in the study area was found in the order of Na^{+}>Mg^{2+}>Ca^{2+}>K^{+} whereas the order of anions in irrigation water was Cl^{-}>SO_4^{2-}>HCO_3^{-} >CO_3^{2-}.The study revealed that 46.05 per cent of irrigation water samples were alkaline in reaction and most of the water samples (69.79 per cent) showed high salinity (C_3) followed by very high salinity (C4-28.97 per cent) and medium salinity (C_2-1.32 per cent). The SAR of water samples were found in the order of S_1>S_2>S_3 class respectively. Based on RSC, majority of water samples were safe (67.11 per cent) followed by moderately safe (15.79 per cent) and unsafe (17.10 per cent).Based on Mg: Ca ratio, 8.55 per cent of irrigation water samples were classified as unsafe for irrigation. As per the guidelines of central soil salinity research institute, 69 samples (45.39 per cent), 17 samples (11.18 per cent), 9 samples (5.92 per cent) and one sample were found to be good, marginally saline, highly alkali and high SAR saline, respectively. Remaining 56 irrigation water samples were classified as medium to high salinity, medium to high sodium water, medium to very high alkalinity as per salinity, SAR and RSC classes established by Gupta (1979).

Out of 152 soil samples 93 soil samples identified as salt affected soils based on pHs, ECe and ESP, of this 5 (3.28 per cent), 58 (31.15 per cent) and 30 (19.73 per cent) soil samples were classified as saline, sodic, saline-sodic respectively. Remaining 59 soil samples were found to be normal. The soil related constraints studied in the salt affected soils and majority of normal soils of Srikalahasthi division were alkalinity, high soluble salt content, moderately to strongly calcareous, low in status of organic carbon, low in available N, P, K and deficient in available sulphur.

Paddy yield of salt affected soils *viz.,* sodic, saline-sodic and saline ranged from 3062 to 4250 kg ha^{-1} with a mean value of 3544 kg ha^{-1} whereas yield of paddy in normal soils ranged from 5062 to 6200 kg ha^{-1} with a mean value of 5496 $kgha^{-1}$. Yield of salt affected soils was less as compared to normal soils in the study area. Salt affected soils and irrigation water quality can be managed by adopting effective reclamation measures by the farmers' so as to improve the health of the soils and quality of irrigation water and ultimately the growth and yield of crops can be improved.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**NAGA RAMYA KRISHNA, T.**
Title of the Thesis	:	**ZINC BIOFORTIFICATION IN GROUNDNUT [*Arachis hypogaea* L.]**
Chairperson	:	**Dr. P. RAVINDRA BABU**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5453**

ABSTRACT

A field experiment entitled "Zinc biofortification in Groundnut (*Arachis hypogaea* L.)" was conducted at Agriculture College Farm, Bapatla, during *kharif*, 2016. The experimental soil was slightly acidic in reaction, non-saline, low in organic carbon, available N, available P_2O_5, medium in available K_2O, sufficient in available sulphur and all micro nutrients except zinc.

The experiment was laid out in randomized block design (RBD) with seven treatments replicated thrice. The treatments consisted of **T**$_1$- RDF (30 kg N-40 kg P_2O_5-50 kg K_2O ha^{-1}); **T**$_2$- T$_1$+ 50 kg $ZnSO_4$ ha^{-1} (soil application); **T**$_3$- T$_1$+ 0.2% $ZnSO_4$ foliar spray at 30and 40 days after sowing; **T**$_4$ - T$_1$ + 37.5 kg $ZnSO_4$ ha^{-1}+ Vermicompost @ 5 t ha^{-1}; **T**$_5$- T$_1$ + 37.5 kg $ZnSO_4$ ha^{-1} + Poultry manure @ 5 t ha^{-1}; **T**$_6$- T$_1$ + 37.5 kg $ZnSO_4$ ha^{-1}+ Farmyard manure @ 5 t ha^{-1}; **T**$_7$- T$_1$ + 37.5 kg $ZnSO_4$ ha^{-1}+ Press mud @ 5 t ha^{-1}. Organic manures were applied one week before sowing as per the treatments. Recommended dose of nitrogen, phosphorus and potassium (30 kg N-40 kg P_2O_5-50 kg K_2O ha^{-1}) were applied to all the plots in the form of urea, single super phosphate and muriate of potash respectively full dose as basal application to the experimental plots before sowing of crop. Zinc as $ZnSO_4$ @ 50 kg ha^{-1} and 37.5 kg ha^{-1} was applied to the respective plots as per the treatments as basal application before sowing i.e., 48 hours after application of P fertilizer. Foliar application of $ZnSO_4$ @ 0.2% twice at 30 and 40 DAS was applied as per the treatments. During pegging stage, gypsum @ 500 kg ha^{-1} was applied near pegging zone.

The influence of various treatments on yield, nutrient content and uptake and soil properties (physico-chemical, available nutrients) were determined by standard procedures at different stages.

The soil properties *viz*., pH and EC were not markedly influenced by the imposed treatments, while significantly high organic carbon was recorded in organic manures treated plots. There was a significant influence of the treatments on available nitrogen, phosphorus, potassium, sulphur and calcium. Among micronutrients (Zn, Fe, Mn and Cu), the treatmental

influence was significant with all four nutrients. The available zinc content was markedly influenced by zinc alone and zinc along with organic manures at all the crop growth stages.

Highest pod yield was recorded by the treatment T_7 that received RDF + 37.5 kg $ZnSO_4$ ha^{-1} + Pressmud @ 5 t ha^{-1}. The effect of treatments on N, P, K, S, Ca, Zn, Fe, Mn and Cu contents in plants was significant. The nutrient contents of groundnut plants at peg formation, pod development and harvest were markedly influenced by the treatments with highest nutrient content recorded in treatment T_7 which was supplied with RDF + 37.5 kg $ZnSO_4$ ha^{-1} + Pressmud @ 5 t ha^{-1}. Application of $ZnSO_4$ (soil, foliar and along with organic manures *viz.,* pressmud, poultry manure, vermicompost and farmyard manure) significantly increased zinc content over control.

The uptake of nutrients at peg formation, pod development and harvest was markedly influenced by the treatments with higher values recorded by the treatment that received RDF + 37.5 kg $ZnSO_4$ ha^{-1} + Pressmud @ 5 t ha^{-1}(T_7) while lower values were recorded with control (T_1).

The highest net returns of Rs. 78805 as well as B: C ratio of 2.03 was recorded in the treatment which received RDF + 37.5 kg $ZnSO_4$ ha^{-1} + Pressmud @ 5 t ha^{-1}(T_7).

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**NAGARJUNA, V.**
Title of the Thesis	:	**CHARACTERIZATION, CLASSIFICATION AND EVALUATION OF GROUNDNUT GROWING SOILS OF SRIKALAHASTI DIVISION IN CHITTOOR DISTRICT FOR SUSTAINABLE LAND USE PLANNING**
Chairperson	:	**Dr. M.V.S. NAIDU**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5535**

ABSTRACT

The present investigation involves "Characterization, classification and evaluation of groundnut growing soils of Srikalahasti division in Chittoor district, Andhra Pradesh for sustainable land use planning". For this, twenty typical pedons from groundnut growing areas were studied for physical, physico-chemical, chemical properties and mineralogy.

The area is characterized by semi-arid monsoonic climate with distinct summer, winter and rainy seasons. The pedons occurs in plains (P1, P2, P4, P5, P6 and P8), very

gently sloping (P3, P7, P9, P10, P11, P12, P13, P14, P15, P16 and P17) and gently sloping (P18, P19 and P20) topography. The P4, P6, P14 and P16 were developed from alluvium parent material while P1, P2, P3, P5, P7, P8, P9, P10, P11, P12, P13, P15, P17, P18, P19 and P20 were originated from granite-gneiss.

The morphological features indicated the presence of AC (P4, P6, P11, P13, P14, P17, P18, P19 and P20), A-(Bw)-C (P1, P3, P7, P8, P9, P10, P15 and P16) and A-(Bt)-C (P2, P5 and P12) profiles. The soils were deep to very deep in depth (expect P11), very light pale brown to very dark brown in colour, sand to sandy clay in texture (in the horizons of different pedons) and had varied structure including crumb, sub-angular blocky, angular blocky and single grain.

The clay content in P11 and P18 exhibited almost a decreasing trend with depth whereas P1 and P12 showed an increasing trend with depth. However, no specific trend with depth was observed in remaining pedons. Physical constants like water holding capacity, loss on ignition and volume expansion followed the trend of clay content. All the pedons exhibited an irregular trend of bulk density with depth.

The groundnut growing soils were moderately acidic to strongly alkaline (5.54 to 8.16) in reaction, non-saline (0.01 to 0.09) and low to medium (0.06 to 0.74 %) in organic carbon. These soils had CaCO3 ranging from 2.40 to 3.23 per cent. The CEC varied from 8.02 to 46.26 cmol (p+) kg^{-1} and exchange complex was dominated by Ca^{+2} followed by Mg^{+2}, Na^{+} and K^{+}. Chemical composition of soils revealed that all the pedons registered higher silica content indicating siliceous nature.

The soils were low to medium (19.20 to 247.60 mg kg^{-1}) in available nitrogen, low to high (4.10 to 21.67 mg kg^{-1}) in available phosphorus and potassium (30.23 to 408.14 mg kg^{-1}) and deficient to sufficient in available sulphur (5.58 to 47.99 mg kg^{-1}). The soils were sufficient in available Fe, Cu and Mn. However, available Zn was sufficient in surface horizons and deficient in sub-surface horizons in all pedons expect P13, P15 and P18 wherein it was found to be sufficient.

Based on CEC / clay ratio, X-ray diffraction analysis, physical, chemical and physico-chemical properties, it is concluded that the mineralogy class for P1, P3, P7, P8, P9, P10, P14 and P16 was smectitic whereas, mineralogy class for P2, P5 and P12 was kaolinitic. However, P4, P6, P11, P13, P17, P18, P19 and P20 have more silica (>80), hence the mineralogy class for these pedons was siliceous.

Based on the morphological, physical, physico-chemical, mineralogical and meteorological data, the groundnut growing soils in Srikalahasti division of Chittoor district were classified as: Fine-loamy, smectitic, isohyperthermic, Typic Haplustepts (P1, P8, P9 and P10); Coarse-loamy, kaolinitic, isohyperthermic, Typic Haplustalfs (P2); Coarse-loamy, smectitic, isohyperthermic, Typic Haplustepts (P3 and P15); Sandy, siliceous, isohyperthermic, Typic Ustifluvents (P4); Fine-loamy, kaolinitic, isohyperthermic, Typic Haplustalfs (P5 and P12); Sandy, siliceous, isohyperthermic, Typic Ustipsamments (P6); Fine-loamy, smectitic, isohyperthermic, Vertic Haplustepts (P7); Coarse-loamy, siliceous, isohyperthermic, Lithic Ustorthents (P11); Fine-loamy, siliceous, isohyperthermic, Typic Ustrorthents (P13); Fine-loamy, smectitic, isohyperthermic, Fulventic Haplustepts (P14 and P16); Coarse-loamy, siliceous, isohyperthermic, Typic Ustrorthents (P17, P18 and P20) and Sandy, siliceous, isohyperthermic, Lithic Ustrorthents (P19).

Based on climate, site and soil characteristics, the groundnut growing soils of Srikalahasti division of Chittoor district were classified into land capability classes and sub-

classes *viz.,* IIIs (P1, P2, P3, P4, P5, P6, P8, P9, P14 and P15), IIIes (P18), IVs (P10, P13, P16 and P17), IVes (P7, P12 and P20) and VIes (P11 and P19).

The soil-site suitability evaluation of groundnut growing soils of Srikalhasti division indicated that P2, P3, P4 P5, P7, P10, P13, P14, P16 and P17 were suitable (S1), P1, P6, P8, P12, P15, P18 and P20 were moderately suitable (S2 – constraints of soil pH, organic carbon and soil depth) and P9, P11 and P19 were marginally suitable (S3 – constraints of soil pH, organic carbon and soil depth) for growing groundnut crop.

Production potential of groundnut growing soils of Srikalahasti division revealed that P1, P2, P3, P5, P6, P7, P8, P9, P10, P12, P13, P14, P15, P16, P17 and P18 of were grouped under the good productivity class while P4, P11, P19 and P20 were classified under average class. The coefficient of improvement (Ci) varied from 1.23 to 2.61 indicating the implementation of judicious soil and water management practices to sustain crop productivity.

Groundnut index leaf samples were severely deficient in leaf N, severely deficient to deficient in leaf P, adequate in leaf K, S, Fe, Cu and Mn and marginally adequate to adequate in leaf Zn.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**PEDDA GHOUSE PEERA S.K.**
Title of the Thesis	:	**INFLUENCE OF RICE STRAW COMPOST AND MICROBIAL CONSORTIUM ON ZINC AVAILABILITY IN SOIL AND FORTIFICATION IN MAIZE (*Zea mays* L.)**
Chairperson	:	**Dr. P.R.K. PRASAD**
Degree	:	**Ph.D.**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5456**

ABSTRACT

The continued investigations on yield maximization of maize are much progress throughout Asian countries. Although much work has been carried out on all the macro and micronutrients based on needs for sustaining maize productivity, the work related to the biofortification of Zn utilizing rice straw compost and microbial consortium is very much limited in our country, in spite of escalating costs and adulteration of Zn mineral fertilizers. Keeping in view the scenario, incubation and field experiments were conducted for two consecutive years (2014-15 and 2015-16) on sandy loam and sandy clay loam soils of

Agricultural college farm, Bapatla, India. The experimental soil and rice straw compost was analysed for available nutrients prior to imposing treatments.

Initially, an incubation study was laid out in a factorial completely randomized design for determining the release rate of zinc in the sandy loam and sandy clay loam soils. The treatments consisted of six levels of $ZnSO_4.7H_2O$ at 0, 6.25, 12.5, 18.8, 25 and 31.3 mg kg^{-1} under four factors *viz*., control (F_1), rice straw compost (RSC) (F_2), microbial consortium (MC) (F_3), RSC+MC (F_4) replicated thrice. Soil was incubated at 30±1°C for 90 days by maintaining moisture at field capacity level. DTPA extractable Zn was analysed at each 15 days interval up to 90 days.

Field experiments were laid out in split plot design, keeping three zinc solubilizers *viz.* RSC, MC and their combination (RSC+MC) and control as main-plot treatments with six graded levels of $ZnSO_4.7H_2O$ *viz.* 0, 12.5, 25.0, 37.5, 50.0 and 62.5 kg ha^{-1} in sub-plots and replicated thrice. Popular cultivar of maize, 30 v 92 used as test crop. The experimental soils (0-15cm) was slightly alkaline in reaction, low in organic C and available nitrogen and medium in available phosphorus and potassium. Other standard package of practices was followed uniformly for all the plots.

Results showed that rice straw compost and microbial consortium in combination maximized the release of Zn at all the periods of incubation in both the soils. Maximum release of Zn was observed at 60th day of incubation in sandy loam soils and at 45th day of sandy clay loam soils when applied with Zn solubilizers. Without Zn solubilizers, Zn release increased only up to 30 days after incubation in both the soils. The performance of microbial consortium was more pronounced in sandy clay loam soils. Whereas, application of rice straw compost showed a consistent release of DTPA extractable Zn in sandy loam soils. Irrespective of Zn solubilizers the increase in Zn release was significant up to 50 kg ha^{-1} in sandy loam soils whereas in sandy clay loam soils it was up to 37.5 kg $ZnSO_4.7H_2O$ ha^{-1}. Though the interaction was not significant in early stages of incubation (15 DAI), significant interactions were recorded from 30 DAI onwards in both the soils.

Growth parameters, yield attributes, kernel and stover yield of maize were significantly higher with the application of $ZnSO_4.7H_2O$ @ 37.5 kg ha^{-1} in combination with RSC+MC during both the years of study. It also ensured the availability of DTPA-extractable Zn in soil at all the crop growth stages and elevated the Zn content in kernel and stover of maize. Whereas, sole application of either microbial consortium or rice straw compost with 50.0 kg $ZnSO_4.7H_2O$ ha^{-1} in sandy loam soils performed on par with the RSC+MC. Magnitude of increase in Zn content of kernel and stover was more distinct during second year of the study on comparison with first year.

The improvement in physical, chemical and biological parameters of the soil at harvest of maize was higher in the RSC incorporated plots. Incorporation of RSC followed by inoculation of microbial consortium just before sowing not only improved concentration and uptake of macronutrients (N, P, K and S) and micronutrients (Fe, Mn, Zn and Cu) of maize but also economise use of costly fertilizer inputs. The results further showed that 37.5 kg $ZnSO_4.7H_2O$ ha^{-1} as basal + rice straw compost with microbial consortium has been proved

to be superior treatment for the best management of Zn in *rabi* maize under sandy loam and sandy clay loam soil conditions.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**PRIYANKA, M. K.**
Title of the Thesis	:	**POTASSIUM DYNAMICS THROUGH ORGANIC MANURES AND POTASSIUM SOLUBILIZING BIOFERTILIZER IN OKRA (*ABELMOSCHUS ESCULENTUS* L.)**
Chairperson	:	**Dr. Ch. SUJANI RAO**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5450**

ABSTRACT

A field experiment entitled "Potassium dynamics through organic manures and potassium solubilizing biofertilizer in Okra (*Abelmoschus esculentus* L.)" was conducted at Agricultural College Farm, Bapatla during 2016. The test soil was non-saline, sandy loam in texture with neutral reaction. The soil was low in available nitrogen, medium in phosphorus and high in potassium status. The available Cu, Zn, Mn and Fe were above their respective critical limits.

The experiment was laid out in Randomized Block Design (RBD) with ten treatments replicated thrice. The treatments comprised of T_1: RDF; T_2: RDF + FYM @ 5 t ha^{-1}; T_3: RDF + Vermicompost @ 5 t ha^{-1}; T_4: RDF + Poultry manure @ 5 t ha^{-1}; T_5: RDNP + 30 kg K_2O + FYM @ 5 t ha^{-1} + K solubilizing biofertilizer; T_6: RDNP + 30 kg K_2O + Vermicompost @ 5 t ha^{-1} + K solubilizing biofertilizer; T_7: RDNP + 30 kg K_2O + Poultry manure @ 5 t ha^{-1} + K solubilizing biofertilizer; T_8: RDNP + FYM @ 5 t ha^{-1} + K solubilizing biofertilizer; T_9: RDNP + Vermicompost @ 5 t ha^{-1} + K solubilizing biofertilizer; T_{10}: RDNP + Poultry manure @ 5 t ha^{-1} + K sloubilizing biofertilizer. Well decomposed organic manures *viz*., FYM, vermicompost and poultry manure @ 5 t ha^{-1} were applied one week before sowing along with potassium solubilizing biofertilizer @ 5 kg ha^{-1}. Recommended dose of nitrogen was applied in four splits in the form of urea; recommended dose of phosphorus was applied in the form of SSP at basal uniformly to all the treatments. Potassium was as per the treatment in the form of muriate of potash.

The influence of various treatments on growth parameters, yield, quality parameters, nutrient content and uptake and soil properties (physico-chemical, available nutrients, different potassium fractions) were determined by standard procedures at different stages.

Different fractions of potassium were significantly influenced by different treatments. Higher content of water soluble K and exchangeable K were recorded under RDF + poultry manure @ 5 t ha^{-1} followed by RDF + vermicompost @ 5 t ha^{-1}. Lowest non exchangeable K and step K content was recorded under RDNP + poultry manure @ 5 t ha^{-1} + K solubilizing biofertilizer followed by RDNP + vermicompost @ 5 t ha^{-1} + K solubilizing biofertilizer. The total K content of soil was not significantly influenced by different treatment.

The soil properties *viz*., pH and EC were not markedly influenced by the imposed treatments, while significantly high organic carbon was recorded in organic manures treated plots. There was a significant influence of the treatments on available nitrogen, phosphorus and potassium. The available potassium content was markedly influenced by levels of potassium, organic manures and K solubilizing biofertilizer at all the crop growth stages. Among micronutrients (Cu, Zn, Mn and Fe), the treatmental influence was significant with all four nutrients.

Highest dry matter production and fruit yield were recorded by the treatment that received RDF + poultry manure @ 5 t ha^{-1} followed by RDF + vermicompost @ 5 t ha^{-1}. The fruit quality parameters *viz.*, crude fibre, crude protein and ascorbic acid content of fruits were significantly influenced by imposed treatments.

The potassium content of okra plants at vegetative, flowering and harvest was markedly influenced by the treatments with highest K recorded in treatment supplied with RDF + poultry manure @ 5 t ha^{-1}. The effect of treatments on other nutrients in plants was not significant.

The uptake of macronutrients at vegetative, flowering and harvest was markedly influenced by the treatments with maximum values recorded by the treatment that received RDF + poultry manure @ 5 t ha^{-1} which was on par with RDF + vermicompost @ 5 t ha^{-1} and RDF + FYM @ 5 t ha^{-1}.

The highest net returns and B: C ratio was recorded in the treatment RDF+ PM @ 5 t ha^{-1} followed by RDF + VC @ 5 t ha^{-1}.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**PURANDHAR, E.**
Title of the Thesis	:	**CHARACTERIZATION, CLASSIFICATION AND EVALUATION OF SOILS OF PUTTUR MANDAL OF CHITTOOR DISTRICT, ANDHRA PRADESH**
Chairperson	:	**Dr. M.V.S. NAIDU**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5531**

ABSTRACT

The present investigation involves characterization, classification and evaluation of soils in Puttur mandal of Chittoor district, Andhra Pradesh. For this, seven representative pedons were selected in seven different locations of the study area covering all types of soils. All the seven pedons were described for their morphological features in the field and horizon-wise samples were collected and analyzed in the laboratory for physical, physico-chemical and chemical properties.

The study area was characterized by semi-arid monsoonic climate with distinct summer, winter and rainy seasons. The Pedons selected were located on nearly level (0-1%) very gently sloping (1-3%) and gently sloping (3-5 %) topography. All pedons were developed from granite-gneiss parent material. The morphological features indicated the presence of AC (Pedons 4 and 5), A-(Bw)-C (Pedons 1 and 7) and A-(Bt)-C (Pedons 2, 3 and 6) profiles. The soils were deep to very deep in depth, dark reddish brown to very dark grey in colour, sand to clay in texture and had single grain, sub-angular blocky and angular blocky structure.

The clay content showed no specific trend with depth in all pedons. Physical constants like water holding capacity exhibited an increasing trend in pedon 2 and a decreasing trend in pedon 4 with depth. However, remaining pedons showed an irregular trend with depth. Loss on ignition showed an increasing trend in pedon 5 and remaining pedons did not show any particular trend with depth. Bulk density showed an increasing trend in pedon 2 whereas remaining pedons did not show any particular trend with depth.

The pedons were slightly acidic to moderately alkaline in reaction, non-saline and low in organic carbon. All the pedons registered low CaCO3 status. CEC values were low to high and exchange complex was dominated by Ca^{+2} followed by Mg^{+2}, Na^{+} and K^{+}. Chemical composition of soils revealed that all the pedons had high silica content indicating siliceous nature.

Regarding nutrients status, the soils were low to medium in available nitrogen, low to high in available phosphorus, medium to high in available potassium and deficient to sufficient in available sulphur. However, the soils were deficient in DTPA- extractable zinc

(except Ap horizon of pedons 1, 2, 3 and 5) and sufficient in DTPA-extractable copper, manganese and Iron (except pedon 7).

Based on morphological, physical, physico-chemical, mineralogical and meteorological data, the soils of Puttur mandal were classified as:

Pedon 1 :	Fine-loamy, smectitic, isohyperthermic, Typic Haplustept
Pedon 2 :	Fine, mixed, isohyperthermic, Ultic Haplustalf
Pedon 3 :	Fine-loamy,mixed, isohyperthermic, Ultic Haplustalf
Pedon 4 :	Fine-loamy, siliceous, isohyperthermic, Typic Ustifluvent
Pedon 5 :	Fine-loamy, siliceous, isohyperthermic, Typic Ustifluvent
Pedon 6 :	Fine-loamy, mixed, isohyperthermic, Ultic Haplustalf
Pedon 7 :	Coarse loamy, smectitic, isohyperthermic, Typic Haplustept

Based on the soil properties, the soils of the Puttur mandal have been classified into land capability classes and sub-classes *viz.,* IIs (Pedons 2 and 7), IIIe (Pedon 1 and 4), IIIwe (Pedon 5), IVe (Pedons 3 and 6).

The soil-site suitability evaluation of study area revealed that pedons 4 and 5 were marginally suitable (S3) for rice and sesame crops. Pedon 4 was moderately suitable (S2) whereas pedon 5 was marginally suitable (S3) for groundnut crop. However, pedon 4 was highly suitable (S1) and pedon 5 was moderately suitable (S2) for growing sunflower. Pedons 1 and 7 were moderately suitable (S2) for groundnut and marginally suitable (S3) for rice, sesame and sunflower. Pedons 2 and 3 were marginally suitable (S3) for growing sesame and moderately suitable (S2) for groundnut. Pedon 2 was moderately suitable (S2) and pedon 3 was marginally suitable (S3) for rice. Pedon 2 was marginally suitable (S3) and pedon 3 was moderately suitable (S2) for growing sunflower. However, pedon 6 was marginally suitable (S3) for growing rice and sunflower and moderately suitable (S2) for growing groundnut and sesame.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**RAMANJANEYA REDDY, A.**
Title of the Thesis	:	**STUDIES ON SOIL RELATED CONSTRAINTS AND THEIR EFFECT ON YIELD AND QUALITY OF SWEET ORANGE [*Citrus sinensis* (L.) Osbeck] IN YSR DISTRICT, ANDHRA PRADESH**
Chairperson	:	**Dr. V. MUNASWAMY**
Degree	:	**Ph.D.**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5536**

ABSTRACT

An investigation was carried out to study the soil related constraints and their effect on yield and quality of sweet orange in YSR district of Andhra Pradesh. To prosecute this investigation, fifty sweet orange orchards aged between 12 to 13 years were selected and soil samples were collected from these orchards at 0-30 cm and 30-60 cm depth. Further, fifty index leaf samples, fruit samples and irrigation water samples were also collected from respective soil sampled orchards.

The soil samples were analyzed for physical properties like texture, colour, bulk density, particle density, percent pore space and water holding capacity, physico-chemical characteristics *viz.,* pH, EC, OC, CEC, SAR, ESP and free $CaCO_3$ and chemical properties *viz.,* available N, P, K, Ca, Mg, S, Fe, Mn, Zn and Cu. Similarly, leaf samples were analyzed for total N, P, K, Ca, Mg, S, Fe, Mn, Zn and Cu and fruit samples were analyzed for per cent juice, titrable acidity, juice pH, TSS and vitamin-C. In irrigation water, quality parameters such as pH, EC, cations *viz.,* Na^+, Ca^{2+}, Mg^{2+}, K^+ and anions *viz.,* CO_3^{2-} , HCO_3^- , Cl^-, and SO_4^{2-} were analyzed.

The various soil textural classes identified were loamy sand (18%), sandy loam (42%), sandy clay loam (34%) and sandy clay (6%) at surface and sandy (4%), loamy sand (14%), sandy loam (38%), sandy clay loam (38%) and sandy clay (6%) at subsurface soils of the study area. The colour of the soils of the study area had their Munsell colour notation in the hue of 10YR/7.5YR/5YR/2.5YR with value 2 to 4 and chroma 0 to 4 at 0-30 cm depth and at 30-60 cm depth the hue of 10YR/7.5YR/5YR/2.5YR with value 2 to 4 and chroma 1 to 6.

The study area soil reaction varied widely, that indicated about 72% of the samples were mildly alkaline, 16% were moderately alkaline and 12% were strongly alkaline at 0-30 cm and at 30-60 cm, 48% were strongly alkaline, 38% were moderately alkaline and 14% were mildly alkaline in pH. The orchards were non-saline in nature as the EC of these soils was far below 4.0 dS m^{-1}. The study area soils were low to medium in organic carbon at surface and low in sub-surface. The organic carbon content decreased with increasing depth.

Out of all the soils of sweet orange orchards studied, 82% were deficit in N and 18% were medium in N, 20% were deficient in P, 60% were medium in P and 20% were high in P, but in case of available K, 32% were in medium range and 68% were in high range. The higher exchangeable calcium and magnesium status was observed in all the orchards both in the surface and subsurface soils.

In soils of sweet orange orchards studied, 24% and 78% were very low in available Fe and Zn, respectively. Low in available Fe, Zn and Mn were 68%, 18% and 8%, respectively. Medium in available Fe, Zn Mn and Cu were 8%, 4%, 38% and 18%, respectively. High in available Mn and Cu were 36% and 82%, respectively. Very high in available Mn was 18%.

Two per cent of the leaf samples deficit in N, 8% deficit in P and 4% deficit in K. Low in N, P, K, Ca and Mg were 42%, 12%, 14%, 2% and 12%, respectively. High in N, P, K, Ca and Mg were 4%, 50%, 16%, 18% and 18%, respectively.

Leaf Zn deficiency was the most severe among the 10 mineral elements tested and 62% of samples were deficient in Zn, followed by Fe (54%), Mn (52%) and Cu (26%).

However, the average leaf content of N, P Ca and Cu was 2.03, 0.16, 2.66 and 8.29, respectively; which was much more than the optimum range.

The negative significant correlation noticed between fruit yield and soil pH (r = -0.512**), free $CaCO_3$ (r = -0.329*), SAR (r = -0.424**) and ESP (r = -0.522**), and also observed a non-significant negative correlation between soil EC with fruit yield of sweet orange.

Fruit yield and fruit weight was positively and significantly influenced by soil organic carbon content (r = 0.360* and r = 0.330*), because the organic carbon content of the soil had a significant positive influence on soil N (r = 0.716**).

The soil mineral nutrients like N, P and K influenced the fruit weight significantly and positively (r = 0.469**, r = 0.446** and r = 0.415**, respectively). Fruit juice per cent had significant positive relation with soil N (r = 0.353*) and P (r = 0.364**). Soil P had a significant positive correlation with TSS (r = 0.438**).

The pH of the water samples collected from sweet orange orchards of study area was varied from neutral to mildly alkaline.

The EC of the irrigation water varied from 0.82 - 3.87 dS m^{-1} with a mean value of 1.82 dS m^{-1}. According to the irrigation EC classification, 76% of the water samples were in high salinity *i.e.*, C3 class and 24% of the water samples categorized as very high salinity *i.e.*, C4 class.

The concentration of major anions of irrigation water collected from all the sweet orange orchards were in the order of $HCO_3^- > Cl^- > SO_4^{2-} > CO_3^{2-}$ and the cations were in the order of $Na^+ > Mg^{2+} > Ca^{2+} > K^+$.

The general constraints that were observed in the sweet orange orchards were low organic carbon, low to medium in available nitrogen and phosphorus content, wide spread deficiency of zinc and iron in the soils, low to medium soil Mn, wide occurrence of soil alkalinity, calcareousness and poor quality of irrigation water *i.e.*, high to very high salinity of the irrigation water.

Nutrient constraints can be overcome by regular application of required doses of fertilizers to the sweet orange orchards on soil and plant test based, application of liberal doses of manures, adapting integrated nutrient management system, foliar application of micronutrients and following fertigation technique.

Calcareous soils can be managed by application of sulphur products, such as elemental sulphur or sulphuric acid (H_2SO_4) acts as soil acidifiers and these products potentially improve nutrient availability in calcareous soils by decreasing soil pH. Sodic soils can be managed by application of gypsum and organic manures.

Cholorosis can be controlled by foliar application of composite mixture of zinc sulphate 0.5%, manganese sulphate 0.2%, boric acid 0.1%, urea 1% and lime 0.4% at two or three times in a year.

The detailed study of the sweet orange crop revealed that the yield and quality of sweet orange grown under adverse soil environment would be reduced drastically due to the poor management practices. The unfavourable soil environment will not be suitable for growing sweet orange. For achieving the maximum yield and good quality, sweet orange crops can be grown in sandy loam or sandy clay loam soils free from $CaCO_3$ coupled with best management practices.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**RISHI KUMAR REDDY, A.**
Title of the Thesis	:	**EFFECT OF VARIOUS ORGANIC MANURES ON SOIL CARBON SEQUESTRATION, SOIL HEALTH AND PRODUCTIVITY OF RAINFED GROUNDNUT (*Arachis hypogaea* L.)**
Chairperson	:	**Dr. K. V. NAGA MADHURI**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5532**

ABSTRACT

The present study entitled **"Effect of various organic manures on soil carbon sequestration, soil health and productivity of rainfed groundnut (*Arachis hypogaea* L.)"** was undertaken during *kharif,* 2016 in a field experiment which was started at the Regional Agricultural Research Station, Tirupati, Acharya N.G. Ranga Agricultural University in *kharif,* 2007, with a prime objective of monitoring soil health. The soil of the experimental field was red sandy loam (Haplustalf). The experiment has six treatments each replicated four times in a randomized block design. The treatments include T_1 : Control (no manure or fertilizers), T_2 : RDF @ 20:40:50 $N:P_2O_5:K_2O$ kg ha^{-1}, T_3 : Vermicompost @ 2.5 t ha^{-1}, T_4 : Poultry manure @ 4 t ha^{-1}, T_5 : Farm yard manure @ 10 t ha^{-1}, T_6 : Pressmud cake @ 10 t ha^{-1}.

Surface soil samples at a depth of 15 cm were collected at harvest in each treatment for analysing physical, physico-chemical, chemical and micro-biological properties. Soil samples were also collected from 0-30, 30-60, 60-90 and 90-120 cm depth at harvest of the crop in each treatment for estimation of total carbon, carbon stock and carbon sequestration.

Significant decrease in soil bulk density (1.18 Mg m^{-3}), increase in porosity (51.2 %) and water holding capacity (40.1 %) at harvest due to the application of FYM @ 10 t ha^{-1} (T_5) was recorded and was on par with pressmud cake @10 t ha^{-1} (T_6). The highest bulk density (1.29 Mg m^{-3}), lowest porosity (45.6 %) was recorded in control (T_1) and lowest water holding capacity (28.1 %) in RDF treatment (T_2). The **bulk density** in soil at harvest

increased with increase in soil depth. The mean bulk density at a depth of 0 to 30 cm was recorded as 1.25 Mg m^{-3}, 1.27 Mg m^{-3} at 30 to 60 cm, 1.30 Mg m^{-3} at 60 to 90 cm and 1.32 Mg m^{-3} at 90 to 120 cm.

Soil pH and organic carbon were significantly increased and EC was not influenced by the application of organic manures at harvest. Highest pH (7.20) was recorded in poultry manure @ 4 t ha^{-1} applied treatment (T_4) and was on par with (7.13) FYM @ 10 t ha^{-1} applied treatment (T_5). Highest organic carbon (0.51 %) was recorded in FYM @ 10 t ha^{-1} applied treatment (T_5) and was on par with pressmud cake @ 10 t ha^{-1} applied treatment (T_6). The lowest pH (6.42) and OC (0.30 %) was recorded in control (T_1). Total carbon content of soil was significantly increased with the application of organic manures. Highest total carbon (0.72 %) was recorded in FYM applied treatment (T_5) and lowest (0.41 %) was recorded in control (T_1). Total carbon content of soil decreased with increase in soil depth at harvest. The mean total carbon content at 0 to 30 cm soil depth was recorded as 0.53 %, 0.48 % at 30 to 60 cm, 0.46 % at 60 to 90 cm and 0.43 % at 90 to 120 cm soil depth.

Soil available nutrients like N, P, K, Ca, Mg and S increased significantly by the application of organic manures at harvest. Highest available nitrogen(236 kg ha^{-1}), phosphorus (61 kg ha^{-1}) and potassium (292 kg ha^{-1}) were recorded in FYM (T_5), poultry manure (T_4) and pressmud cake (T_6) applied treatments respectively, whereas the lowest was observed in control (T_1). Highest soil exchangeable calcium (6.5 cmol (P^+) kg^{-1}) and available sulphur (9.4 mg kg^{-1}) were recorded in pressmud cake (T_6) applied treatment. Whereas, FYM applied treatment (T_5) recorded the highest exchangeable magnesium (4.0 cmol (P^+) kg^{-1}). Lowest exchangeable magnesium and available sulphur were recorded in RDF treatment (T_2) and exchangeable calcium was lowest in control (T_1).

Soil DTPA extractable micronutrients like Fe, Zn, Cu and Mn also increased significantly with the application of organic manures at harvest. Highest Fe (7.1 mg kg^{-1}), Zn 4.7 (7.1 mg kg^{-1}) and Cu (0.73 mg kg^{-1}) content were recorded in FYM applied treatment (T_5) followed by poultry manure applied treatment (T_4). The lowest Fe, Zn and Cu were recorded in control (T_1). Whereas, highest Mn was observed in pressmud cake applied treatment (T_6) followed by FYM applied treatment (T_5) and lowest Mn was recorded in RDF treatment (T_2).

Total microbial population viz., bacteria, fungi and actinomycetes population at harvest was higher in all the organic manure applied treatments than RDF treatment **(T_2)** and control **(T_1)**. The highest population viz., bacteria (124 cfu gm^{-1}), fungi (12 cfu gm^{-1}) and actinomycetes (42 cfu gm^{-1}) were recorded in pressmud cake applied treatment **(T_6)** and lowest was recorded in RDF treatment **(T_2)**.

Soil organic carbon stock at harvest was recorded highest (1867 Mg C ha^{-1}) in pressmud cake applied treatment (T_6) followed by FYM applied treatment (T_5) (1699 Mg C ha^{-1}). Lowest was recorded in RDF treatment (T_2) and control (T_1). Organic carbon stock at harvest increased with increase in soil depth. The mean soil organic carbon stock at a depth of 0 to 30 cm was 1477 Mg C ha^{-1}, 2726 Mg C ha^{-1} at 30 to 60 cm, 3271 Mg C ha^{-1} at 60 to 90 cm and 3629 Mg C ha^{-1} at 90 to 120 cm. Carbon sequestration rate also showed similar trend when organic manures were applied but no regular pattern was observed with respect to depth.

Significant differences were recorded in carbon sequestration potential in organic manure applied treatments. Highest carbon sequestration potential (535 Mg C ha^{-1}) was recorded in treatment receiving FYM (T_5) and was on par with pressmud cake applied treatment (T_6). Lowest (65 Mg C ha^{-1}) was recorded in RDF treatment (T_2). The soil carbon sequestration potential at harvest stage increased with increase in soil depth. The mean soil carbon sequestration potential at a depth of 0 to 30 cm was 196.65 Mg C ha^{-1}, 287.28 Mg C ha^{-1} at 30 to 60 cm, 302.1 Mg C ha^{-1} at 60 to 90 cm and 743.47 Mg C ha^{-1} at 90 to 120 cm.

Pod yield of groundnut was significantly influenced by the application of different organic manures. The highest pod yield (1531 kg ha^{-1}) was recorded in RDF treatment (T_2) and was on par with FYM (T_5) (1470 kg ha^{-1}), poultry manure (T_4) (1454 kg ha^{-1}), pressmud cake (T_6) (1446 kg ha^{-1}) and vermicompost applied treatments (T_3) (1418 kg ha^{-1}). Whereas, lowest (1188 kg ha^{-1}) was recorded in control (T_1).

Highest nitrogen (64.29 kg ha^{-1}), phosphorus (19.43 kg ha^{-1}) and potassium uptake (69.04 kg ha^{-1}) were recorded in pressmud cake applied treatment (T_6) and the lowest was recorded in control (T_1).

In the present study, among various organic manures, FYM and pressmud cake application @ 10 t ha^{-1} were found most effective in maintaining soil health by improving soil physical properties, soil carbon stock and carbon sequestration rate and by supplying essential nutrients apart from maintaining microbial population in soil. They also helped in sustaining pod yields similar to chemical fertilizers. Depending on the availability, any of the organic sources like FYM or pressmud cake can be suggested to achieve organic farming in groundnut crop under rainfed situations.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**RUPA DEVI, BANDI.**
Title of the Thesis	:	**COMPARATIVE ASSESSMENT OF CROP RESIDUES INCORPORATION AND THEIR APPLICATION AFTER COMPOSTING ON SOIL PROPERTIES AND PERFORMANCE OF MAIZE**
Chairperson	:	**Dr. P. PRASUNA RANI**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5455**

ABSTRACT

A field experiment entitled **"Comparative assessment of crop residues incorporation and their application after composting on soil properties and performance of maize"** was conducted during *kharif*, 2016 at Agricultural College Farm, Bapatla to study the influence of crop residues and their composts on soil properties (physical, physico-chemical properties, available nutrient status and biological activity) and performance of maize (Pioneer-3396) in terms of yield, nutrient content and uptake.

The experiment was laid out in RBD with nine treatments replicated thrice. The treatments comprised of **T_1** - 100% RDFN (120 kg N), **T_2 - *100% RDFN + 25% N through rice straw,*** **T_3 - *100% RDFN + 25% N through rice compost***, **T_4 -*100% RDFN + 25% N through maize stalk***, **T_5 - *100% RDFN + 25% N through maize compost,*** **T_6 - *75% RDFN + 25% N through rice straw,*** **T_7 - *75% RDFN + 25% N through rice compost,*** **T_8 - *75% RDFN + 25% N through maize stalk and*** **T_9 - *75% RDFN + 25% N through maize compost***.

The experimental soil was clay in texture, non-saline and slightly alkaline in reaction. The soil was low in available nitrogen, medium in phosphorus, high in potassium and sufficient in sulphur. The available Fe, Mn and Cu were above their respective critical limits while, Zn was deficient. Calculated quantities of crop residues and composts were applied one month and seven days, respectively before sowing the crop to supply required level of nitrogen. Recommended dose of fertilizer nitrogen was applied in three equal split doses as per the treatments. Entire quantity of phosphorus (60 kg ha^{-1} P_2O_5) was applied as basal, while potassium (60 kg ha^{-1} K_2O) in two equal splits. Foliar spray of 0.2 per cent $ZnSO_4$ was given twice on observation of zinc deficiency. Among the organic sources tested (rice straw, rice compost, maize stalk and maize compost), maize compost was found to be superior with respect to nutrient composition, followed by rice compost. The crop was harvested at 110 days after sowing. Soil samples collected at sowing, knee high, tasseling and harvest stages and plant samples collected at harvest stage were analyzed following standard procedures.

Inorganic fertilizer along with crop residues or composts didn't show marked difference in water holding capacity (harvest), pH and EC of the soils. All integrated treatments recorded comparable values of organic carbon and were significantly superior to the inorganic treatment. The treatment supplied with 100% RDFN + 25% N though maize compost was found to be significantly superior to control (100% RDFN) in available nutrient content (except K and Zn) and biological activity. No significant influence of treatments was recorded related to potassium and zinc. Application of 100% RDFN + 25% N though rice compost was identified as next best treatment followed by 75% RDFN + 25% N though maize compost in maintaining overall soil quality.

The performance of maize in terms of kernel yield, stover yield, nutrient content and uptake was significantly influenced by the imposed treatments. The treatment supplied with 100% RDFN + 25% N through maize compost recorded maximum kernel yield, stover yield, nutrient content and uptake and it was followed by treatment supplied with 100% RDFN + 25% N through rice compost and 75% RDFN + 25% N through maize compost.

From the present study, it can be concluded that application of 100% RDFN + 25% N through maize compost resulted in maximum yield, improved soil water holding capacity, nutrient status and biological activity followed by the treatments supplied with 100% RDFN + 25% N through rice compost and 75% RDFN + 25% N through maize compost. Since,

maize compost with 75% RDFN exhibited comparable performance to that of best treatments, in improving yield and soil properties it can be stated that substituting nitrogen through maize compost can reduce the fertilizer nutrient requirement by 25 per cent while, improving the quality of produce.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**SRI SINDHU, Y.**
Title of the Thesis	:	**EFFECT OF DIFFERENT SOURCES OF BIOCHAR AND MICROBIAL CONSORTIUM ON GROWTH AND YIELD OF BLACKGRAM *(KHARIF)* IN BLACK SOILS**
Chairperson	:	**Dr. P. RATNA PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5448**

ABSTRACT

The present study entitled "Effect of different sources of biochar and microbial consortium on growth and yield of *kharif* blackgram in black soils" was carried out in green house at Agricultural College, Bapatla during 2015-2016. The experiment was laid out in factorial CRD with 15 treatments using two factors *viz.,* biochars (coarse maize biochar, powdered maize biochar, coarse sorghum biochar, powdered sorghum biochar and no biochar) and microbial consortia (fungal, bacterial and no consortium). Biochars of sorghum and maize residues were prepared by indigenous heating and characterized for different properties.

Soil samples collected at 30, 45 DAS and harvest were analyzed for physical, physico-chemical properties, nutrient status, microbial population and enzyme activity following prescribed procedures. Plant height, drymatter accumulation (at different stages of crop growth) and yield (seed and haulm) at harvest were recorded. Plant samples were processed and estimated for content of macro and micronutrients by following standard procedures.

The bulk density and water holding capacity of soils at harvest were not significantly influenced by the imposed treatments and their interaction. Similar non significant effect of treatments was recorded with respect to the pH and EC of soil samples collected at different stages and CEC at harvest. Higher organic carbon, available nutrients and biological activity were observed in treatment with powdered sorghum biochar, which was found to be significantly superior to no biochar treatment and at par with powdered maize biochar and coarse sorghum biochar supplied treatments. Treatment with bacterial consortium recorded maximum organic carbon, available nutrients and biological activity and was found to be on par with fungal consortium and significantly superior to no microbial consortium treatment.

Among different treatment combinations, significantly higher organic carbon, available nutrient status, microbial population and enzyme activity were observed in the treatment combination, which received powdered sorghum biochar x bacterial consortium compared to no biochar x no microbial consortium treatment. The treatment combination of powdered sorghum biochar x bacterial consortium was on par with the combination of powdered maize biochar x bacterial consortium, coarse sorghum biochar x bacterial consortium and powdered sorghum biochar x fungal consortium.

Different sources of biochars significantly influenced the plant height, drymatter accumulation at all stages of crop growth and yield (seed and haulm) at harvest. The treatment supplied with powdered sorghum biochar was found to be superior to no biochar treatment and at par with powdered maize biochar treatment. Among microbial consortium treatments, the treatment supplied with bacterial consortium significantly increased the plant height, drymatter accumulation at all stages of crop growth, yield (seed and haulm) at harvest and was found to be at par with fungal consortium. The treatment combination of powdered sorghum biochar x bacterial consortium recorded significantly higher plant height, drymatter accumulation at all stages of crop growth and yield (seed and haulm) at harvest compared to no biochar x no microbial consortium treatment and at par with the treatment received powdered sorghum biochar x fungal consortium. There was no significant influence of the type of biochars, microbial consortium and their interaction on nutrient content (N, P, K, Fe, Zn, Cu and Mn) of blackgram at all stages of crop growth. Based on the experimental results it is observed that the influence of microbial consortia were found to be effective in improving nutrient content and performance of blackgram crop, whereas higher yield of black gram was observed in combined application of powdered biochar and bacterial consortium followed by use of coarse biochar along with bacterial consortium.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**SRAVANI, B.**
Title of the Thesis	:	**COMPARATIVE EVALUATION OF AB-DTPA AND DTPA EXTRACTANTS FOR CATIONIC MICRONUTRIENTS IN CALCAREOUS SOILS**
Chairperson	:	**Dr.P.R.K.PRASAD**
Degree	:	**M.Sc (Ag.)**
College	:	**AGRICULTURAL COLLEGE, BAPATLA**
Accession Number	:	**D5451**

ABSTRACT

Research work was carried out to evaluate the ability of AB-DTPA extractant to extract cationic micronutrients (Zn, Fe, Mn and Cu) in calcareous soils of Piduguralla mandal, Guntur district, A.P. One hundred and ten representative surface soil samples were

collected from 15 villages of study area by following random sampling technique. The soil samples were analysed for various physical, physico-chemical and chemical properties of calcareous soils and extraction of cationic micronutrients with DTPA and AB-DTPA for assessing the comparative ability of these extractants in extracting soil available micronutrients (Zn, Fe, Mn and Cu).

The results indicated that the soils of study area belong to four different textural classes viz., silty clay loam (1.81%), sandy clay loam (17.27 %), sandy clay (31.81 %) and clay (49.09 %). Out of which, clay was the dominant texture. The soils were neutral to moderately alkaline in reaction, non saline, non sodic and moderately to strongly calcareous in nature. Out of all, 70 per cent of samples were highly calcareous and 30 % were moderately calcareous in nature. The soils were low in organic carbon, available nitrogen and available phosphorus, high in available potassium. Available sulphur was well above the critical limit. The cation exchange capacity of the soils ranged from 27.0 to 52.5 cmol (p^+) kg^{-1} with high base saturation values varying from 87.1 to 99.90 per cent. The exchangeable bases on the exchange complex were found to be in the order of $Ca^{2+} > Mg^{2+} > Na^{2+} > K^+$.

Considering the critical limit given by Lindsay and Norvell (1978), for DTPA extracted micronutrients, all samples were deficient in zinc while Fe, Mn and Cu ranged from deficient to sufficient. Based on the critical limits given by Soltanpour and Schwab (1977) for AB-DTPA extracted micronutrients, 85.4 % samples were low and 14.6 % samples were medium in zinc status; 47.2 % samples were low, 40.9 % samples were medium and 11.8 % samples were high in iron status; 31.8 % were medium and 68.2 % samples were high in manganese status, 9 % samples were low and 91 % samples were were high in copper status. The availability of nutrients was affected significantly and positively by organic carbon while negatively by calcium carbonate and pH.

To explore the feasibility of adoption of AB-DTPA as an extractant in calcareous soils, Zn, Fe, Mn and Cu content of soils were also extracted with AB- DTPA. It was observed that the amounts of Zn, Fe, Mn and Cu were higher when compared to their respective conventional method of extraction. AB-DTPA method of extraction of micronutrients showed significant and positive correlation with the conventional methods of extraction of Zn, Fe, Mn and Cu. This indicated the feasibility of using AB-DTPA as an extractant for the calcareous soils of Piduguralla mandal.

A biological study was conducted using pot culture studies to evaluate the performance of blackgram crop and efficiency of extractants to extract cationic micronutrients from calcareous soils. The suitability of AB-DTPA in extracting micronutrients was evaluated in comparison with the DTPA extraction (conventional method) and the amount of micronutrients absorbed by blackgram crop.

Correlation studies were also carried out between micronutrients extracted by DTPA and AB-DTPA and soil properties. Between DTPA and AB-DTPA extractants tested for micronutrient availability, the mean available micronutrient content was the highest in AB-DTPA than DTPA and their efficiency in extracting available micronutrient content of soils was higher in AB-DTPA than DTPA based on correlation values in the pot culture study. Highest positive and significant correlation was observed between zinc, iron, manganese and copper uptake and AB-DTPA extracted micronutrient cations (0.451**, 0.941**, 0.443** and 0.386**, respectively) than with DTPA extracted cationic micronutrients (0.437**, 0.489**, 0.441** and 0.379**, respectively).

To-day's challenge is to select from the soil extraction tests such methods that allow simultaneous extraction of several nutrients including micronutrients from soils. From results of the present study, DTPA and AB-DTPA extractants showed significant positive correlation (r = 0.902**, 0.939**, 0.907**, 0.897**) with each other and with that of biological indices of blackgram, suggesting that AB-DTPA could be used effectively for estimating available cationic micronutrients in calcareous soils of Piduguralla mandal.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**SUPRIYA, K.**
Title of the Thesis	:	**CHARACTERIZATION, CLASSIFICATION AND EVALUATION OF SOILS OF MAHANANDI MANDAL OF KURNOOL DISTRICT, ANDHRA PRADESH**
Chairperson	:	**Dr. P. KAVITHA**
Degree	:	**M.Sc (Ag.)**
College	:	**S.V. AGRICULTURAL COLLEGE, TIRUPATI**
Accession Number	:	**D5533**

ABSTRACT

The present investigation involves characterization, classification and evaluation of soils in Mahanandi mandal of Kurnool district in Andhra Pradesh. Ten representative pedons were selected in ten different locations of the study area covering all types of soils. All the ten pedons were described for their morphological features in field and horizon-wise samples were collected and analyzed in the laboratory for physical, physico-chemical and chemical properties.

The study area was characterized by semi-arid monsoonic climate with distinct summer, winter and rainy seasons. The pedons selected were confined to plains and gently sloping topography. Pedons 1, 2, 6 7, 8, 9 and 10 were developed from granite – gneiss whereas pedons 3, 4, and 5 were originated from limestone.

The morphological features indicated the presence of AC (Pedons 3 and5 and ABC (Pedons 1, 2, 4, 6, 7, 8, 9 and 10) profiles. The soils were deep to very deep in depth, black to brown in colour, loamy sand to clay loam in texture and had sub-angular blocky, angular blocky and single grain structure.

The clay content in pedons 2 and 4 showed an increasing trend with depth. However, no specific trend with depth was observed in the remaining pedons. Physical constants like water holding capacity and volume expansion followed the trend of clay content. Most of the pedons exhibited an irregular trend in bulk density with depth.

All the pedons were neutral to moderately alkaline in reaction, non-saline and low to medium in organic carbon content. All these pedons were low to high in CaCO3 status. CEC values were low to high. The exchange complex was dominated by Ca^{2+} followed by Mg^{2+}, Na^{+} and K^{+}.

Regarding the fertility status, the soil samples were low to medium in available nitrogen, low to high in available phosphorus, high in potassium and deficient to sufficient in available sulphur. As far as DTPA extractable micronutrients are concerned, the available iron, zinc, copper and manganese were deficient to sufficient.

Soil fertility maps were also prepared for Agricultural college farm, Mahanandi for various parameters such as pH, EC, organic carbon, available macronutrients (N, P, K and S) and micronutrients (Zn, Fe, Cu and Mn) under GIS environment using *Arc*GIS. Similarly soil map and land capability maps were also prepared for the above farm.

Based on morphological, physical, physico-chemical, mineralogical and meteorological data the soils of Mahanandi mandal were classified as:

Pedon 1	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 2	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 3	:	Sandy, siliceous, isohyperthermic, Typic Ustorthent
Pedon 4	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 5	:	Fine-loamy, siliceous, isohyperthermic, Typic Ustorthent
Pedon 6	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 7	:	Fine-loamy, smectitic, isohyperthermic, Vertic Haplustept
Pedon 8	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 9	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept
Pedon 10	:	Fine-loamy, smectitic, isohyperthermic, Fluventic Haplustept

Based on the soil properties, the soils of the Mahanandi mandal have been classified into land capability classes and sub-classes *viz.,* IIs (Pedons 1, 4, 9 and 10), IIe (Pedons 7 and 8), IIes (Pedon 2), IIIs (Pedon 6) and IIIes (Pedons 3, 5).

The soil-site suitability evaluation revealed that pedons 6, 9 and 10 were highly suitable (S1) for growing rice, groundnut, sorghum and redgram and marginally suitable (S3) for sugarcane. Pedons 5 and 7 were highly suitable (S1) for growing rice and moderately suitable (S2) for groundnut, sugarcane, sorghum and redgram. Pedon 8 is highly suitable (S1) for growing rice, sorghum and redgram and marginally suitable (S3) for growing groundnut.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Author	:	**VENKATA MADHURI, C.**
Title of the Thesis	:	**EFFECT OF LONG - TERM APPLICATION OF ORGANIC MANURES ON SOIL ORGANIC MATTER FRACTIONS AND PRODUCTIVITY OF RAINFED GROUNDNUT (Arachis hypogaea L.)**
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Degree	:	**M.Sc (Ag.)**
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ABSTRACT

The present study entitled **"Effect of long-term application of organic manures on soil organic matter fractions and productivity of rainfed groundnut (*Arachis hypogaea* L.)**" was taken up in long term experiment on going since 2007 at Regional Agricultural Research Station, Tirupati, Acharya N.G. Ranga Agricultural University. The present study was carried out during *kharif*, 2016 with a prime objective of monitoring the changes in soil organic matter fractions as influenced by long term application of organic manures. The experiment has 6 treatments each replicated four times in a randomized block design. The treatments include T_1: Control (no manure and fertilizers), T_2: RDF (20 Kg of N ha^{-1}, 40 Kg of P_2O_5 ha^{-1}, 50 K_2O Kg ha^{-1}), T_3 : Vermicompost @ 2.5 t ha^{-1}: T_4 : Poultry manure @ 4 t ha^{-1} T_5: Farm yard manure @ 10 t ha^{-1}: T_6 : Press mud cake @ 10 t ha^{-1}.

Soil samples were collected from each treatment at 0-15 cm before sowing and at harvest of crop and analyzed for soil organic matter fractions physico-chemical, chemical characters, and crop yield at harvest was recorded.

Among the physico-chemical properties soil EC and organic carbon was significantly influenced by organic manures but soil pH showed non significant variation. The major nutrients (N, P and K) showed significant variation among the treatments, where highest values were observed in organic manures compared to control and RDF. The secondary nutrients (Ca, Mg and S) and micronutrients (Zn, Fe, Mn and Cu) also followed similar trend of increasing contents with organic manure application. It was further observed that all soil nutrient contents increased at harvest under RDF and organic manures application but decreased in control treatment compared to status of before sowing of crop.

Humic acid content in soil before sowing and harvest of the crop was significantly varied in organic manure treatments. Before sowing humic acid was ranged from 0.25 to 0.92 g kg^{-1} while at harvest it was ranged from 0.23 to 1.26 g kg^{-1}. Among the treatments FYM recorded highest values followed by pressmud cake treatment.

Oxygen containing functional groups (total acidity, carboxyl and phenolic groups) of humic acid were increased with application of various organic manures. Before sowing total acidity was ranged from 4.2 to 8.9 me g^{-1}, carboxyl group ranged from 2.2 to 3.4 me g^{-1} and phenolic groups ranged from 2.0 to 5.7 me g^{-1}. At harvest of crop total acidity was ranged from 3.4 to 10.1 me g^{-1}, carboxyl groups ranged from 2.2 to 3.4 me g^{-1} and phenolic groups ranged from 2.0 to 5.7 me g^{-1}. The contribution of carboxyl groups towards per cent of total acidity before sowing of crop was ranged from 33.72 to 57.41 per cent and phenolic groups ranged from 42.59 to 66.28 per cent, while at harvest carboxyl group contribution ranged from 32.22 to 52.94 per cent and phenolic groups 47.06 to 67.78 per cent.

E_4/E_6 ratio of humic acid in soils under various organic manures treatments was significantly varied. Before sowing E_4/E_6 ratio was ranged from 4.5 to 5.19, while at harvest it was ranged from 3.45 to 5.63. E_4/E_6 ratio was decreased from +13.1 to -23.3 per cent from sowing to harvest of the crop.

Potentiometric titrations curves of humic acid extracted from soils of various treatments before sowing and harvest of crop are similar and sigmoidal in nature with each other indicating the apparent monobasic and had a single break indicating weak acid polyelectolytic character of humic acid.

Conductometric titration curves of humic acid extracted from soils of various organic manure treatments before sowing and at harvest of crop were similar in nature indicating weak acidic character of humic acid.

UV-spectral characteristics of humic acid extracted from soils of various treatments before sowing and at harvest of crop were almost similar in nature indicating these are featureless with a decreasing optical density with increase in wavelength. These are steeper in nature which indicated more aromatic character of humic acid.

The mean values of NPK content in plant at harvest were 1.53 %, 0.36 % and 1.18 % respectively. The N uptake ranged from 33.71 to 64.29 kg ha^{-1}, P uptake ranged from to 8.92 to 20.28 kg ha^{-1}, K uptake was ranged from 23.17 to 69.04 kg ha^{1}. The pod yield of groundnut crop at harvest was significantly varied with different manure treatments ranged from 1188 to 1531 with a mean value of 1417 kg ha^{-1}. Haulm yield of groundnut was ranged from 3070 to 4315 with a mean value of 3756 kg ha^{-1}.

The correlation studies before sowing revealed that humic acid content was significantly correlated with total acidity (0.993**), carboxyl groups (0.812*) and phenolic-OH groups (0.960**). Total acidity was positively correlated with phenolic-OH groups (0.984**), P uptake (0.842*). A positive and significant relation was observed between N uptake and pod yield (0.957**) between P uptake and phenolic-OH groups (0.887*) and K uptake showed significant relation with phenolic-OH groups (0.873*) and P uptake (0.951**). At harvest also humic acid content showed positive correlation with total acidity (0.945**), phenolic-OH groups (0.938**) and P uptake (0.823*).Total acidity showed positive significant relation with carboxyl groups (0.832*), phenolic-OH groups (0.983**), N uptake (0.843*), P uptake (0.858*) and K uptake (0.855*). N uptake was positively significantly correlated with carboxyl groups (0.846*), yield (0.957**).A positive and significant relation was also observed between P uptake and phenolic-OH groups (0.896*) and between K uptake and phenolic-OH groups (0.908*) and P uptake (0.951**).

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