

## CHARACTERIZATION AND CLASSIFICATION OF SOIL AND LAND RESOURCE ENVERONS OF DECCAN PLATEAU

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### ABSTRACT

In the present study eight representative pedons were selected based on topography from various physiographic units identified in Chevella mandal of Ranga Reddy district in deccan plateau of Andhra Pradesh. All the pedons were studied for their morphological characteristics and horizon wise samples were processed for laboratory analysis for physical, physico-chemical and chemical characteristics. Based on morphological, physical, physico-chemical, chemical and meteorological data, according to revisions of US Soil Taxonomy revealed that pedon 1 of uplands and pedon 3 and 4 of midlands were classified as order Alfisols. Where as, pedon 2 of uplands classified as Entisol. The pedons 5 and 6 of midlands and pedons 7 and 8 of low lands classified in the order Inceptisols

*(Key words: Deccan plateau, soil taxonomy, soil characterization, soil classification)*

The soil and land resource inventory at regional and state level are providing a basis for blanket recommendation of various package of practices including fertilizer and other inputs. The inherent diversity in soils and the adopted practices with intensive application, the soils are evidently expressing numerous complex problems, which are identified at different stages. Further, it is becoming difficult to provide solution at later stages. The multi pronged problems of intensive cropping are much diversified in nature and manifesting physically, chemically, biologically and ultimately nutritionally and the blanket recommendations are not providing a suite of solutions.

The present study is planned taking mandal as a unit. In this entire mandal soil and land resources are systematically accounted and prepared a resource inventory is prepared which act as ready reference reckoned for any planning activity for the development and improvement of mandal soil and land resources further.

### MATERIALS AND METHODS

This area is located between 17°13' and 17°16' North latitudes and 79°05' and 74°06' East longitudes in deccan plateau. Physiographically, the study area is located at an average height of 530 m above the mean sea level (MSL), covering an area of 2,150 Acres. It is characterized by semi arid

climatic condition, with the average rainfall of 1100 mm, of which 74% is received during southwest monsoon, 16 % during northeast monsoon and 8 % during summer season. The study area forms a part of Deccan Plateau. The general slope of the land is from north to south. Based on variation in relief factor, lands were characterized in to uplands, midlands and lowlands and were studied in detail and their characteristics are presented in table 1. The detailed morphological features of these eight pedons were described as per the procedure outlined in Soil Keys to soil taxonomy (Soil Survey Staff 2006). The soil samples representing each horizon of the pedons were collected and characterized for important physical and physico-chemical properties using standard procedures.

### RESULTS AND DISCUSSION:

The pedons 1 and 2 were developed on upland, pedons 3, 4, 5 and 6 on midlands and pedons 7 and 8 on low land area. Soils on low land are very deep and poorly drained whereas the soils on upland and midland are moderately deep to shallow and are well drained. The colour of the soils varied from dark reddish brown (5YR3/2) to pale brown (7.5YR6/3) in upland, very dark grayish brown (10YR3/2) to dark brown (7.5YR3/3) in midlands and dark yellowish brown (10YR4/4) to very pale brown (10YR7/4) in lowlands. In midland the colour did not differ much between horizons in different pedons. Further, the variation of colour from dark grayish brown to dark brown in midland was due to

admixture of organic matter and iron oxides. The colour varied from very pale brown to very dark grayish brown in lowlands, which might be influenced by the topography and impeded drainage in the sub-surface layers. Similar findings were also reported by Vara Prasad Rao *et al.* (2008).

The texture of soils was found to vary from sandy clay loam to sandy clay. The texture of lowland physiographic units was finer than upland and midlands mainly due to lateral movement of finer fractions from uplands and midlands, difference in parent material, physiography, insitu weathering and the translocation of clay (Basava Raju *et al.*, 2005). The structure of the study area varied from weak to strong, fine to medium and granular to sub angular blocky. The variation in soil structure is a reflection of physiographic position of the pedons (Singh and Agarwal, 2003). The consistency of the soils occurring on upland and midlands varied from loose to very hard(dry), firm to friable (moist) and non sticky and non plastic to slightly sticky and slightly plastic (wet). Whereas the soils in low land exhibited slightly hard to hard (dry), firm to friable moist and non sticky and non plastic to sticky and plastic. Similar findings were also reported by Thangasamy *et al.* (2005).

Physico chemical characteristics of the soils are presented in table 2. The pH of the soils varied from 7.3 to 7.5(uplands), 7.5 to 7.9(midlands), 7.8 to 8.2(lowlands). The lowland pedons have relatively high pH values than that of upland pedons. This increase in soil pH down the slope could be due to leaching of bases from higher topography and getting deposited at lower elevations. The electrical conductivity of pedons ranged from 0.30 to 0.81 dS m<sup>-1</sup> indicating moderate salt content in these pedons. The upland pedons showed a less EC. The EC was slightly higher in the horizons of midlands and lowland pedons. In lowlands, slightly higher EC was recorded compared to midlands. This can be attributed to accumulation of salt in lowlands. These results were similar to those of Sitanggag *et al.* (2006) in soils of Shikohpur watershed in Gurgaon district of Haryana.

The lowland pedons were higher in organic carbon content than other pedons. The distribution of organic carbon in these profiles is mainly associated with physiography and land use. These

findings are in conformity with those findings of Walia and Rao (1996). The CEC in soils ranged from 13.0 to 33.1 c mol (p+) kg<sup>-1</sup>, which corresponds to clay content in the horizons. The higher CEC value was observed in A horizon of lowlands (45.1 c mol (p+) kg<sup>-1</sup>) than upland and midland pedons. The base saturation was found to vary from 38.2 to 93.9 per cent. The A horizon of upland pedons is less base saturated than A horizon of lowland pedons, indicating high degree of leaching in upper slopes.

## SOIL CLASSIFICATION

Based on morphological, physical, physico-chemical characteristics of the soils and climate data, the soils were classified according to keys to Soil Taxonomy (Soil Survey Staff 2006) in to the order Entisols (pedon2) which do not have any diagnostic horizon. The presence of lithic contact at a shallow depth of less than 25 cm and above 1 m, having an organic carbon content decrease with increasing depth and reaches a level of 0.2 per cent at a depth of 1.25 m, not permanently saturated with water and do not have characteristics associated with wetness, hence placed under the Orthents at sub order level. As the moisture regime is Ustic, the pedons 2 were classified as Ustorthents at great group level. This pedon 2 was classified as Lithic Ustorthents at great group level because of the presence of lithic contact within 50 cm of the mineral soil surface. The pedons 1, 3 and 6 were classified under Alfisols because of the presence of an argillic (B<sub>v</sub>) sub-surface diagnostic horizon and the pedons 4, 5, 7 and 8 were classified under the order inceptisols because of the absence of any other diagnostic horizon other than cambic (B<sub>w</sub>) horizon. As the moisture regime is Ustic, the pedons 1, 3 and 6 were classified as Ustalfs at sub order level. These pedons were classified as Haplustalfs at great group level because other than argillic horizon these soils not having any horizon like natric horizon, petro calcic horizon, durepan and plinthite horizons. Further, these pedons 1,3 and 6 did not have vertic properties and lithic contact with in 50 cm from the soil surface. Hence these pedons classified as Typic Haplustalfs at sub group level. As the moisture regime is Ustic, the pedons 4, 5, 7 and 8 were classified as Ustepts at sub order level and were classified as Haplustepts at great group level because the pedons did not have

either duripan or calcic horizon and the base saturation is more than 60 per cent at a depth between 0.2 to 0.7 m from the soil surface. The pedons 4, 5 and 8 were classified as Typic Haplustepts at sub group level because these pedons did not have vertic properties and lithic contact with in 50 cm from the soil surface. The pedons 8 were classified as Vertic Haplustepts at sub group level, considering cracks with in 100 cm of mineral soil surface.

The results lead to a conclusion that the soils of Chevella mandal were shallow to very deep, well to poorly drained, neutral to slightly saline, low to high in organic carbon, low to medium in CEC, moderately to high base saturated and sandy loam to clayey with variation in relation to physiography. Regarding nutrient status the soils were low to medium in available nitrogen and phosphorous, low to high in available potassium, low to medium in available sulphur and low in available zinc. Different landforms of Chevella mandel of Ranga Reddy district in deccan platue were classified up to sub-group level.

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## SCREENING OF YEAST ISOLATES AND PRODUCTION OF ALCOHOL FROM OVER RIPENED SAPOTA FRUIT PULP

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### ABSTRACT

Ethanologenic yeasts were isolated from different sources like spoiled fruits, market yard wastes, industrial wastes and orchard soils. Cultures were identified and screened for alcohol production, AMY-2 was found to be the best among the isolates. Over ripened sapota fruit pulp with reducing sugars 7.62 (g 100g<sup>-1</sup>), total sugars 11.85 (g 100g<sup>-1</sup>), total soluble solids 19.50 (°Brix) and pH 5.4 was used for fermentative production of alcohol. About 30.17-67.00 (g L<sup>-1</sup>) of alcohol was obtained when fermentation was conducted at different pH's (4.0, 4.5, & 5.0), temperatures (ambient temp.- 30-38.6°C & controlled temp.- 26°C) and with cultures (standard culture *Saccharomyces cerevisiae*-MTCC-172 & local best isolate AMY-2) for 72 h. It is established that over ripened sapota fruits can be used effectively for fermentative production of alcohol at pH 5.0 and temperature 26°C as fermentation conditions in 24 h.

The total area under sapota cultivation in India is 1,56,100 ha, with a total production of 13,07,800 MT and total productivity of 8.4 MT ha<sup>-1</sup> during the year 2008-09 (Indian Horticulture Database, 2009). The post harvest losses of the fruits, were estimated to be about 30-40%, in general, due to several reasons which accounts to a loss of around 6,750 crore rupees every year. Sapota fruit is highly perishable in nature, requires a quick disposal and in glut period a large quantity of the fruit is wasted. Hence, marketing of sapota becomes a serious problem. The Sapota fruits are good source of sugars, which range from 12 to 18 % and appreciable amount of protein, fat, and minerals like calcium, potassium, iron etc (Gautam and Chandawat, 1998) are found in the fruits. Because of its high sugar content the over ripened or spoiled sapota fruits can be used in a profitable manner. One of the approaches is fermentative production of alcohol from over ripened Sapota fruits.

In view of fast depletion of fossil fuels and environmental pollution due to gaseous emissions, alternative fuels such as bioethanol and biodiesel are becoming important.

Biofuel such as alcohol is obtained by microbial fermentation of plant biomass to generate the green fuel. Currently, there is a growing interest for ecologically sustainable bio-fuels, such as alcohol produced by fermentation from renewable sources

as fuel or fuel additive. Among all the sustainable alternative fuels, ethanol is an important fuel source, which is renewable and reduces the green house effect, global warming and climate change (Demirbas, 2003).

The present investigation was carried out with the objective of isolating ethanologenic yeasts from different sources and to check the suitability of sapota sugars for alcohol production, in addition to giving some economic returns to farmers even from over ripened or spoiled fruits during market glut etc.

### MATERIALS AND METHODS

The yeast strains were isolated from different sources like spoiled fruits, market yard wastes, industrial wastes and orchard soils following spread plate technique under aseptic conditions. The samples were inoculated on to Sabouraud Dextrose Agar medium and incubated at 37°C for 24-48 h.

All the isolates obtained from different sources and standard culture were screened for alcohol production with sugar as a fermentation medium (23 °B) so as to choose the best isolate for alcohol production. 200 ml of sugar medium was taken into the bottles for fermentative production of alcohol. All the bottles were pasteurized at 82 °C for 30 minutes and rapidly cooled at room temperature. The yeast inocula were transferred to the pasteurized

fermentation bottles containing 200 ml of sucrose medium, two g of yeast extract powder and 100 ppm of KMS at the rate of 5% under aseptic conditions.

The fruits of Kallipatti variety used in the experiment were collected from local market of Hyderabad, Andhra Pradesh, India. Over ripened fruits with uniform quality were selected for the pulp preparation. Sapota fruits washed with potable water were used for preparation of pulp. Pulp was prepared by removing peel and deseeding. Further, this pulp was homogenized in a mixer and then diluted by using water. Then the Brix which was 19.45, was adjusted to 23 °B by adding sugar solution to the pulp and used in various treatments. The composition of homogenized pulp was determined before starting of fermentation - Reducing sugars: 7.62 g 100g<sup>-1</sup>, Total sugars: 11.85 g 100g<sup>-1</sup>, TSS: 19.50 °B and pH 5.4.

The standard culture *Saccharomyces cerevisiae* (MTCC-172) obtained from the Institute of Microbial Technology, Chandigarh (IMTECH) and one of the best local isolate, AMY-2, were maintained on Sabouraud Dextrose Agar slants. Inoculum was built up by transferring pure culture inoculating into the Sabouraud broth. Each of the mother culture was used for inoculation of the pulp as per the experimental plan and allowed for fermentation. Batch fermentation of the inoculated pulp was carried out in a number of reagent bottles with cultures (*Saccharomyces cerevisiae* MTCC-172 & *Saccharomyces cerevisiae* AMY-2), with different pH's (4.0, 4.5 & 5.0) and incubating at different temperatures (ambient temp.- 30-38.6 °C & controlled temp.- 26 °C), for a period of 3 days. Samples were collected at 24 h intervals and centrifuged in a centrifuge (Sigma) at 15,000 rpm for 10 min. They

were analysed for the alcohol content, total and reducing sugars.

All the chemicals and reagents used in the experimentation and analysis were of A.R. grade, purchased from standard chemical companies. The dehydrated media and chemicals of Himedia were used for screening, growing and maintenance of yeast cultures.

Reducing and Total sugars in the sapota pulp was estimated by DNS method (Sadashivam and Manickam, 2008). The total soluble solids content of the pulp was determined by using ERMA hand refractometer and expressed in Brix (Ranganna, 1986). pH of the fruit pulp was determined by digital pH meter. Alcohol content in fermented pulp was estimated by using spectrophotometer at 600 nm as per the procedure given by Natu *et al.*, (1986).

## RESULTS AND DISCUSSION

Yeast isolates (AMY-1 to AMY-10) obtained from different sources were purified and maintained on Sabouraud Dextrose Agar medium. Based on the morphological, cultural and alcohol producing ability of all yeast pure cultures, it was concluded that they belonged to *Saccharomyces cerevisiae*.

All pure yeast isolates including MTCC-172 were screened for alcohol production with sugar medium for 24 h fermentation period. Alcohol content ranged from 29.80 to 67.85 g L<sup>-1</sup> among the local isolates and MTCC-172. Alcohol content after fermentation was found to be the highest and nearly equal with MTCC-172 (67.85 g L<sup>-1</sup>) and pure isolate AMY-2 (67.80 g L<sup>-1</sup>). These two cultures were significantly different from other isolates in terms of alcohol production

**Table 1. Screening of yeast isolates and standard culture for alcohol production**

Yeast Isolates	Alcohol Content (g L <sup>-1</sup> )	Yeast Isolates	Alcohol Content (g L <sup>-1</sup> )
AMY-1	43.50	AMY-7	29.80
AMY-2	67.80	AMY-8	58.40
AMY-3	59.40	AMY-9	44.10
AMY-4	55.50	AMY-10	49.80
AMY-5	62.30	MTCC-172	67.85

\*values presented are mean of three replications

The two yeast cultures MTCC-172 and AMY-2 were used for fermenting the over ripened sapota fruit pulp for alcohol production. Based on the literature available, for finding out the optimal fermentation conditions like pH and temperature, different pH's (4.0, 4.5 and 5.0), temperature conditions (ambient and 26°C) and different time intervals (24, 48, 72 h) were used, in the present experiment, and alcohol content measured during 72 h of fermentation. Before fermentation, an experiment was carried out to know the minimum concentration of pectinase which will increase the flowability of sapota pulp. Flowability was found to be maximum

with 0.5% pectinase concentration. Pectinase treatments decreased the viscosity of the juice and increased the fermentation rate during the ethanol fermentation (Joshi and Bhutani, 1991).

**Alcohol content**

*Saccharomyces cerevisiae* MTCC-172 exhibited higher alcohol production with over ripened sapota fruit pulp. Alcohol content observed was maximum (67.00 g L<sup>-1</sup>) at 24 h of fermentation and it decreased with increase in fermentation time i.e. up to 72 h (Table 2). The findings, in the present studies, also indicate that 24 h time is sufficient for maximal formation of alcohol with both cultures MTCC-172 & AMY-2.

Table 2. Alcohol content in over ripened sapota pulp during three days of fermentation

Treatments	Alcohol content (g L <sup>-1</sup> )		
	Day 1	Day 2	Day3
<i>S. cerevisiae</i> MTCC-172 + pH 4.0+ Ambient Temperature (30-38.6°C)	39.80	42.41	41.10
<i>S. cerevisiae</i> MTCC-172 + pH 4.0+ Control Temperature (26°C)	40.21	39.60	39.89
<i>S. cerevisiae</i> MTCC-172 + pH 4.5+ Ambient Temperature (30-38.6°C)	55.82	55.85	55.80
<i>S. cerevisiae</i> MTCC-172 + pH 4.5+ Control Temperature (26°C)	58.80	56.60	57.42
<i>S. cerevisiae</i> MTCC-172 + pH 5.0 + Ambient Temperature (30-38.6°C)	62.80	61.50	59.78
<i>S. cerevisiae</i> MTCC-172 + pH 5.0 + Control Temperature (26°C)	67.00	65.47	64.92
<i>S. cerevisiae</i> AMY-2 + pH 4.0+ Ambient Temperature (30-38.6°C)	30.17	26.50	29.80
<i>S. cerevisiae</i> AMY-2 + pH 4.0+ Control Temperature (26°C)	32.40	34.34	33.37
<i>S. cerevisiae</i> AMY-2 + pH 4.5+ Ambient Temperature (30-38.6°C)	46.50	45.83	42.17
<i>S. cerevisiae</i> AMY-2 + pH 4.5+ Control Temperature (26°C)	45.22	48.20	45.71
<i>S. cerevisiae</i> AMY-2 + pH 5.0 + Ambient Temperature (30-38.6°C)	55.61	53.71	52.80
<i>S. cerevisiae</i> AMY-2 + pH 5.0 + Control Temperature (26°C)	58.19	57.85	58.00
<b>SEm±</b>	0.43	0.39	0.37
<b>CD at 5%</b>	1.29	1.17	1.11

\*values presented are mean of three replications

The data clearly reveal that both cultures produced higher alcohol content. The alcohol content with sapota pulp was higher (67.00 g L<sup>-1</sup>) in treatment with *S. cerevisiae* MTCC-172 + pH 5.0 + Control Temperature (26°C). The alcohol content produced ranged from 39.80 to 67.00 g L<sup>-1</sup> in different treatments against the culture AMY-2 which produced alcohol in the range of 30.17 to 58.19 g L<sup>-1</sup> in different

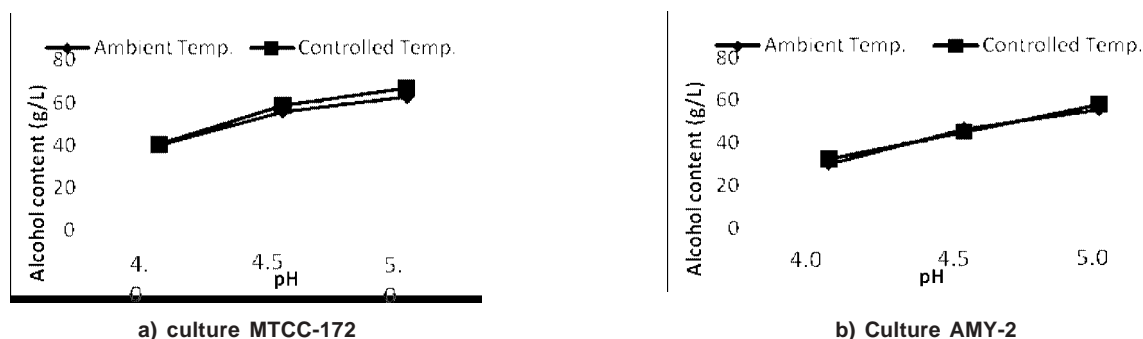
treatments. Liimatainen *et. al.*, (2000) reported average alcohol yields of 7.69g 100g<sup>-1</sup> when fermentation was carried out with waste potatoes.

The data indicate that alcohol content increased significantly with increase in pH of over ripened sapota pulp i.e. from 4.0 to 5.0 with both cultures. Maximum alcohol production was at pH 5.0 (Fig 1). Thuesambat *et. al.*, (2007), reported that

pH 5.0 was found to be optimum for maximum ethanol production 88.1 g L<sup>-1</sup> from Jerusalem artichoke plant juice using *Saccharomyces cerevisiae*. It is evident from the data that the alcohol content was higher at temperature 26°C than at

ambient temperature (ranged from 30 to 38.6°C) during the fermentation period with culture MTCC-172 but with culture AMY-2, the difference in alcohol production was minimum under ambient and controlled conditions (Fig 1

**Fig 1. Effect of pH and temperature on alcohol content with a) culture MTCC-172; b) Culture AMY-2**



Among all treatments with MTCC-172, the highest alcohol content (67.00 g L<sup>-1</sup>) was formed with pH 5.0, 26° C and 24 h. Similarly, among all treatments with AMY-2, the highest alcohol content (58.19 g L<sup>-1</sup>) was formed with pH 5.0, 26° C and 24 h. Hence, it can be concluded that the alcohol production was maximum at pH-5.0, 26°C, and 24 h of fermentation time with both cultures when substrate used was over ripened sapota fruit pulp. Reddy and Reddy, (2007) reported that 8.5-10% (w/v) of ethanol was produced from mango pulp fermentation with fermentation conditions of pH 5.0 and 30°C temperature.

Based on present study, it is established that over ripened sapota fruits can be used effectively for fermentative production of alcohol with pH 5.0 and temperature 26°C as fermentation conditions in 24 h.

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## EFFECT OF WEED MANAGEMENT PRACTICES ON WEED CONTROL AND YIELD OF ONION (*Alium cepa L*) IN VERTISOLS

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### ABSTRACT

Field experiment carried out at Regional Agricultural Research Station, Lam, Guntur during *rabi* 2003 and 2004 with three herbicides as pre-emergence application and integrated with one hand weeding at 45 DAT, weed free (weeding at 30, 45 and 60 DAT) and unweeded control revealed that integration of oxyflourfen @ 0.15 kg ai ha<sup>-1</sup>, oxadiargyl @ 0.1kg ai ha<sup>-1</sup> and pendimethalin @ 1.0 kg ai ha<sup>-1</sup> with one hand weeding at 45 days after transplanting proved to be effective in significantly reducing weed density and increasing the bulb yield over application of herbicides alone. Among the herbicides oxyflourfen @ 0.15 kg ai ha<sup>-1</sup> with one hand weeding at 45 days after transplanting recorded highest bulb yield and was on par with oxadiargyl @ 0.1kg ai ha<sup>-1</sup> and pendimethalin @ 1.0 kg ai ha<sup>-1</sup> with one hand weeding at 45 days after transplanting. Hand weeding at 15,30,45 and 60 days after transplanting has recorded highest weed control efficiency of 80-88%,improved the plant height, number of leaves per plant, pseudostem diameter, bulb diameter, bulb weight and yield per hectare and significantly superior over herbicide alone or integrated weed management treatments.

Onion is an important commercial vegetable and spice crop. In Krishna agroclimatic zone, it is establishing as an alternate crop to tobacco and other established mono-cultured crops. Weeds pose a serious problem in onion because of its poor competitive ability, non branching habit, sparse foliage, shallow root system and extremely slow growth in initial stages. Uncontrolled weeds reduce bulb yield of onion by 54% when compared with hand weeding (Tewari *et al*, 1999). Manual weeding is laborious, expensive and time consuming. Manual weeding is not possible in some situations where sufficient labour is non available at periods of crop weed control and where field conditions do not permit. In such situations the control of weeds by herbicides assumes greater significance because this is an efficient and economical method (Verma and Singh 1996). Integrated weed management approach involving herbicides at low dose and cultural practices provides economical and eco friendly weed control. Information on this aspect, in Krishna zone is meagre. Hence the present study was undertaken.

### MATERIALS AND METHODS

A field experiment was conducted at Regional Agricultural Research Station Lam, Guntur during *rabi* 2003 and 2004. The soil of the experimental

site was slightly alkaline in reaction with pH 8.01, EC 0.25 dsm<sup>-1</sup>, low in available nitrogen (189 kg ha<sup>-1</sup>N), medium in available phosphorous(36 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and medium in exchangeable potassium(275 kg K<sub>2</sub>O ha<sup>-1</sup>). Eight treatments were laid out in randomized block design with three replications. Onion Variety Nasik Red was transplanted on both sides of ridges 30cm apart with 10 cm spacing between the seedlings. All the recommended package of practices except weed control were followed. The herbicides were sprayed on third day after transplanting by knapsack sprayer using flood jet nozzle as per the treatments with a spray volume of 500 l ha<sup>-1</sup>. Observations were recorded on survival percentage of seedlings, plant height, number of leaves per plant, bulb characters and bulb yield. Weed counts were recorded at harvest and were subjected to square root transformation.

### RESULTS AND DISCUSSION

#### Effect on weeds:

The weed flora of the experimental site consisted *Cynadon sp*, *Cyperus sp*, *Trianthema portulacastrum* (33%), *Digera arvensis* ( 21%) *Celosia argentia* (9%), *Cleome viscose* (7%), *Cynodon dactylon* (15%) *Cyperus rotundus* (10%) and other weed species (5%). All the weed control treatments

significantly reduced the weed density as compared to unweeded control (Table 1). Maximum density of 42.2 weeds m<sup>-2</sup> as recorded in 2003 and 49.1 m<sup>-2</sup> in 2004 in the weedy check. They were reduced to a minimum of 5.2 and 9.6 m<sup>-2</sup> with weed control efficiency of 80 and 88 per cent in the corresponding years due to hand weeding at 15,30,45 and 60 days after transplanting. The herbicides oxyflourfen @ 0.15 kg ai ha<sup>-1</sup> and oxydiargyl @ 0.1 kg ai ha<sup>-1</sup> applied on third day after transplanting of onion significantly reduced the density of weeds. The weed control efficiency of these herbicides was 31.5 to 37.7 and 28.4 to 35.4% respectively. Application of pendimethalin @ 1.0 kg ai ha<sup>-1</sup> did not reduce the density of weeds significantly compared to the weedy check. Application of pendimethalin @ 1.0 kg ai ha<sup>-1</sup> followed by hand weeding at 45 days after transplanting significantly reduced the density of weeds compared with herbicide alone during 2003 and 2004. The weed control efficiency was 54.5 per cent and 59.9 per cent in the two years. Integration of herbicides with one hand weeding at 45 days after transplanting was found to be effective in reducing weed density over sole application of herbicides. Among the integrated treatments, oxadiargyl @ 0.1kg ai ha<sup>-1</sup> followed by hand weeding at 45 days after transplanting recorded the highest weed control efficiency of 59 per cent, closely followed by pendimethalin @ 1.0 kg ai ha<sup>-1</sup> + hand weeding at 45 days after transplanting. However, none of the integrated treatments could reach the level of weed free treatment (84%).

#### Effect on onion crop:

The results showed that 96-99% of the onion seedlings survived in different weed management treatments, indicating that the herbicides had no phytotoxicity (Table1). The growth of onion was severely affected in the weedy check. The plant height, number of leaves per plant and pseudo stem diameter were significantly reduced due to severe competition for resources owing to significant reduction in weed density in the weed free check. The plant height and number of leaves per plant increased two fold than in the weedy check in both the years. The pseudo stem diameter also improved

significantly. These results are in conformity with the findings of Kewat *et al* (2006) and Warade *et al* (2006).The herbicide sprays were less effective than hand weeding. The plant height, number of leaves per plant and pseudo stem diameter of onion were significantly reduced (Table 2). However, the integrated weed management comprising spray of any one of these three herbicides followed by hand weeding at 45 days after transplanting enabled the crop to produce the number of leaves on par with hand weeded check. Hand weeding at 15, 30, 45 and 60 days after transplanting of onion was the most effective (Table3) in terms of increased diameter and weight of the bulbs significantly compared to the weedy check. The bulb yield increased from 123 q ha<sup>-1</sup> in 2003 and 116 q ha<sup>-1</sup> in 2004 in the weedy check to 280 and 265 q ha<sup>-1</sup> due to hand weeding gaining an yield advantage of 128% during the two years. Herbicide application either alone or integrated with hand weeding at 45 days reduced the bulb diameter and yield significantly compared to hand weeding. The results are in accordance with those reported by Kolhe (2001).The integrated weed management was significantly superior to the corresponding herbicide treatment in improving the diameter and weight of bulbs as well as yield during both the years. The results are in accordance to those reported by Kewat *et al* (2006). The higher yield in these treatments was due to effective control of weeds in the early stage by chemicals and at later stages by hand weeding, which ultimately resulted in increased crop growth and yield.

#### Economics of weed management

It is inferred that hand weeding at 15, 30,45 and 60 days after transplanting is the best weed management practice to improve the crop growth, yield components and yield of onion and recorded the highest benefit cost ratio. If labour scarcity is acute, spraying oxyflourfen @ 0.15 kg ai ha<sup>-1</sup> or oxydiargyl @ 0.1 kg ai ha<sup>-1</sup> or pendimethalin @ 1.0 kg ai ha<sup>-1</sup> three days after transplanting, followed by hand weeding 45 days after transplanting is the best weed management strategy rather than herbicide spray alone.



**Table 2. Effect of weed management on yield, yield attributes and economics of onion**

Treatments	Bulb diameter (cm)		Bulb weight (q)		Bulb yield (ha <sup>-1</sup> )		BCR	
	2003	2004	2003	2004	2003	2004	2003	2004
T1-Weedy (check)	3.3	3.4	27.4	24.2	123	116	2.92	2.75
T2-HW at 15,30,45,60 DAT	4.9	4.9	40.1	40.32	280	265	5.67	5.37
T3-Oxyflourfen @150g ai ha <sup>-1</sup>	3.7	3.8	30.1	30.7	159	150	3.75	3.54
T4-Oxydiargyl @0.1kg ai ha <sup>-1</sup>	3.8	3.9	32.2	30.2	165	152	3.86	3.55
T5-Pendimethalin @ 1kg ai ha <sup>-1</sup>	3.9	3.9	31.4	29.8	154	149	3.62	3.50
T6- T3+ HW at 45 DAT	4.5	4.6	37.4	35.6	237	220	5.29	4.91
T7-T4+ HW at 45DAT	4.5	4.6	37.2	36.8	226	223	5.00	4.93
T8-T5+ HW at 45DAT	4.6	4.5	38.2	37.0	226	222	5.30	4.94
SEm +	0.03	0.03	1.75	1.39	20	15		
CD at 5%	0.06	0.05	3.70	2.97	42	32		

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## RESPONSE OF LOW LAND RICE TO SOURCE, TIME AND METHOD OF ZINC APPLICATION

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### ABSTRACT

Field experiments were conducted during kharif, 2008 and 2009 in clay loam soils to study the influence of zinc on growth and yield of low land rice at Regional Agricultural Research Station, Warangal, Andhra Pradesh. Results revealed that there was no significant difference between two sources of Zn i.e., ZnSO<sub>4</sub> and Biozinc but significant difference was observed in method of application i.e., basal and foliar application in producing yield. It was found that significantly higher yield attributes, grain yield (7312 and 7042 kg/ha, respectively) and net returns (Rs.51, 212 and 62,344/ha, respectively) were recorded with basal application of Biozinc or ZnSO<sub>4</sub> @ 50 kg/ha + foliar spray @ 3 g/l at 30 DAT. Even foliar spray of ZnSO<sub>4</sub> or Biozinc @ 3 g/l at 30 and 45 DAT recorded significantly higher yield attributes, grain yield and net returns over control but inferior to basal application of Zn during both the years of study.

In Andhra Pradesh, cultivation of zinc sensitive varieties (MTU 1001, MTU 1010 etc.) in large areas coupled with continuous cropping without rotation, indiscriminative application of complex fertilizers in rice induced Zn deficiency. Thus, next to N and P deficiency, zinc is becoming the most important nutritional factor, limiting the grain yield of wetland rice. The deficiency can be corrected by soil applications or foliar sprays of a suitable Zn fertilizer. In general, recommendations for soil application of Zn for crops vary from 5 to 17 kg Zn ha<sup>-1</sup> in the form of ZnSO<sub>4</sub> (Fenster et al. 1984). Dose and time of zinc application are important for correcting the deficiency. Source of zinc is also a critical factor for increasing its available form of zinc to rice for higher yields. The information related to the source and time of Zn application is inadequate in coarse rice varieties in Andhra Pradesh. Keeping in view of these factors, the present investigation was taken up to know the influence of Zinc on growth and yield of low land rice.

### MATERIALS AND METHODS

Field experiments were conducted during kharif, 2008 and 2009 at Regional Agricultural Research Station, Warangal, Andhra Pradesh. The soil was clay loam with a P<sup>H</sup> of 8.5 and EC of 0.6 d Sm<sup>-1</sup>, low in organic carbon (0.5 %) and available nitrogen (220 kg/ha), high in available P (59 kg P<sub>2</sub>O<sub>5</sub>/

ha) and available K (384 kg K<sub>2</sub>O/ha) and available Zn at 0.7 ppm. The experiments were laid out in a Randomized Block Design comprising of seven treatments i.e., T<sub>1</sub>:Control, T<sub>2</sub>: 50 kg ZnSO<sub>4</sub>/ha as basal application, T<sub>3</sub>: 50 kg ZnSO<sub>4</sub>/ha as basal application + foliar spray @ 3g/l at 30 DAT, T<sub>4</sub>: 50 kg Biozinc/ha as basal application, T<sub>5</sub>: 50 kg Biozinc/ha as basal application + foliar spray @ 3 g/l at 30 DAT, T<sub>6</sub>: Foliar spray of ZnSO<sub>4</sub> @ 3 g/l at 30 and 45 DAT and T<sub>7</sub>: Foliar spray of Biozinc @ 3 g/l at 30 and 45 DAT. Biozinc is a natural derivative of glucose fermentation and contains 12% zinc gluconate (organic zinc) on dry weight basis along with sulphur (as certified by the manufacturing company). Rice variety, MTU-1001 (Vijetha) was used in the study.

Rice nursery was sown on 1<sup>st</sup> July and 28<sup>th</sup> June and transplanting was taken up on 1<sup>st</sup> August and 29<sup>th</sup> July during 2008 and 2009, respectively. The crop was harvested on 16<sup>th</sup> and 13<sup>th</sup> November during 2008 and 2009, respectively. A rainfall of 421.5 mm was received during 2008 in 23 rainy days and 309.4 mm during 2009 in 20 rainy days throughout the crop growth period. All the recommended practices were followed. Observations on yield attributes and yield of rice were recorded. Soil samples were drawn after harvest of rice during two years and analyzed for DTPA-extractable Zn as per the procedure given by Lindsay and Norvell (1978).

## RESULTS AND DISCUSSION

Number of tillers/m<sup>2</sup> at 30 and 60 DAT during 2009 and 2008, respectively were not significantly influenced by zinc nutrition (Table 1). Significantly higher number of tillers/m<sup>2</sup> (533) was observed with basal application of 50 kg Biozinc/ha + foliar spray of 3g/l at 30 DAT (T<sub>5</sub>) and was at par with T<sub>3</sub> (518), T<sub>4</sub> (509) and T<sub>2</sub> (496) treatments during 2008 at 30 DAT while, number of tillers/m<sup>2</sup> at 60 DAT were also significantly influenced by T<sub>5</sub> treatment (403) and was at par with T<sub>4</sub> (397) treatment during 2009. There was no significant difference between foliar spray of ZnSo<sub>4</sub> or Biozinc @ 3 g/l twice at 30 and 45 DAT during both the years. Basal application of Biozinc or ZnSo<sub>4</sub> influenced the tiller number but not foliar nutrition of Zn during both the years.

Significantly higher number of panicles/m<sup>2</sup> was noticed with basal application of 50 kg Biozinc/ha + foliar spray @ 3 g/l at 30 DAT (317 and 303) during 2008 and 2009, respectively and was at par with basal application of Biozinc or ZnSo<sub>4</sub> @ 50 kg /ha + foliar spray @ 3 g/l at 30 DAT or basal application of Biozinc or ZnSo<sub>4</sub> @ 50 kg /ha alone (Table 2). Foliar fertilization of Biozinc (270 and 245) / ZnSo<sub>4</sub> (259 and 254) were inferior to basal application of Biozinc (296 and 292) / ZnSo<sub>4</sub> (284 and 271) but superior over control (231 and 218) during 2008 and 2009, respectively. Foliar application of zinc can overcome the negative effects of Zn deficiency on plant growth when it is applied at optimal range compared to control (Cengiz Kaya and David Hags, 2002). Zn applications to the marginally Zn-deficient soil increased the Zn concentration in the soil and promoted its uptake by the rice crop, and helped to increase the grain yield by ensuring the early emergence of panicles which permitted the greater storage of assimilates in grains (Srivastava *et al.*, 1999). There was no significant difference between foliar spray of ZnSo<sub>4</sub> or Biozinc @ 3 g/l twice at 30 and 45 DAT during both the years in producing number of panicles/m<sup>2</sup>.

Similar trend was observed with respect to the number of filled grains/panicle during both the years (Table 2). Soil application of ZnSo<sub>4</sub> @ 25 kg

ha<sup>-1</sup> produced significantly maximum number of panicles/hill· filled grains/panicle and grain yield as reported by Uddin *et al* (1981).

Significantly higher number of chaffy grains/panicle was recorded with control (22) compared to basal application of 50 kg Biozinc/ha + foliar spray @ 3 g/l at 30 DAT (11) and there was no significant difference between T<sub>4</sub> (13), T<sub>3</sub> (15), T<sub>2</sub> (17) treatments during 2009. The number of chaffy grains/panicle were not significantly influenced by Zn nutrition during 2008 (Table 2). There was no significant difference between foliar spray of ZnSo<sub>4</sub> (19) or Biozinc (20) @ 3 g/l at 30 and 45 DAT in producing number of chaffy grains/panicle. Zn nutrition has not significantly influenced the 1000-grain weight (g) during both the years (Table 2).

Significantly higher grain yield (7312 kg/ha) was recorded with basal application of Biozinc @ 50 kg/ha + foliar spray @ 3 g/l at 30 DAT and was at par with basal application of ZnSo<sub>4</sub> @ 50 kg /ha + foliar spray @ 3 @ g/l at 30 DAT (7003 kg/ha) and basal application of Biozinc @ 50 kg /ha (6986 kg/ha) during 2008 and basal application of Biozinc @ 50 kg /ha (6943 kg/ha) during 2009 compared to foliar spray of Biozinc or ZnSo<sub>4</sub> @ 3 g/l at 30 and 45 DAT (Table 3). Basal application of ZnSo<sub>4</sub> @ 50 kg/ha alone increased the grain yield by 14.2 and 21.6 % over control during 2008 and 2009, respectively. On the other hand, basal application of ZnSo<sub>4</sub> @ 50 kg/ha along with foliar spray @ 3 g/lit at 30 DAT increased the grain yield by 4.1 and 1.4 % over basal application of ZnSo<sub>4</sub> during 2008 and 2009, respectively. Basal application of Biozinc @ 50 kg/ha alone increased the grain yield by 15.7 and 21.8 % over control during 2008 and 2009, respectively. Basal application and foliar spray of Biozinc @ 3 g/l increased the grain yield by 4.5 and 1.4 % over basal application of Biozinc during 2008 and 2009, respectively. Foliar fertilization of ZnSo<sub>4</sub>; Biozinc @ 3 g/l at 30 and 40 DAT increased the grain yield by 6.5 and 12.5 %; 9.1 and 12.6 %, respectively during 2008 and 2009 over control. There was no significant difference between foliar spray of ZnSo<sub>4</sub> and Biozinc @ 3 g/l at 30 and 45 DAT during both the years in

producing grain yield. Soil application of ZnSO<sub>4</sub> gave significantly higher seed yield than foliar spray of 0.5 % ZnSO<sub>4</sub> at 25 DAS in cluster bean during *kharif* at Gwalior (Sharma *et al.*, 2004). Foliar sprays of Zn can not be compared with soil application. Soil application of ZnSO<sub>4</sub> @ 22.4 kg ha<sup>-1</sup> significantly increased the grain yield of rice over control in sodic soils at Ludhiana (Sharma *et al.*, 1982).

Significantly higher straw yield (8621 kg/ha) was recorded with basal application of Biozinc @ 50 kg/ha + foliar spray @ 3 g/l at 30 DAT and 22.6% higher over control (7029 kg/ha) and was at par with basal application of Biozinc @ 50 kg /ha (8530 kg/ha), basal application of ZnSO<sub>4</sub> @ 50 kg /ha + foliar spray @ 3g/l at 30 DAT (8281 kg/ha) and basal application of ZnSO<sub>4</sub> @ 50 kg/ha (8185 kg/ha) during 2009. There was no significant difference between foliar spray of Biozinc (7682) and ZnSO<sub>4</sub> (7794) @ 3 g/l at 30 and 45 DAT during 2009. The straw yield was not significantly influenced by zinc nutrition during 2008 (Table 3). 14.1 and 17.6 % increase in straw yield was observed with basal application of ZnSO<sub>4</sub> and Biozinc, respectively over control. During 2009, 9.8 and 8.5 % increase in straw yield recorded with foliar spray of ZnSO<sub>4</sub> and Biozinc, respectively over control. In addition to basal application, foliar spray by ZnSO<sub>4</sub> and Biozinc increased the straw yield by 15.1 and 18.5 %, respectively over control.

There was no significant difference between sources of Zn i.e., ZnSO<sub>4</sub> and Biozinc in producing tillers, yield attributes and yield in low land rice during both the years. On the other hand, significant

difference observed between method of application i.e., basal and foliar spray during both the years in producing tillers, yield attributes and yield.

The DTPA-Zn in the soil after harvest of the crop was not influenced by zinc nutrition. There was not much change in the values (ppm) of soil zinc during two years (Table 4). However, the DTPA-Zn was higher in plots where zinc was applied (0.8 to 1.1 ppm) compared to control (0.7 ppm).

Basal application of 50 kg Biozinc/ha + foliar spray @ 3 g/l at 30 DAT has recorded high net returns during 2008 and 2009 (Rs.51,212 and 62,344/ha, respectively), followed by basal application of 50 kg ZnSO<sub>4</sub>/ha + foliar spray @ 3 g/l at 30 DAT (Rs.49,584/ha) during 2008 and basal application of 50 kg Biozinc/ha only (Rs.61,240/ha) during 2009 (Table 3). There was very little difference between foliar spray of ZnSO<sub>4</sub> (Rs.44,641 and 54,515/ha) and Biozinc (Rs.45,550 and 53,359/ha) compared to basal application of ZnSO<sub>4</sub> (Rs.46,470 and 57,830/ha) or Biozinc (Rs.47,961 and 61,240/ha) alone during 2008 and 2009, respectively.

Growing of zinc sensitive varieties like MTU 1001, MTU 1010 etc. coupled with high soil available P, resulted in Zn deficiency. This is very frequent in sodic soils. Thus, the findings indicated that for Zn sensitive varieties, basal application of Biozinc or ZnSO<sub>4</sub> @ 50 kg/ha and foliar spray @ 3 g/l at 30 and 45 DAT are essential in low land rice for getting higher profitable yields in alkali/sodic soils of Andhra Pradesh.

**Table 1. Tillers/m<sup>2</sup> at 30 and 60 DAT of rice as influenced by zinc nutrition**

Treatments	No. of tillers/m <sup>2</sup>			
	30 DAT		60 DAT	
	2008	2009	2008	2009
T <sub>1</sub> : Control	423	409	336	290
T <sub>2</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application	496	487	388	371
T <sub>3</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application + foliar spray @ 3g/l at 30 DAT	518	492	409	374
T <sub>4</sub> : 50 kg Biozinc/ha as basal application	509	511	399	397
T <sub>5</sub> : 50 kg Biozinc/ha as basal application + foliar spray @ 3 g/l at 30 DAT	533	521	418	403
T <sub>6</sub> : Foliar spray of ZnSO <sub>4</sub> @ 3 g/l at 30 and 45 DAT	451	448	377	332
T <sub>7</sub> : Foliar spray of Biozinc @ 3 g/l at 30 and 45 DAT	462	442	370	327
SE <sub>±</sub>	29.6	34.6	22.6	11.2
CD at 5%	64.5	NS	NS	24.4

**Table 2. Yield attributes of rice as influenced by zinc nutrition**

Treatments	Panicles/m <sup>2</sup>		Filled grains/panicle		Chaffy grains/panicle		1000-grain weight (g)	
	2008	2009	2008	2009	2008	2009	2008	2009
T <sub>1</sub> : Control	231	218	140	140	19	22	22	22
T <sub>2</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application	284	271	181	175	11	17	22	23
T <sub>3</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application + foliar spray @ 3g/l at 30 DAT	301	275	203	179	9	15	23	24
T <sub>4</sub> : 50 kg Biozinc/ha as basal application	296	292	193	191	10	13	23	24
T <sub>5</sub> : 50 kg Biozinc/ha as basal application + foliar spray @ 3 g/l at 30 DAT	317	303	221	204	7	11	24	24
T <sub>6</sub> : Foliar spray of ZnSO <sub>4</sub> @ 3 g/l at 30 and 45 DAT	259	254	169	163	14	19	22	23
T <sub>7</sub> : Foliar spray of Biozinc @ 3 g/l at 30 and 45 DAT	270	245	177	162	13	20	22	23
SE <sub>±</sub>	17.6	12.6	17.9	11.2	4.5	3.0	1.2	1.6
CD at 5%	38.4	27.5	39.0	24.4	NS	6.6	NS	NS

**Table 3. Yield and Economics of rice as influenced by zinc nutrition**

Treatments	Grain yield (kg/ha)		Straw yield (kg/ha)		Net returns (Rs./ha)	
	2008	2009	2008	2009	2008	2009
T <sub>1</sub> : Control	5889	5429	8000	7029	39,179	45,348
T <sub>2</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application	6725	6601	9150	8185	46,470	57,830
T <sub>3</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application + foliar spray @ 3g/l at 30 DAT	7003	6696	9753	8281	49,584	58,925
T <sub>4</sub> : 50 kg Biozinc/ha as basal application	6986	6943	8940	8530	47,961	61,240
T <sub>5</sub> : 50 kg Biozinc/ha as basal application + foliar spray @ 3 g/l at 30 DAT	7312	7042	9260	8621	51,212	62,344
T <sub>6</sub> : Foliar spray of ZnSO <sub>4</sub> @ 3 g/l at 30 and 45 DAT	6295	6202	9820	7794	44,641	54,515
T <sub>7</sub> : Foliar spray of Biozinc @ 3 g/l at 30 and 45 DAT	6481	6113	9060	7682	45,550	53,359
SE±	155	129	755	259	-	-
CD at 5%	336	282	NS	565	-	-

Cost (Rs./kg): Zn So<sub>4</sub>: 31 ,Biozinc: 45

Cost of cultivation (Rs./ha): T<sub>1</sub>: 23,000; T<sub>2</sub>: 24,550, T<sub>3</sub>: 24,597; T<sub>4</sub>: 25,250; T<sub>5</sub>: 25,318; T<sub>6</sub>: 23,093 T<sub>7</sub>:23,135

Price (Rs./kg): Grain :9.2 (2008), 10.0 (2009); Straw (Rs./kg): 1.0 (2008), 2.0 (2009)

**Table 4. Influence of Zn nutrition on DTPA-Zn content in soil after harvest of rice**

Treatments	DTPA-Zn in the post harvest soil (ppm)	
	2008	2009
T <sub>1</sub> : Control	0.7	0.6
T <sub>2</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application	0.8	1.0
T <sub>3</sub> : 50 kg ZnSO <sub>4</sub> /ha as basal application + foliar spray @ 3g/l at 30 DAT	0.8	1.0
T <sub>4</sub> : 50 kg Biozinc/ha as basal application	0.9	1.1
T <sub>5</sub> : 50 kg Biozinc/ha as basal application + foliar spray @ 3 g/l at 30 DAT	1.0	1.1
T <sub>6</sub> : Foliar spray of ZnSO <sub>4</sub> @ 3 g/l at 30 and 45 DAT	0.7	0.8
T <sub>7</sub> : Foliar spray of Biozinc @ 3 g/l at 30 and 45 DAT	0.7	0.8
<b>Initial value</b>	<b>0.7 ppm</b>	

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## HETEROSIS FOR YIELD AND YIELD ATTRIBUTING TRAITS IN SAFFLOWER, (*Carthamus tinctorius* L.)

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### ABSTRACT

Heterobeltiosis and standard heterosis for seed yield and its attributes was studied in 20 hybrids developed through line x tester mating design (4 high yielding lines and 5 wilt resistant testers) in safflower. Significant positive heterosis over better parent (BP) and standard heterosis (SC) for seed yield ranged from 10.28% to 43.58% and -0.65% to 44.31%, respectively. The cross combinations Manjira x GMU 1702 (44.31%) and A-1 x GMU 2914-15 (39.36%) exhibited significant positive standard heterosis over Manjira for seed yield. These superior crosses also exhibited significant and positive heterosis for number of capitula per plant, number of seeds per capitulum and test weight. Hybrid vigour of superior crosses may be exploited commercially after verifying the stability performance across the environments over years.

**Keywords:** Heterobeltiosis, standard heterosis, safflower

Exploitation of heterosis has been an important breeding tool in safflower in the recent years. With the availability of male sterile sources in safflower, exploitation of heterosis on commercial scale has become feasible and economical. After the release of first safflower hybrid DSH- 129, few high yielding hybrids have been released for commercial cultivation. Though per se performance of parental lines provides clues, reliable information on magnitude of heterosis and combining ability of parent for yield and its component characters involved in the inheritance of different characters are of more helpful in selecting appropriate parents and desirable cross combination for commercial exploitation of hybrid vigour. The present study was, therefore undertaken to determine the extent of heterobeltiosis and standard heterosis in safflower and to identify heterotic hybrids.

### MATERIAL AND METHODS

The experimental material comprised of four high yielding varieties as lines viz., Nira, HUS 305, Manjira and A-1 and five wilt resistant testers (male parents) viz., GMU 1702, GMU 1946, GMU 2914-16, GMU 3272 and GMU 6915 obtained from Directorate of Oilseeds Research, Hyderabad. The parents were crossed in line x tester mating design and the resulting 20 hybrids along with 9 parents were evaluated in randomized block design with three replications during *rabi*, 2008-09 at Agricultural

Research Station, Tandur. Each entry was planted in 4 rows of 5m length keeping 45cm row to row and 20 cm plant to plant distance. Recommended package of practices was followed for raising a normal crop. Observations on five randomly selected competitive plants were recorded for eight traits (Table1). However, days to 50% flowering and days to maturity were recorded on plot basis. Each character was analyzed using the techniques suggested by Panse and Sukhatme (1967) and heterosis in  $F_1$  hybrids was estimated over better parent and standard check, Manjira.

### RESULTS AND DISCUSSION

Analysis of variance for parents and their hybrids for different traits revealed significant differences for all the traits suggesting the presence of considerable genetic variation in respect of various traits studied. Parents vs. hybrids comparisons were significant for plant height, number of seeds per capitula and seed yield (Table 1). This indicated the presence of overall heterosis for the characters studied.

Earliness in flowering is highly desirable trait for a crop like safflower to fit in various cropping sequences. Hence, the crosses exhibiting heterosis in negative direction are of immense value for earliness. Hybrids, HUS 305 x GMU 2914-15 (-7.11%) and A-1 x GMU 2914-15 (-6.69%) exhibited significant and maximum negative standard heterosis for days to 50% flowering. For early maturity, hybrids A-1 x GMU 3272 (-4.69% and -2.40%) and HUS 305 x GMU

6915 (-4.14% and -2.70%) depicted significant heterobeltiosis and standard heterosis in the desirable direction, respectively. Four hybrids viz., HUS 305 x GMU 6915 (-11.90%), Manjira x GMU 6915 (-17.46%), A1 x GMU 1946 (-22.45%) and A-1 x GMU 6915 (-16.08%) exhibited highly significant and desirable negative heterobeltiosis for plant . Similar results were also reported by Patil *et al.* (1998).

Two hybrids viz., Manjira x GMU 1702 (15.48% and 13.45%), A-1 x GMU 2914-15 (10.98% and 13.10%) exhibited significant and maximum positive heterosis over better parent and standard check for number of capsules per plant. The range of heterobeltiosis for this character varied from -41.44% (Manjira x GMU 3272) to 15.48% (Manjira x GMU 1702). The range of heterobeltiosis for number of seeds per capitula varied from -25.89% (HUS 305 x GMU 1946) to 38.55% (Manjira x GMU 1702) whereas, the standard heterosis values ranged from 6.41% (HUS 305 x GMU 1946) to 48.72% (HUS 305 x GMU 2914-15). The cross Manjira x GMU 1702 which exhibited positive significant heterobeltiosis and standard heterosis also exhibited similar estimates of heterosis for number of seeds per capitulum. Patil and Narkhede (1996) reported similar results for this trait.

Heterobeltiosis for test weight varied from -18.57% (Nira x GMU 3272) to 13.14% (Nira x GMU 6915) and standard heterosis for this trait ranged from -13.75% to 11.46%. Highly significant positive heterobeltiosis and standard heterosis for seed yield was recorded by Manjira x GMU 1702 (43.58% and 44.31%) followed by HUS 305 x GMU 6915 (38.73% and 38.63%) and A-1 x GMU 2914-15 (21.70% and 39.36%), respectively. Comparison of the above top three crosses for yield based on per se performance, heterosis over better parent and standard check indicated that most superior hybrids were accompanied by significant and positive heterosis over better parent and standard check for yield

attributes viz. number of capitula per plant, number of seeds per capitulum and test weight advocating that the high heterosis for seed yield resulted through contribution of its component traits (Table 2). Results are in agreement with the findings of Manjare and Jambhale (1995).

Considerable heterobeltiosis and standard heterosis observed for seed yield and other associated characters suggested the presence of large genetic diversity among the males and the females and also the unidirectional distribution of allelic constitution contributing towards desirable heterosis in the present material. Low and non-significant magnitude of desirable heterosis and heterobeltiosis observed for some of the characters viz., oil content (%) indicated the narrow genetic base among the males and the females and also the ambidirectional distribution of allelic constitution contributing towards undesirable heterosis. It may also be due to mutual cancellation of effects of dominant alleles present in the material.

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## INHERITANCE OF RESISTANCE TO *FUSARIUM* WILT IN SAFFLOWER (*Carthamus tinctorius* L.) GENOTYPES

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### ABSTRACT

*Fusarium* wilt of safflower caused by *Fusarium oxysporum* f.sp. *carthami* is a major constraint to safflower yield in peninsular India. Though considerable efforts have been made to breed varieties with durable resistance, it has not yet been fully achieved, probably due to the fact that genetics of host-plant inheritance is not well understood. Three safflower genotypes with consistent resistance over more than 3 years of testing were selected to study the inheritance of resistance. F<sub>2</sub> plants of cross Nira x GMU 1946 segregated into resistant and susceptible plants to give a good fit ratio of 9:6:1. However in Manjira x GMU 1946 and in other crosses with GMU 2914-15 as male parent, plants segregated into R and S plants to give a ratio of 9:7 indicating the resistance in these parents is governed by two dominant genes with complementary type of gene action. In the cross Nira x GMU 1702, the F<sub>2</sub> plants segregated in the ratio of 13:3 indicating inhibitory type of gene action.

**Key words:** *Fusarium* wilt, safflower, inheritance

*Fusarium* wilt of safflower caused by *Fusarium oxysporum* f.sp. *carthami* is a major constraint yield in peninsular region of India (Kalpana *et al.*, 1993). The fungus is seed borne inflicting disease on the crop at any growth stage affecting all aerial parts. It can cause losses ranging from 10-100% under conditions favouring the disease (Chakrabarthy, 1980). The long lasting, achievable and economical method to combat disease is varietal resistance. Despite the fact that considerable efforts have been put to generate resistant varieties with durable resistance, still this has not been fully achieved, probably due to the fact that the genetics of resistance of the host is not explored and exploited to the fullest. The major setback appears from the complexity of resistance and limited work done on genetics of resistance. One dominant, one recessive or two dominant with complimentary gene action or additive gene action were reported in the crosses of various genotypes with diverse susceptible genotypes (Anonymous, 1975). However, it is not clear whether these reported genes represent the same loci because allelic tests in most cases were not performed. The situation is further complicated because of the lack of near isogenic lines and knowledge of expression of the genes. The present study describes the inheritance of disease in three resistant and susceptible genotypes of safflower.

### MATERIALS AND METHODS

The material consisted of three resistant genotypes viz., GMU 1946, GMU 2914-15 and GMU 1702 with diverse pedigree (Table 1). The genotypes gave consistent resistance reaction over more than 3 years of testing. To study the inheritance of resistance, these were crossed with susceptible varieties, viz., Nira, Manjira and Sagarmuthyalu to generate enough F<sub>1</sub> seed during rabi 2007-08. The F<sub>1</sub> from all the crosses were advanced for testing the F<sub>2</sub> generation against *Fusarium* wilt during rabi 2008-09. Some F<sub>1</sub> seeds were also kept for testing along with the F<sub>2</sub> in the next growing season. One row of parents alternating with the F<sub>1</sub> and 15-20 rows of F<sub>2</sub> progenies of the crosses were sown in October 2008 in the wilt nursery at ARS, Tandur. The row length was kept as 4 m with row spacing of 40 cm. The plants were raised in normal in the wilt sick plot and the crop was inoculated for disease development when the plants were at seedling and vegetative stage in Nov-Dec using field screening technique (Bockelman, 1973). Mass culture of *Fusarium oxysporum* f.sp. *carthami* was prepared on sorghum grains. The flasks were inoculated with the culture and incubated for seven days to get profuse fungal growth. The contents of the flasks were mixed with soil to build up inoculum in the wilt sick plot. To ensure higher disease build-up especially in drought conditions, a spray of inoculum were given 20-25 days after sowing and humid conditions with the help

of sprinkler were maintained for a period of 3-4 days after inoculation. Further, water spray technique was used to maintain high disease pressure during crop season. The water spray was discontinued after 21 days and the disease observation were recorded when the disease severity was stabilized and there was no further increase in severity following 1-9 point scale (Shinde *et al.*,1994). Data obtained were statistically analysed using the chi-square test to ascertain goodness of fit of F<sub>2</sub> generation for the inheritance of resistance and its gene action.

## RESULTS AND DISCUSSION

The data on wilt incidence was recorded at the crop seedling, vegetative and flowering stages. The parents GMU 1946, GMU 2914-15 and GMU 1702 showed < 10% wilting even at maturity stage during 2005-06, 2006-07 and 2007-08. Hence they were considered as resistant. Among susceptible genotypes, Nira exhibited 100% mortality at seedling stage, while Manjira and Sagarmuthyalu exhibited 50-70% mortality during vegetative stage. The plants of parents and F<sub>1</sub>s rated from 0.0 – 5.0 with most plants rating 1.0 or 3.0 on 1- 9 scale based on percentage of plants wilted. In F<sub>2</sub>, plants with rating up to 3.0 were considered resistant to generate ratio. The plants rating from 5.0 to 9.0 were considered susceptible. The F<sub>1</sub>'s of all the crosses in the present study were resistant indicating dominance of

resistance in these genotypes. In F<sub>2</sub> population of cross Nira and GMU 1946, of the total of 415 plants, 253 were resistant and 162 were susceptible giving a good fit to ratio of 9:6:1(resistant, moderately susceptible and susceptible) indicating that resistance is governed by two additive genes in the resistant cultivar tested. However, GMU 2914-15 in crosses with Nira, Manjira and Sagarmuthyalu gave a total of 398,442 and 432 plants, respectively out of which 217 in cross Nira x GMU 2914-15, 254 in cross Manjira x GMU 2914-15 and 238 in cross Sagarmuthyalu x GMU 2914-15 were resistant and 181 in Nira x GMU 2914-15, 188 in Manjira x GMU 2914-15 and 194 in Sagarmuthyalu x GMU 2914-15 were susceptible. In these crosses, a ratio of 9:7 was obtained indicating that the resistance in these parents is governed by two dominant genes with complimentary gene actions (Table 1). In the cross Nira x GMU 1702, the F<sub>2</sub> plants segregated in the ratio of 13:3 indicating inhibitory type of gene action for the inheritance of *Fusarium* wilt.

The present findings indicate that the *Fusarium* wilt resistance is simply inherited involving two dominant genes. The resistance can be transferred to susceptible varieties and will help in developing wilt resistant safflower varieties with good agronomic attributes for achieving the desirable improvement in the yield in safflower.

**Table 1. *Fusarium* wilt response of F<sub>1</sub> and F<sub>2</sub> plants of 3 susceptible safflower genotypes with resistant genotype GMU 1946**

Cross	F <sub>1</sub> reaction	No. of F <sub>2</sub> plants			Expected ratio	X <sup>2</sup> value (p<=0.05)
		R	S	Total		
Nira x GMU 1946	R	253	162	415	9:6:1	1.717
Manjira x GMU 1946	R	296	200	496	9:7	1.036
Sagarmuthyalu x GMU 1946	R	264	198	462	9:6:1	0.097

**Table 2. *Fusarium* wilt response of F<sub>1</sub> and F<sub>2</sub> plants of 3 susceptible safflower genotypes with resistant genotype GMU 2914-15**

Cross	F <sub>1</sub> reaction	No. of F <sub>2</sub> plants			Expected ratio	X <sup>2</sup> value (p<=0.05)
		R	S	Total		
Nira x GMU 2914-15	R	217	181	398	9:7	0.161
Manjira x GMU 2914-15	R	254	188	442	9:7	0.145
Sagarmuthyalu x GMU 2914-15	R	238	194	432	9:7	0.103

**Table 3. *Fusarium* wilt response of F<sub>1</sub> and F<sub>2</sub> plants of 3 susceptible safflower genotypes with resistant genotype GMU 1702**

Cross	F <sub>1</sub> reaction	No. of F <sub>2</sub> plants			Expected ratio	X <sup>2</sup> value (p<=0.05)
		R	S	Total		
Nira x GMU 1702	R	338	68	406	13:3	0.246
Manjira x GMU 1702	R	252	187	439	9:6:1	0.146
Sagarmuthyalu x GMU 1702	R	254	210	464	9:6:1	0.188

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## COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD COMPONENT TRAITS IN RICE (*Oryza sativa* L.)

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### ABSTRACT

One hundred and fifteen hybrids were developed utilizing Line (5 CMS lines) x Tester (23 testers) fashion. The hybrids along with parents were evaluated for eight characters during kharif, 2007 at RARS, Warangal to understand the gene action in rice. The combining ability analysis revealed significant differences among the parents for all the characters studied indicating the predominance of dominance gene action in governing yield and related traits. This suggests the possibility of exploiting heterosis. Two CMS lines (APMS 6A and CRMS 32A) and six testers (1096, 612-1, GQ-70, GQ-120, KMR 3 and SG 27-77) were found to be good general combiners for yield and other yield attributes. The hybrids APMS 6A x 612-1, PUSA 5A x KMR-3, CRMS 32A x IR 43 exhibited higher specific combining ability with at least one of the parent possessing positive alleles for grain yield. The interrelationship of sca with sca revealed that predominance of non additive gene action viz., additive x dominance and dominance x dominance type for gene interaction for most of the hybrid combinations which could be exploited for heterosis breeding programme in rice.

Substantial increase in rice (*Oryza sativa* L.) production can be achieved only with the use of suitable hybrids. This can be further hastened by choice of suitable outstanding parents with favourable alleles, which on crossing would give heterotic hybrids. The line x tester analysis of combining ability proposed by Kempthorne (1956) is the most common method used to find out the general and specific combiners and study the nature of gene action governing the inheritance of different characters. The main objective of this investigation was to identify good general and specific combiners for yield and its component characters.

### MATERIALS AND METHODS

Five CMS lines viz., IR 58025A, IR 79145A, APMS 6A, PUSA 5A and CRMS 32A were crossed with 23 diverse elite restorers selected from rice germplasm maintained at Directorate of Rice Research (DRR), Hyderabad during *rabi*, 2006 using line x tester design. The resultant 115  $F_1$ s and 28 parents were grown in Complete Randomized Block Design with two replications during *kharif*, 2007 at Regional Agricultural Research Station, Warangal, Andhra Pradesh. Two hybrids (KRH 2 and PA 6201) and two pure lines (Jaya and IR 64) were used as standard checks. Twenty 25 days old seedlings were transplanted at a spacing of 20 x 15 cm and all the

recommended agronomic practices were followed. In each entry, five plants were selected randomly from each replication and biometrical observations were recorded for plant height, productive tillers per plant, panicle length, panicle weight, filled grains per panicle, spikelet fertility %, 1000 grain weight and grain yield per plant. Days to 50% flowering was recorded on plot basis. The mean data were analyzed for combining ability following the standard method of Kempthorne (1956).

### RESULTS AND DISCUSSION

Presence of significant and high variance due to genotypes for all the traits studied (Table 1) indicated the existence of wide variability among the genotypes. The combining ability variance of lines and testers was significant for productive tillers per plant and filled grains per panicle. In addition, the lines for panicle weight, spikelet fertility, grain yield  $\text{plant}^{-1}$  and productivity  $\text{day}^{-1}$  were also showed significance. The high and significant mean squares of lines x testers revealed that lines and testers interacted and produced markedly different combining ability effects and it might be due to wide genetic diversity of lines and testers. The estimates of variance due to SCA were much higher than that of due to GCA variances for all the nine characters revealing the importance of dominance and epistatic

gene interactions in controlling these traits. Predominance of non-additive gene action for grain yield and components has also been reported (Sanjeevkumar *et al.*, 2007 and Sarma *et al.* 2007). Hence, heterosis breeding is an appropriate and right approach for yield improvement in rice.

The *gca* is generally attributed to the additive effects of genes and is fixable (Sprague and Tautam, 1942). Hence selection of the parents based on *gca* effects is of great importance in breeding programme. The general combining ability (*gca*) effects of the parents in the present study have brought to the light suggesting them to use in successful breeding programme, especially hybrid breeding. Three lines (APMS 6A, PUSA 5A and CRMS 32A) and eight testers (1096, 612-1, GQ-37-1, GQ-70, GQ-120, KMR 3, SC5 9-3 and SG 27-77) were found to be the good general combiners for grain yield (Table 2). The lines APMS 6A and CRMS 32A were also good general combiners for yield components like panicle weight, filled grains per panicle and per day productivity, while PUSA 5A for dwarf plant stature, productive tillers per plant and per day productivity, which is early to flower indicating its usefulness in breeding for earliness. The restorers 1096 and GQ-70 were found good for dwarfness, early flowering, productive tillers per plant, filled grains per panicle, spikelet fertility *per cent* and productivity per day, while 612-1 and KMR-3 contributed maximum favourable alleles for earliness, productive tillers per plant, panicle length and productivity per day.

SC5 9-3 and SG 27-77 can be used as good source for panicle weight, filled grains per panicle and productivity per day. For improving earliness in days to 50% flowering, productive tillers per plant and productivity per day, the line GQ 37-1 can be used as it possessed desirable significant *gca* effects. Extent of grains filling in hybrids is influenced by the restoration ability of male parents. In respect of spikelet fertility %, 1096, GQ-25, GQ-70, SG-26-120, 124, 517 and IR 43 possessed significant positive *gca* effects. These parents had low sterility and can be used as potential donors in improving this character. Mahadevappa (1985) reported spikelet

fertility in hybrids as one of the reasons for not realizing the full yield potential in rice hybrids. Multiple crossing among the above parents is also recommended to get superior recombinants with desirable traits along with grain yield.

The number of cross combinations generated from parents having different types of *gca* effects (*viz.*, positive significant, negative significant or non significant) and their corresponding *Specific Combining Ability* effects were observed. Almost all types of *sca* effects were obtained from any type of parental combinations.(Table 3)

Instances where the *gca* effects of both the parents were negative but the *sca* effect of the resultant hybrid was positive was observed for grain yield per plant in hybrids IR 58025A x 619-2, IR 58025A x IR 60, IR 58025A x SC5 2-2-1, IR 58025A x SG 26-120 and IR 79156A x SG 26-120. Such behaviour has been attributed to over dominance and epistasis (Rahman *et al.*, 1981)

Some crosses were derived from parents having high *gca* resulted in high *sca* effects for grain yield per plant in hybrids APMS 6A x 612-1, PUSA 5A x KMR-3 and APMS 6A x SC5 9-3 suggesting the presence of additive x additive type of gene action. This indicated that selection could be effective in F<sub>2</sub> generation and utilized in transgressive breeding.

Significant positive *gca* effect in any one of the parents and negative or non significant effect on the other parents leading to significant *sca* effect in hybrids could be observed for grain yield per plant in hybrids IR 79156A x 1096, APMS 6A x GQ-25, PUSA 5A x IR 43, IR 58025A x GQ 37-1, IR 58025A x GQ-70, IR 79156A x SG 27-77, PUSA 5A x 611-1, IR 79156A x GQ-70, IR 79156A x KMR-3, CRMS32A X IR 43 and PUSA 5A x 124. The high yield potential of cross combinations with high x low *gca* effects was attributed to interactions between positive alleles from good combiner and negative alleles from poor combiner (Dubey, 1975). Similar results were also obtained by Peng and Virmani (1999). All these

results revealed that there is no direct relationship between *gca* effects of parents and *sca* effects of hybrid combinations. This can also be explained from the point of gene action since *gca* is due to additive gene action, whereas *sca* is due to dominance and epistasis gene action.

The present investigation on interrelationship of *gca* with *sca* revealed that predominance of non additive gene action *viz.*, additive x dominance and dominance x dominance type for gene interaction for most of the hybrid combinations, which could be exploited for heterosis breeding programme in rice.

The lines APMS 6A and CRMS 32A and testers 1096, 612-1, GQ-70, GQ-120, KMR 3 and SG 27-77 could be used as potential donors in breeding for improving grain yield and attributing traits. The hybrids *viz.*, APMS 6A x 612-1, PUSA 5A x KMR-3, CRMS 32A x IR 43 were found to possess high *sca* effects for grain yield and yield attributing traits with at least one of the parent possessing positive alleles. Hence these hybrids can be specifically suitable for exploiting heterosis for increased grain yield in rice in near future.

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Table 2. General combining ability (sca) effects of hybrids for grain yield and associated traits in rice

LINES	DFF	PHT	PT	PL	PWT	FG	SF%	GY	PPD
IR 58025A	-1.71**	0.90	-0.55**	0.16	-0.56**	-22.86**	-1.69**	-3.56**	-7.02**
IR 79156A	0.03	2.73**	-0.76**	0.35*	-0.43**	-15.93**	3.74**	-2.23**	-4.29**
APMS 6A	2.05**	-0.02	0.79**	0.05	0.55**	23.70**	1.21**	1.72**	3.01**
PUSA 5A	-0.58*	-4.26**	0.54**	0.78**	0.02	-5.54**	-3.51**	1.41**	3.07**
CRMS 32A	0.22	0.64	-0.02	0.22	0.41**	20.63**	0.25	2.66**	5.23**
SE (lines)	0.28	0.48	0.15	0.14	0.06	1.84	0.43	0.31	0.66
<b>TESTERS</b>									
1096	-4.56**	6.20**	1.12**	0.56	0.89**	54.61**	2.09*	3.00**	7.85**
1005	-1.66**	1.00	-0.28	0.16	-0.01	29.31**	-1.14	0.49	1.17
619-2	4.34**	-1.43	-1.25**	0.28	0.07	-4.31	0.84	-2.60**	-7.13**
612-1	-5.56**	10.00**	1.79**	1.89**	0.09	-32.89**	-9.83**	5.42**	13.77**
611-1	0.04	-1.25	-0.65	-0.14	-0.25	-34.01**	-7.86**	-3.64**	-7.87**
GQ-25	-0.06	1.48	-0.28	0.13	0.38**	19.05**	1.86*	-1.43*	-3.29*
GQ-37-1	-2.96**	0.90	1.85**	-0.14	-0.13	-4.51	-1.05	1.97**	5.34**
GQ-70	-5.26**	-4.16**	1.29**	-0.48	0.06	33.89**	1.99*	2.02**	6.40**
GQ-120	1.14	0.70	0.22	-0.19	-0.25	-10.47**	0.77	2.03**	4.52**
KMR-3	-5.56**	5.53**	1.12**	0.76*	0.12	-12.39**	1.04	3.26**	9.19**
IBL-57	-6.36**	-0.95	0.85*	1.29**	-0.01	9.93*	-3.54**	-3.06**	-4.73**
BR827-35	0.84	1.68	0.09	0.34	0.33**	-5.75	-1.53	-2.00**	-4.50**
EPLT-109	-1.46	-8.79**	-0.01	1.49**	-0.17	-6.39	-0.38	-4.75**	-9.85**
SC <sub>5</sub> 2-2-1	2.14**	-0.66	0.02	0.67*	0.48**	10.87**	0.23	-0.05	-0.92
SC <sub>5</sub> 9-3	0.44	2.47*	0.30	0.20	0.28*	11.03**	0.96	1.76**	2.78
SG27-77	1.14	1.48	0.09	0.48	0.44**	23.07**	0.92	3.11**	5.75**
SG26-120	-0.06	5.27**	1.52**	0.75*	-0.13	0.41	6.34**	0.70	1.41
118	4.64**	-0.97	-1.18**	-0.11	0.31*	26.37**	0.95	0.08	-1.45
124	1.74**	4.32**	-1.21**	0.82**	-0.67**	-23.85**	4.87**	0.24	-0.07
517	6.24**	-4.62**	-1.45**	1.59**	-0.04	-21.47**	2.15*	-2.16**	-6.97**
IR 43	4.34**	-8.73**	-1.38**	1.34**	-0.57**	-7.25	2.17*	-2.10**	-5.00**
IR55	2.04**	-6.85**	-1.65**	0.18	-0.43**	-33.47**	-1.73	-1.03	-2.63
IR60	4.34**	-2.61*	-0.91**	-0.45	-0.79**	-21.87**	-0.10	-1.30*	-3.76**
SE (testers)	0.59	1.03	0.32	0.30	0.13	3.94	0.93	0.66	1.43

DFF = Days to 50% flowering; PHT = Plant height; PBT = Panicle bearing tillers;

PL = Panicle length; PWT= Panicle weight (g) ; FG = Filled grains/ panicle ;

SF = Spikelet fertility % ; GY = Grain yield/ plant (g) ; and PPD = Productivity/ day (kg/ha).

**Table 3. Specific combining ability (sca) effects of selected hybrids for grain yield and associated traits in rice**

CROSSES	DFF	PHT	PT	PL	PWT	FG	SF%	GY	PPD
IR 58025A x 1005	-3.89**	-9.14**	1.58*	-0.13	-0.21	63.30**	2.33	3.75*	9.92**
IR 58025A x 619-2	-3.89**	-5.54*	0.71	0.59	-0.68*	-23.08*	-0.90	5.06**	11.92**
IR 58025A x GQ-37-1	8.91**	6.55**	-1.55*	2.50**	0.49	-6.88	14.10**	8.00**	12.49**
IR 58025A x GQ-70	-3.29**	3.02	1.84	0.68	0.31	23.22**	3.49	7.61**	17.95**
IR 58025A x GQ-120	2.31	-7.72**	0.41	-0.45	0.09	-11.72	-1.36	-6.57**	-14.96**
IR 58025A x SC5 2-2-1	-2.19	3.19	1.45	1.04	1.78**	63.64**	1.86	7.93**	17.19**
IR 58025A x SC5 9-3	-6.99**	-10.78**	0.93	-2.50**	-0.94*	-29.62**	-1.29	-4.13**	-5.90
IR 58025A x 124	3.71**	-8.29**	-0.99	-0.45	-0.13	-27.14**	-2.60	-6.44**	-14.18**
IR 58025A x 517	-0.79	5.90**	0.41	1.46*	-0.25	11.28	-1.52	5.13**	11.03**
IR 58025A x IR 43	10.61**	11.85**	-0.15	1.04	0.05	32.66**	-3.24	-6.94**	-16.41**
IR 58025A x IR55	5.41**	8.38**	0.78	1.35*	0.25	4.08	7.38**	-4.67**	-11.06**
IR 58025A x IR60	-1.89	2.80	-0.62	2.23**	0.45	-1.22	6.89**	5.44**	11.27**
IR 79156A x 1096	2.77*	0.17	0.73	-0.71	-0.53	-39.33**	-4.17*	3.13*	5.09
IR 79156A x 1005	2.87*	2.37	-0.37	0.69	-0.27	-26.13**	4.25*	-2.69	-6.76*
IR 79156A x 612-1	-2.73*	6.70**	-1.27	1.46*	0.24	9.97	-1.60	-4.79**	-10.12**
IR 79156A x GQ-37-1	-10.83**	10.30**	-0.17	2.66**	0.89**	40.59**	-4.10	4.83**	14.81**
IR 79156A x GQ-70	-6.03**	8.69**	2.06**	2.16**	0.36	-0.81	-7.98**	8.11**	19.82**
IR 79156A x GQ-120	8.57**	-10.68**	0.46	-1.63*	0.43	25.35**	5.79**	-7.57**	-18.87**
IR 79156A x KMR-3	-4.23**	-2.35	2.22**	0.92	0.73*	28.67**	5.54**	4.62**	11.22**
IR 79156A x BR827-35	-7.13**	3.36	1.26	1.51*	0.43	-50.07**	2.87	6.29**	15.34**
IR 79156A x SC5 2-2-1	7.57**	-0.39	-1.17	-1.73*	-0.36	10.51	4.05	-5.16**	-12.80**
IR 79156A x SG27-77	-6.93**	7.39**	2.27**	1.03	0.81*	55.01**	3.80	5.89**	15.06**
IR 79156A x SG26-120	-11.73**	10.09**	0.33	2.93**	1.15**	30.67**	-1.99	6.26**	18.02**
IR 79156A x 124	9.47**	6.13**	-1.77*	0.62	-0.41	-12.67	-2.14	-3.27*	-9.87**
IR 79156A x IR 43	-0.63	-4.82*	-1.60*	-3.14**	-0.10	-14.37	1.34	-4.77**	-10.67**
APMS 6A x 612-1	-5.25**	7.45**	0.84	1.25	0.17	-0.96	6.49**	16.77**	39.13**
APMS 6A x 611-1	12.15**	-5.04*	-0.06	0.28	0.06	-19.34*	4.60*	-3.67*	-10.75**
APMS 6A x GQ-25	-3.75**	-1.03	0.74	0.02	0.00	23.20**	4.37*	7.60**	17.05**
APMS 6A x GQ-37-1	-5.85**	1.74	0.28	0.11	0.80**	69.76**	0.10	3.38*	9.27**
APMS 6A x GQ-120	-10.45**	9.75**	2.76**	1.16	-0.16	14.32	5.73**	9.47**	23.83**
APMS 6A x IBL-57	9.05**	1.57	-1.22	-0.57	0.02	15.52	8.92**	5.42**	7.75*
APMS 6A x BR827-35	11.85**	-7.81**	-0.96	-0.95	-1.14**	-30.00**	-0.61	-4.82**	-13.29**
APMS 6A x EPLT-109	-4.35**	-1.17	-1.03	-0.45	-0.65*	-39.96**	-1.51	-5.15**	-9.39**
APMS 6A x SC5 9-3	-0.25	1.26	2.16**	0.94	1.70**	71.92**	3.13	9.94**	20.13**
APMS 6A x SG27-77	4.05**	-9.36**	-0.29	-2.00**	0.10	6.08	-3.18	-3.42*	-8.98**
PUSA 5A x 612-1	8.38**	-10.98**	-2.42**	-2.42**	-0.26	0.48	-17.35**	-8.27**	-20.94**
PUSA 5A x 611-1	-0.72	-12.56**	-2.72**	-2.72**	0.37	59.30**	11.32**	3.46*	7.45*
PUSA 5A x GQ-70	4.58**	-10.10**	-0.50	-0.50	-0.57*	-43.20**	-1.32	-9.03**	-20.97**
PUSA 5A x GQ-120	-6.82**	5.99*	0.66	0.66	1.07**	44.06**	0.30	12.79**	29.56**
PUSA 5A x KMR-3	-2.62	7.33**	1.04	1.04	0.49	22.58*	3.48	21.60**	48.72**
PUSA 5A x SC5 2-2-1	2.18	-0.71	1.49*	1.49*	-0.66*	-8.08	-3.33	-4.96**	-11.07**
PUSA 5A x SC5 9-3	-5.12**	-4.20	-1.05	-1.05	-0.35	-34.54**	-1.96	-5.77**	-9.75**
PUSA 5A x 517	7.58**	-13.28**	-0.36	-0.36	0.69*	-30.64**	-1.88	2.99*	3.18
PUSA 5A x IR 43	4.98**	3.84	0.39	0.39	-0.22	-25.76**	2.93	5.25**	7.33*
CRMS 32A x 1096	-2.92*	3.21	0.53	0.53	-1.20**	-26.09**	1.66	-6.09**	-11.57**
CRMS 32A x GQ-120	6.38**	2.66	0.25	0.25	-1.42**	-72.01**	-10.46**	-8.13**	-19.56**
CRMS 32A x KMR-3	10.58**	-0.07	-0.45	-0.45	0.04	22.81*	10.06**	-6.35**	-17.49**
CRMS 32A x IR 43	-14.82**	-1.39	1.23	1.23	0.64*	35.77**	1.09	13.50**	34.96**
CRMS 32A x IR55	-11.02**	13.32**	1.13	1.13	1.14**	13.99	-1.05	8.44**	22.71**
SE(crosses)	1.33	2.31	0.66	0.66	0.29	8.82	2.07	1.47	3.20

## **SURVEY ON LEVEL OF AFLATOXIN CONTAMINATION IN EASTERN AND WESTERN MANDALS OF CHITTOOR DISTRICT OF ANDHRAPRADESH**

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### **ABSTRACT**

A study was conducted to obtain information on aflatoxin awareness among farmers and traders and quantification of aflatoxin contents in groundnut kernels of both kharif (2007) and rabi season (2007-08) produce derived from various kinds of groundnut pods collected from different delivery chain and also collected from different storage points in Eastern and Western mandals of Chittoor district of Andhra Pradesh. Most of the farmers and collectors were not aware of aflatoxin problem in groundnut. However, the millers who are already exporting hand picked selection groundnut kernels to Singapore, Malasia are aware of the problem. Among the surveyed samples, two kinds of aflatoxins (B1 and B2) were found, however, aflatoxin B1 was more often found. Aflatoxin problem was more in kharif produce than in rabi produce. Aflatoxin B1 range was highest from the groundnut kernels collected from farmers in kharif (33-40 ppb) than in rabi season (20-32 ppb) and lowest aflatoxin B1 was observed from retailers (8-10 ppb in kharif and 5-10 ppb in rabi ).

Aflatoxins produced by soil borne fungi viz., *Aspergillus flavus* and *A.niger* in various agricultural commodities pose serious animal as well as human health hazards. Of late globalization brought tremendous export potential of agricultural commodities produced in India. However aflatoxin contamination in our agricultural commodities impedes exports due to stringent tolerable limits of toxins imposed by developed nations. Chittoor is one of the largest groundnut producing districts in Andhra Pradesh. In this context, a survey was conducted in the Chittoor district regarding aflatoxin status in agricultural commodities which will help in determining present levels of contamination which helps in recommending measures to avoid the problem.

Aflatoxin contamination of groundnut due to invasion by *Aspergillus flavus* and *A. parasiticus* is a major problem of rainfed agriculture. Rabi groundnuts largely produced in Chittoor district of Andhra Pradesh under irrigated conditions are highly preferred for export due to the kernel size. Majority of aflatoxin contamination of local groundnuts occurred at wholesale and retail levels, and especially in traditional markets selling raw kernels (Dharmaputra *et al.*, 2007a and 2007b) despite their moisture contents being less than 8 percent. The

objectives of this study were to obtain information on the pre and post harvest handling of groundnuts, awareness about aflatoxins and on the level of aflatoxin contamination at various stages in the groundnut delivery chain.

### **MATERIALS AND METHODS**

A survey was conducted during rain fed kharif (July, 2007) and during irrigated rabi (November, 2007) at Sri Kalahasti, Eerpedu, Piler and Rompicherla Mandals of Chittoor district. These areas were selected because of production of large quantities of groundnuts, besides five big groundnut mills (factories) located in these mandals.

Interviews and sampling of groundnut pods were carried out during the survey. A total of 176 respondents participated in the survey. Among them, 76 were farmers and the remaining were collectors, processors and retailers. From the 176 respondents, a total number of 325 groundnut pod samples were collected during the survey. Interviews with farmers, collectors (middlemen), wholesalers and retailers were made using questionnaires.

Samples (2 kg kernels per sample) of rabi and kharif season kernels collected from various sources were divided three times to obtain working samples for analyzing aflatoxin content.

Aflatoxin analysis has been performed by High Performance Liquid Chromatography (HPLC) with immunoaffinity column clean up and post-column derivatization using a photochemical reactor for enhanced detection (PHRED) system for derivatization (Waltking and Wilson, 2006).

**RESULTS AND DISCUSSION**

The results of the interview at various stages of delivery chain indicated that 1) Most of the farmers sold the groundnuts to local traders after harvest. 2) Harvesting was carried out by pulling the groundnut plants manually. 3) Pod stripping was also carried out manually. 4) Fifty per cent of the farmers only dried and stored groundnuts before sending to collectors or processors. 5) Collectors (middle men) sold the groundnuts directly to factories or stored the groundnuts in gunny bags for short period (up to 7-10 days). 6) Most of the farmers and collectors were not aware of aflatoxin problem in groundnut. 7) Some of the factory people were aware of aflatoxin problem in processed groundnut.

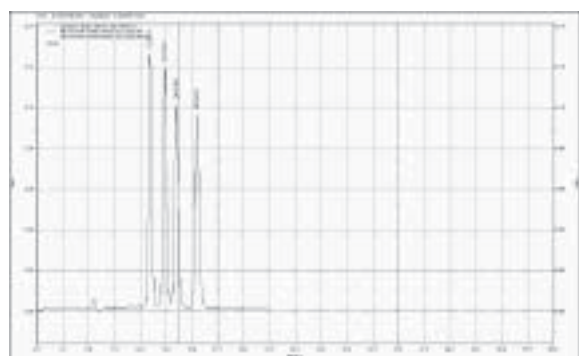
Quantification of aflatoxin B1 was done by comparing the standard peak area and sample peak area. Standard aflatoxins (B1, B2, G1 and G2) peak areas are shown in fig 1(a) and one infected groundnut kernel sample containing aflatoxin B1 and B2 and one healthy groundnut kernel sample is shown in fig 1(b) and 1(c) respectively. The result of the level of aflatoxin contamination during survey revealed that, two kinds of aflatoxins (B1 and B2) were found in surveyed samples. Aflatoxin B1 was more often

found. The Aflatoxin B1 content of groundnut kernels derived from various kinds of groundnut collected from different delivery chains during kharif season was greater than those from the rabi season (table 1). The Aflatoxin B1 content of groundnut kernels from farmers was greater (33-40 ppb in kharif and 20-32 ppb in rabi season) than the other members of delivery chain. Lowest aflatoxin B1 was observed from retailers (8-10 ppb in kharif and 5-10 ppb in rabi season). According to Dharmaputra *et al.*, (2007a and 2010) 33 per cent of raw kernels samples were contaminated with aflatoxin B1 with more than 15 ppb and the range infection by *A.flavus* was higher in the kernels collected from wholesaler than those from retailer.

The study revealed that awareness about aflatoxin problem in groundnut at farmer level is only minimal. Right management practices and drying methods to minimize aflatoxin problem in groundnut need to be inculcated among the farming community by rigorous trainings and frontline demonstrations. Rabi produced groundnuts are safer in terms of aflatoxin contamination compared to kharif produced groundnuts. In the groundnut delivery chain, more aflatoxin contaminated groundnuts were recorded at farmer level.

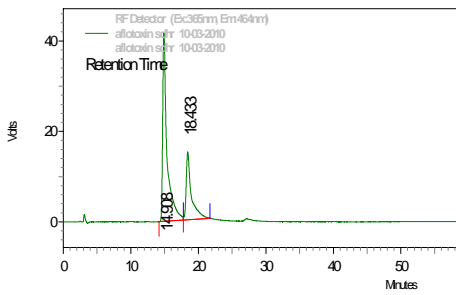
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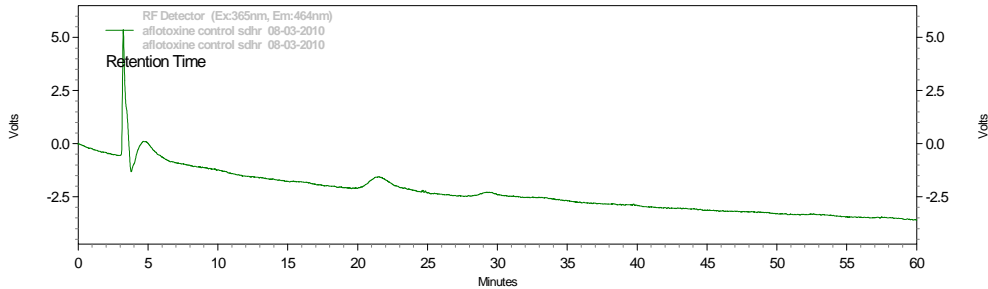
Peak no.	Peak name	Retention Time	Area
1	G2	11.39	2728197
2	G1	12.5	2715818
3	B2	14.492	2414365
4	B1	17.892	2634453

**Fig: 1a.** Custom report for aflatoxin standards analysed through HPLC



Peak no.	Peak name	Retention Time	Area
1	B2	14.908	1867766
2	B1	18.433	798194

**Fig 1b:** Custom report for aflatoxin estimation in infected groundnut sample analysed through HPLC



**Fig 1c:** Custom report for aflatoxin estimation in healthy groundnut sample analysed through HPLC

Table 1. Aflatoxin B1 content of groundnut kernels derived from various kinds of groundnut collected from different delivery chains during season.

Delivery chain	Number of samples	Range of aflatoxin B1 content (ppb)	
		<i>Kharif'</i> 2007	<i>Rabi'</i> 2007-08
Farmer	38	20-32	33-40
Middle men (collector)	17	15-18	20-31
Wholesaler	17	10-14	10-22
Retailer	16	5-10	8-10
Total	88		

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## COMPARISON OF DIFFERENT DIALLEL MATING DESIGNS IN SESAME (*Sesamum indicum* L.)

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### ABSTRACT

In present study, the relative efficiency of the four methods of Griffing's numerical approach vis-à-vis partial diallel cross design in sesame (*Sesamum indicum* L.) was studied. The results indicated that the magnitude of general combining ability variance (GCA) and specific combining ability variance (SCA) varied with the method of analysis. The *per se* performance had the highest magnitude of correlation coefficients with *gca* effects computed through M2 method followed by M1 method. The association between *gca* effects estimated through M2 v/s M4 and M1 v/s M3 were found to be comparable. The precision of estimates of *gca* effects computed through partial diallel cross analysis was affected by the sampling of the crosses. The *per se* performance of direct crosses had the highest magnitude of correlation coefficients with *sca* effects computed through M2 method followed by M1 method. The association between *sca* effects estimated through M2 v/s M4 and M2 v/s M3 methods were comparable. The rank correlation between ranks of the *sca* effects of direct crosses through M1 and M3 methods differed and was not comparable.

**Key words:** Sesame, combining ability, diallel cross and partial diallel cross

India is the largest producer of sesame in the world with a production of about 6.41 lakh tonnes from an area of 17.2 lakh hectares. However, the productivity of sesame in India is 372 kg/ ha compared to world average of 440 kg/ha. It indicates that still there is a scope to enhance the production of sesame in India by employing appropriate plant breeding techniques. The diallel analysis is used in crop improvement programmes to identify superior parents for crossing and for characterizing general, specific and reciprocal effects. In this study four methods of Griffing's (1956) numerical approach and partial diallel analysis of Kempthorne and Curnow (1961) were used for the analysis. The four methods of diallel analysis depending on the material involved in the study were (i) parents (n),  $n(n-1)/2$   $F_1$ s and reciprocals, (ii) parents and  $F_1$ s only, (iii)  $F_1$ s and reciprocals and (iv)  $F_1$ s only.

The different procedures when applied to same crop variety often give a different picture of genetic makeup. Such discrepancy can primarily be assigned to the method of computation applied in estimating parameters and the extent to which the assumptions involved in each method are fulfilled. The comparative efficiency of some of the biometrical procedures can be of great value in assessing the true picture of the

genetic makeup of a particular crop. The accuracy of the analysis is improved by using the appropriate method. The present investigation was undertaken to study the relative efficiency of the four methods of Griffing's numerical approach vis-à-vis partial diallel cross design.

### MATERIALS AND METHODS

The present study was based on a full diallel set of parents viz., VNP local, VRI-1, Danbakkae, Jinjukkae, PTDL-1 and Koteche. The 30  $F_1$ s (15 direct + 15 reciprocal crosses) along with six parents were grown with a spacing of 30 x 20 cm in randomized complete block design (RCBD), with three replications at Experimental Farm, Department of Agricultural Botany, Faculty of Agriculture, Annamalai University, Annamalainagar during *Rabi*, 1999-2000. The recommended agronomic and cultural practices were followed to raise healthy crop. Observations were recorded on 15 random plants in each genotype for days to first flower, number of capsules / plant, 1000-seed weight (g) and seed yield / plant (g). Each character was subjected to statistical analysis following Gomez and Gomez (1983). The means of the parents, direct and reciprocal crosses were subjected to the combining

ability analysis of four methods of Griffing's (1956) numerical approach viz., method 1 (M1), method 2 (M2), method 3 (M3) and method 4 (M4) and by partial diallel cross (PDC) design (Kempthorne and Curnow 1961). For partial diallel cross analysis, a sample size of three crosses was used and the crosses ( $ns/2=9$ ) were sampled following circulant matrix design. The error means for squares of respective RCBD were used further in combining ability analysis.

## RESULTS AND DISCUSSION

The magnitude of variances due to general combining ability variance (GCA) and specific combining ability variance (SCA) were found to vary with the method of analysis (Table-1). However, the overall GCA / SCA variance ratio did not vary much for all the characters studied. This indicated preponderance of non-additive component of gene action across the methods of estimation. Results of all the four methods were complementary to each other and not alternative.

The correlation coefficients between *per se* performance and *gca* effects estimated through different methods were computed and compared (Table 2). The *per se* performance had the significant and highest magnitude of correlation coefficients with *gca* effects computed through M2 method followed by M1. Further, correlation coefficients between the *gca* effects estimated through M2 v/s M4 and M1 v/s M3 were of high magnitude and hence, were comparable. In Partial Diallel Cross, correlation coefficient showed significant *gca* effects in M4. The rank correlation coefficients reflected that rankings of the lines differed with respect to the method of combining ability analysis. Strong correlations between ranks of lines based on *per se* performance v/s *gca* effects estimated through M2 method followed by M4 method were observed for all the characters studied. The rankings of lines based on *gca* effects computed through M1 method were significant and highly correlated compared with M3 method.

The correlation coefficients between *per se* performance and *sca* effects estimated through four approaches of Griffing were computed and compared (Table 3). The *per se* performance had significant and highest magnitude of correlation coefficients with *sca* effects computed through M2 method followed by M1 method. Further, correlation coefficients among *sca* effects estimated through four approaches revealed that the association between *sca* effects estimated through M2 v/s M4 and M1 v/s M3 methods were of high magnitude and hence, were comparable. Correlation coefficients estimated through M1 and M2 methods showed highly significant values compared with M3 and M4. The rank correlations computed between ranks based on *sca* effects estimated through M2 method followed by M4 methods correlated with the ranks based on *per se* performance of the direct crosses. Rank correlation coefficients estimated through M1 and M2 methods showed highly significant values compared with M3 and M4.

The association between *per se* performance of reciprocal crosses and *rca* effects calculated (Table 4) through M1 or M3 methods of Griffing (1956) were of low magnitude. The correlation coefficient estimated through M1 method showed high significant effects than M3 method. Further, the mutual association between *rca* effects computed through M1 and M3 methods, was of low magnitude. This indicated significant differences for *rca* effects computed through two methods. The rank correlation coefficient analysis also depicted the similar results. The results of present study clearly suggest that ; a breeder is required to study full diallel. To know the real genetic worthiness of the test material, the sampling of crosses in partial diallel cross analysis has given variable picture when compared to full or other diallel approaches.

**Table 1. Combining ability variances estimated through four methods of Griffing's numerical approach and partial diallel analysis in sesame**

Character	Variances	Griffing's method				Partial diallel cross analysis
		M1	M2	M3	M4	
Days to first flowering	GCA	1.60	2.45	524.12	0.74	45.26
	SCA	11.34	8.07	2110.53	9.55	0.90
	GCA/SCA	0.14	0.30	0.25	0.08	50.16
Number of capsules / plant	GCA	18.51	53.75	1135.55	79.57	35.77
	SCA	127.43	236.55	468.50	194.39	128.24
	GCA/SCA	0.15	0.23	0.24	0.41	0.28
1000 – seed weight	GCA	0.01	0.003	3.21	0.01	0.003
	SCA	0.01	0.02	12.84	0.02	0.01
	GCA/SCA	0.76	0.14	0.25	0.25	0.29
Seed yield / plant	GCA	0.31	0.66	13.37	1.04	0.96
	SCA	2.01	4.19	56.71	4.03	1.85
	GCA/SCA	0.15	0.16	0.24	0.26	0.52





**Table 4. The correlation coefficients between *rca* effects of reciprocal crosses computed through different methods of combining ability analysis of four methods of Griffing in sesame**

Character	Method of estimation	Simple correlation coefficient (r)		Rank correlation coefficient ( $r_s$ )	
		M1	M3	M1	M3
Days to 50% flowering	M1	0.38*	-0.47**	<b>0.49**</b>	-0.80**
	M3		<b>-0.10</b>		<b>-0.26</b>
Number of capsules / plant	M1	0.26	-0.54**	<b>0.27</b>	-0.15
	M3		<b>-0.04</b>		<b>-0.53**</b>
1000 – seed weight	M1	0.19	-0.30	<b>0.08</b>	-0.20
	M3		<b>-0.25</b>		<b>0.32*</b>
Seed yield/plant	M1	0.21	-0.55**	<b>0.19</b>	-0.07
	M3		<b>0.08</b>		<b>-0.54</b>

\* Significant at 5 per cent level

\*\* Significant at 1 per cent level.

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## GLYCAEMIC INDEX AND GLYCAEMIC LOAD OF WHEAT BASED FOODS

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### ABSTRACT

Diabetes mellitus is widely prevalent all over the world affecting millions of people in both developed and developing countries. Wheat is one of the most important cereal crops in the world. The wheat based meal showed the lowest Glycaemic Response (GR) in non- insulin dependent diabetics because of its blood sugar reducing properties. The present study was aimed to prepare the wheat based foods based on particle size and method of cooking and to determine the Glycaemic index and Glycaemic load of the prepared foods. Broken wheat porridge, whole wheat flour porridge and whole wheat flour chapathi were prepared. Six healthy non-medicated women aged from 40 to 50 years were selected. Blood samples were drawn before and at 30, 60, 90 and 120 minutes after consumption of the test meal. Glycaemic Index (GI) and Glycaemic Load (GL) were calculated. The glucose concentration after ingestion of 50 g carbohydrate from the whole wheat flour porridge was higher than the broken wheat porridge within 30 minutes. Broken wheat slows digestion and absorption of carbohydrate, hence it reduced the glucose response. The peak value was observed at 30 minutes ingestion of whole wheat flour chapathi. Broken wheat porridge and whole wheat flour porridge had low Glycaemic Index and whole wheat flour chapathi fell under medium Glycaemic Index food. The Glycaemic load of broken wheat porridge and whole wheat flour porridge was medium.

In Indian diet, the major carbohydrate is starch derived from the cereals such as rice, wheat, ragi (finger millet) and jowar (FAO, 1998). Approximately 70 percent of the world wheat production is used as food, mainly as bread and other baked products such as cakes and cookies and also as a source of protein and dietary fiber for many people around the world (Bodgan and Dobraszczyk, 2001). Wheat based meal showed the lowest Glycaemic Response (GR) in non-insulin dependent diabetics because of its blood sugar reducing properties (Kavitha and Prema, 1997).

Dietary carbohydrate components shown to be related to lower insulin resistance include higher intakes of total fiber, cereal fiber and whole grain (Julie *et al.* 2004). Carbohydrates that are low or moderately glycaemic would also be suitable for diabetes management ( Mckeown *et al.* 2004). Glycaemic Index is a numerical system of measuring raised circulating blood sugar that the carbohydrate triggers. The higher the value the greater the blood sugar response (Brand Miller *et al.* 2004). Glycaemic Load (GL) was introduced to assess the relationship between the average Glycaemic Response (GR) of foods consumed and the health outcome in epidemiological studies Liu *et al.* 2001). Glycaemic

Response (GR) is a function of the digestibility of available carbohydrate. Glycaemic impact of carbohydrate foods has been related to the rate of digestion of available carbohydrate (Englyst *et al.* 2003).

Many factors like type of carbohydrate, fiber, protein, fat and method of preparation, determine the GI of a particular food. Hence, the present study was aimed to prepare the wheat based foods based on particle size and method of cooking and to determine the Glycaemic index and Glycaemic load of the prepared foods.

### MATERIALS AND METHODS

**TEST MEALS:** Wheat (*Triticum aestivum*) was procured from the local market of Tirupattur. Dried wheat samples were cleaned and split into broken kernels using electrical mixer and part of the wheat was ground to a fine flour in the flour mill. Broken wheat and salt were added into hot water, boiled and made into a thick consistency (NIN, 2004). Whole wheat flour (100g) was mixed with 0.5g common salt and water needed to give correct hand feel. Dough was kneaded to bring it to chapathi making consistency and allowed to rest for 30 min at room temperature. Dough was divided into balls. Each

dough ball was rolled and flattened to chapathi and roasted on a preheated non-stick hot plate for 20 seconds on one side, 10 seconds on an other side, and held over flame until complete puffing occurred (Rao and Bharathi, 1996).

**SUBJECTS:** Six healthy non – medicated women aged from 40 to 50 years were selected and consent was obtained from all the selected subjects. The fasting blood glucose level of the group was within the normal range (94.33±5.01 mg/dl) and gave normal 2 h response to glucose tolerance test. Glucose (50g) was administered for conducting Glucose Tolerance Test on the first day. After the GTT, test foods such as broken wheat porridge, whole wheat flour porridge, whole wheat flour chapathi were given on the second, third and fourth day respectively. Blood samples were drawn before and at 30, 60, 90 and 120 min after consumption of the test foods. The blood samples were collected through finger prick using a hypodermic needle. Each blood sample was placed on a test strip which was inserted into a calibrated glucometer (Optimum/one touch) which gave direct readings after 5 seconds.

**CARBOHYDRATE BASIS FOR GLYCAEMIC INDEX (GI) DETERMINATION**

GI of foods such as broken wheat porridge, whole wheat flour porridge and whole wheat flour chapathi was measured. The test foods contained significant amount of available carbohydrate that

means total carbohydrate minus dietary fiber. A 50 g available carbohydrate load had been proposed as a reference amount for GI testing.

**CALCULATION OF GLYCAEMIC INDEX**

Incremental Area Under Curve (AUC) was recommended by the Food and Agriculture Organization (1998), and it is calculated as AUC using the incremental AUC, ignoring area under the baseline. Assuming that at times  $t_0, t_1, \dots, t_n$ , the blood glucose concentrations are  $G_0, G_1, \dots, G_n$ , respectively:

$$AUC = \sum_{x=1}^n Ax$$

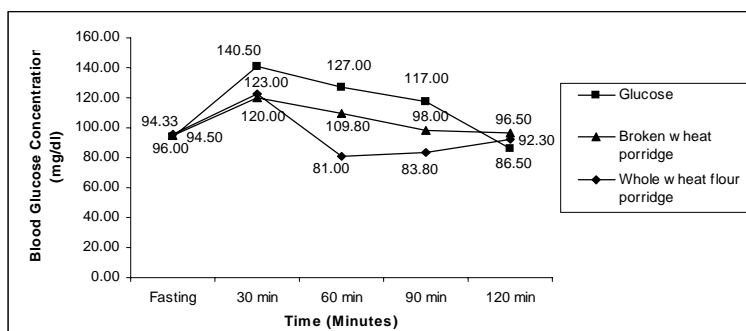
where  $Ax$  is the AUC for the  $x$ th time interval, and the  $x$ th time interval is the interval between times  $t_{x-1}$  and  $t_x$ .

The results were expressed as mean and standard deviation.

**RESULTS AND DISCUSSION**

Glucose tolerance test was carried out in the selected healthy women (n=6). The blood glucose level was estimated in the empty stomach at zero hour, after that, broken wheat porridge was given. After 30, 60, 90 and 120 minutes, the blood glucose levels were recorded. The next day, whole wheat flour porridge was served and the same procedure was followed. The mean blood glucose levels were shown in figure – 1.

**Figure 1. Mean blood glucose concentration of wheat based foods with reference to processing**



The mean fasting blood glucose level of the selected healthy women was 94.33+5.01 mg/dl and it was increased to peak level 140.5+ 6.47 mg/dl within 30 minutes after ingestion of 50g glucose. The blood glucose level was declined to 127+5.22, 117+3.89 and 86.5+12.82mg/dl at 60, 90 and 120

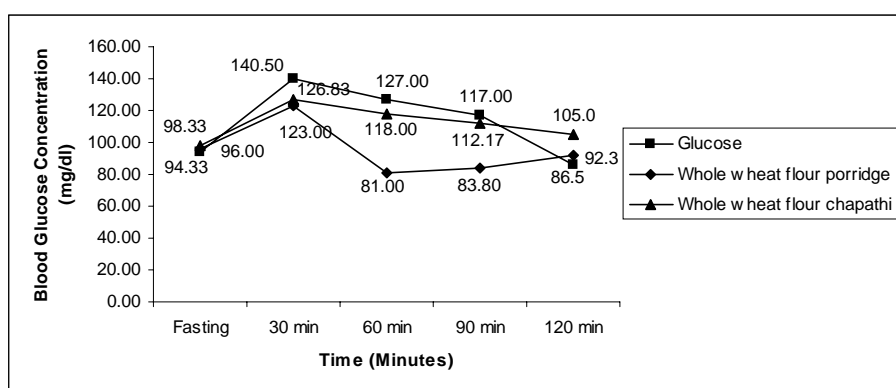
minutes respectively. The glucose concentration after ingestion of 50g carbohydrate from the broken wheat porridge was increased to 120+5.83 mg/dl within 30 minutes and 109.8+5.12 mg/dl at 60 minutes and slightly increased to 96.5 ± 6.56 mg/ dl at 120 minutes. The glucose concentration after ingestion of 50g

carbohydrate from the whole wheat flour porridge was  $123 \pm 5.09$ ,  $81 \pm 8.36$  and  $92.3 \pm 4.37$  mg/dl at 30, 60 and 120 minutes respectively. Moreover the peak values were observed at half an hour after ingestion of broken wheat porridge and whole wheat flour porridge. Similar results were observed by Asna *et al.* (2006) who stated that the GR at 30 min after consumption of dumpling meals were comparatively higher than the two roti meals. Thereafter the levels showed a reducing trend at one hour, the mean blood glucose value (81 mg/dl) of whole wheat flour porridge recorded a lower response when compared with broken wheat flour porridge (109.8 mg/dl). Broken wheat slows digestion and absorption of carbohydrate, hence it reduces the glucose response.

Foods with an intact botanical structure tend to have lower GI values, as the starch is protected from enzymatic degradation by the outer layer of the

grain kernel (Juntunen *et al.* 2002). Particle size of flour affected the quality and starch gelatinization (Lowerance *et al.* 1986). If the particle size of flour is big, the flour cannot absorb the necessary water, and medium particle size increases the water absorption of flour (Pomeranz *et al.* 1988). Granfeldt *et al.* (2005) revealed that the factors such as variety, cooking and processing may affect a food's GI. The researchers found that the GI of wheat, maize and oats increased from whole grains (lowest GI), cracked grains, course flow to fine flour (highest GI). Methods of cooking affect the digestibility of wheat starch. Gelatinization may be one of the factors that determine the rate of starch digestion (Susan *et al.* 1987). The mean blood glucose response of the test foods in normal women is given in the Figure-2.

**Figure 2. Mean blood glucose concentration of wheat based foods with reference to cooking**



The glucose concentration after ingestion of 50g carbohydrate from the whole wheat flour chapathi was increased to  $126.8 \pm 5.19$  mg/dl within 30 minutes and  $118 \pm 3.52$  mg/dl for 60 minutes. The glucose

concentration was  $112.16 \pm 3.31$  mg/dl and  $105 \pm 5.44$  mg/dl for 90 minutes and 120 minutes respectively. The mean values obtained for different products are presented in table-1

**Table 1. Glycaemic index of wheat based foods**

Food Product	Quantity of available CHO	Glycaemic Index (GI)	Category*
Broken Wheat Porridge	50	$33.74 \pm 11.49$	Low
Whole Wheat Flour Porridge	50	$45.26 \pm 7.26$	Low
Whole Wheat Flour Chapathi	50	$59.86 \pm 10.9$	Medium

\* www.glycemic index.com

From Table – 1, it is clear that the mean GI of broken wheat porridge, whole wheat flour porridge and whole wheat flour chapathi was found to be 34, 45 and 60 respectively. The two food products namely broken wheat porridge and whole wheat flour porridge recorded low Glycaemic Index (GI) values. Whole wheat flour chapathi fell under medium Glycaemic Index (GI) value. The values were found to be closer to the recently published values suggested for ragi roti 68 (Asna, 2006), chapathi 62

(Without Oil) (Asna, 2006) and porridge 55 (www.ginews.com).

Ludwig (2003) revealed that porridge made from larger and more intact cereals was found to have a lower Glycaemic Index (GI) than that made from more finely ground cereals. Increased processing and starch retrogradation can affect Glycaemic Index (Foster Powell *et al.* 2005). The results of the present study were agreeable, indicating that fine wheat flour had high Glycaemic Index (GI).

**Table 2 . Glycaemic load of wheat products**

Food Product	Glycaemic Load (GL)	Category*
Broken Wheat Porridge	16.88±5.75	Medium
Whole Wheat Flour Porridge	22.63±3.63	Medium
Whole Wheat Flour Chapathi	29.96±5.45	High

\* www.glycemic index.com

Table – 2 shows the Glycaemic Load (GL) of wheat based foods. The mean GL of broken wheat porridge, whole wheat flour porridge and whole wheat flour chapathi was found to be 17, 23 and 30 respectively. Glycaemic Load (GL) of the broken wheat porridge and the whole wheat flour porridge was medium.

It can be concluded that the Glycaemic effect of wheat was affected by different forms of wheat and the method of preparation. Broken wheat porridge had lower GI than whole wheat flour porridge followed by chapathi. Moreover starch in food was influenced by the food processing and preparation conditions applied. Starch may be resistant due to the structure or starch crystal formation after cooking. Hence, selection of low GI foods would improve the Glycaemic profile of humans.

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## ASSESSMENT OF VARIABILITY AND CAUSE AND EFFECT RELATIONSHIP IN INTERSPECIFIC CROSSES OF SORGHUM (*Sorghum bicolor* (L.) Moench)

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In the present study, an attempt was made to investigate genetic variability and identify the most responsible yield components for seed yield among interspecific crosses of sorghum. The findings of the study would be useful for establishing selection criteria in sorghum breeding programme for higher seed yield. This study was conducted at Agricultural Research Station, Tandur during 2009-10 rabi season. The experimental material comprised of 29 segregating progenies of two interspecific crosses in  $F_4$  generation viz., *Sorghum bicolor* (cs3541) x *Sorghum usumberense* (Sb x Su) and *Sorghum bicolor* (cs3541) x *Sorghum lewisonii* (Sb x Sl) which were sown in randomized block design with 3 replications. The progenies were grown in 2 rows plot of 5 m length with row to row distance of 45 cm and the distance within the row was maintained at 15 cm. Recommended agronomic practices were followed to raise a good crop. Observations were recorded on the characters, viz., days to 50% flowering, days to maturity, plant height (cm), panicle length (cm), test weight(g), seed yield per plant (g) and fodder yield (t/ha). Data were recorded from ten randomly selected plants from each segregating family per replication and the average was taken for analysis.

Standard statistical procedures were used for the analysis of variance and genotypic and phenotypic coefficient of variation. The association between yield and yield component traits and among themselves was computed based on genotypic and phenotypic coefficient of variances and covariances (Goulden, 1952). Path coefficient analysis was done to partition the genotypic and phenotypic correlation coefficient into components of direct and indirect

effects according to the method of Dewey and Lu (1959). The statistical analysis was done by using WINDOSTAT package.

Wide range of genetic variability was observed among the segregating progenies for different characters (Table 1). The relative magnitude of PCV percent was higher than the corresponding GCV percent for all the characters studied, which indicated that these traits are having interaction with environment to some extent. The genotypic and phenotypic coefficient of variation ranging from 3.51 to 49.01 and 3.44 to 100.31, respectively, were highest for fodder yield and seed yield in the cross Sb x Su and lowest for days to maturity in both the crosses. In general, the genetic variability was comparatively high for fodder yield and seed yield in both the crosses whereas for panicle length and test weight in Sb x Su only. Thus it offers better scope for the selection of desirable characters from the present segregating material. Since the selection capacity of population mostly depends on the magnitude of heritable variation, the heritability coupled with genetic advance as percentage of mean is more desirable. The genetic advance as percentage of mean ranged from 3.69 to 100.43 and 3.63 to 53.38 in both the crosses, respectively. High heritability estimates were recorded for days to maturity, plant height, test weight and seed yield indicating lesser influence of environment in both the crosses. Days to 50% flowering, panicle length and fodder yield exhibited low heritability values and were highly influenced by environmental conditions in both the crosses. These results are in agreement with the earlier findings of Narkhede *et al.* (2000).

The studies on correlation will be useful to know the intensity and direction of association of a character with yield. In the present study, seed yield

showed positive significant correlation with days to maturity in the cross *Sb x Sl* and test weight and fodder yield in both the crosses (Table 2). Days to 50% flowering exhibited significant positive association with days to maturity in the cross *Sb x Sl* and plant height in the cross *Sb x Su*. Days to maturity recorded significant positive correlation with fodder yield in the cross *Sb x Sl*. Plant height recorded significant positive correlation with panicle length and test weight in the cross *Sb x Sl*. Test weight showed positive significant correlation with panicle length in *Sb x Sl* and fodder yield in *Sb x Su*. The present study revealed the desirable associations of seed yield with days to maturity in *Sb x Sl* and with fodder yield in both the crosses.

The study on direct and indirect effects of yield and yield attributing traits on seed yield indicated that days to 50% flowering, plant height, panicle length, test weight and fodder yield had positive direct effects on seed yield (Table 3). These results were in agreement with the earlier findings of Patil and Parameshwarappa (1993). The negative direct effect of days to maturity with seed yield were manifested through negative indirect effects via days to flowering in both the crosses and panicle length and fodder yield in *Sb x Sl* and plant height in *Sb x Su*. Positive direct effect of plant height with seed yield was manifested through positive indirect effects of days to 50% flowering, days to maturity, panicle length and fodder yield in *Sb x Su* and through panicle length and test weight in *Sb x Sl* there by resulting in positive association with seed yield. Panicle length exhibited positive direct effect through days to 50% flowering, plant height and test weight and negative indirect effect through fodder yield in both the crosses.

Indirect effects of test weight were positive through days to maturity, panicle length and fodder yield and negative through days to 50% flowering in both the crosses resulting in strong association with seed yield.

The genotypic residual effects *viz.*, 0.584 in *Sb x Su* and 0.686 in *Sb x Sl* were high in magnitude which shows that yield contributing characters which contributed to yield were highly influenced by the environment. The characters plant height, panicle length, test weight and fodder yield which showed positive correlation with seed yield should be given due importance in the selection for yield improvement. Hence, these characters can be used as selection indices and careful selection should be exercised for evolving high yielding genotypes.

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## FARMERS PERCEPTION TOWARDS UNDERSTANDABILITY AND UTILITY OF VYAVASAYA PANCHANGAM

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After the establishment of agricultural universities in India, which are the chief sources of innovations in agricultural field, the need for speedy communication of research findings to the farming community has increased multifold. So an attempt was made to find out the perception of farmers towards understandability and utility of vyavasaya panchangam published by Acharya N.G Ranga Agricultural University.

Expost –Facto research design was followed for the study. The study was conducted in Rangareddy district of Andhra Pradesh. Four mandals were selected and three villages from each selected mandal were selected for the study. From each selected village 10 respondents were selected by simple random sampling, thus constituting a total sample of 120 farmers. Data collected from the selected respondents by using an interview schedule and results were drawn after processing the data.

The respondents were classified into three categories based on the perception towards understandability of the information provided in Vyavasaya Panchangam using class interval technique. It could be indicated from the Table 1 that a majority of the respondents had medium perception towards understandability (55.0%), followed by high (23.3%) and low (21.7 %). In order to increase the perception towards understandability of any information material, the literacy level of the farmers must be improved by conducting various educational programmes through government organizations/institutions.

Majority of respondents (table 2) stated that it is easy to understand each sentence (96.7%),

paragraph (96.7%), chapter (94.2%), meanings of general words (89.2%) and content preview of Vyavasaya Panchangam as a whole (85.0%), as the Vyavasaya Panchangam is published in simple, local and informal language. Majority of respondents perceived that English words (53.2%) in Vyavasaya Panchangam are moderate to understand by most of the respondents, whose literacy level is only primary schooling. They stated that they are capable of understanding English words which are very popular among Telugu speaking people. Majority of the respondents perceived that technical terms (60.9%) used in Vyavasaya Panchangam were moderate to understand as also indicated by Venkatesham (2002). If less number of technical terms are used, the farmers would be able to follow the message easily. In the view of the rapid changes in agricultural technology, new technical terms are frequently being evolved to communicate new ideas. It may be difficult to translate those terms into easy Telugu language. Hence, it may be compulsory to use some of the important English technical terms in the regional language. Attempts would be made by the publishers of Vyavasaya Panchangam to translate these new technical terms into simple telugu terms.

Awareness programs could be organized by extension agents to educate farmers on this new concept. Illustrations coupled with messages make the subject matter easier to understand. Tables used in the Vyavasaya Panchangam were moderate to understand (58.4%). As most of the respondents are from primary schooling they are having less knowledge to understand the tables mentioned. Better understanding could be brought out by

conducting group discussions among respondents by extension personnels. In order to make the subject matter more realistic/lively it may be necessary to introduce more appropriate illustrations for communicating the latest innovative ideas better. Group discussion should be conducted among the respondents reading Vyavasaya Panchangam.

The respondents were classified in to three categories based on the perception towards utility of information provided in Vyavasaya Panchangam presented in the Table 1. It could be indicated from the Table 1 that majority of the respondents had medium perception towards utility (55.8%), followed by high (27.5 %) and low (16.7 %) of information as also reported by Venkatesham (2002). The medium level of perception on utility of the information can be attributed due to the medium farming experience, low knowledge and skills in adopting the new agricultural practices and medium literacy level to understand and use the information published in Vyavasaya Panchangam. Majority of respondents accepted that the information provided in Vyavasaya Panchangam is timely, specific and need based (Table 3).

The respondents were rated high utility on the topics of vyavasaya panchangam like postal addresses of research stations and extension centres, description of damaged symptoms of pests and diseases, particulars of seed rate, spacing and seed treatment, content of traditional panchangam, text on agricultural implements etc. And the least rated topics are information on fisheries, post harvest technology, compatibility charts for fertilizers and pesticides, micro nutrient recommendations, Rabbit-rearing etc (Table 4). The high ranking on some of the topics might be due to the usefulness of the information to clear their doubts on the text provided in the panchangam. The description on damage symptoms of pests and diseases is useful to locate the right pest to take appropriate remedy. There will be direct applicability of the information provided on seed rate, spacing and seed treatment. The farmers could not able to understand the technicalities behind the compatibility charts for fertilizers & pesticides, post harvest technology and pisciculture. As the area under pisciculture is restricted to only some localities. The information on micronutrient recommendation doesn't have direct relevance to the crops grown by the farmers hence they were least rated.

**Table1. Distribution of the respondents according to their Perception towards understandability and 2 utility of Vyavasaya Panchangam**

N=120

S.No	Category	Understandability	Utility
		Percentage	Percentage
1.	Low	21.70	16.70
2.	Medium	55.00	55.80
3.	High	23.30	27.50
	TOTAL	100.00	100.00

**Table 2. Distribution of the respondents based on their understanding towards various components of Vyavasaya Panchangam**

N=120

S.No.	Items	Percentage	Rank
1.	Meaning of each sentence	96.7	1
2.	Meaning of each paragraph	96.7	1
3.	Symptoms of damage by the pests and diseases	95.9	2
4.	Usage of language	95.0	3
5.	Meaning of each chapter	94.2	4
6.	Illustrations	90.0	5
7.	Meanings of general words	89.2	6
8.	Continuity between the chapters	88.3	7
9.	Continuity throughout the panchangam.	88.3	7
10.	Continuity in the chapter from one para to another para	85.0	8
11.	Meaning of the content preview in Vyavasaya Panchangam as a whole	85.0	8
12.	Information on dairy management	82.5	9
13.	Information on poultry rearing	78.3	10
14.	Information on sheep & goat rearing	70.8	11
15.	Font size	70.8	11
16.	Information on fuel for cooking in rural areas	64.2	12
17.	Information on foods and nutrition	55.0	13
18.	Balance use of insecticides at proper time	47.5	14
19.	Balance use of herbicides at proper time	46.7	15
20.	English words	46.7	15
21.	Fertilizer doses	45.8	16
22.	Dosages of fungicides	45.8	16
23.	Technical words used	38.3	17
24.	Examples given/ illustrations	33.3	18
25.	Information on low cost production technologies	30.8	19
26.	New words used	26.7	20
27.	Table contents	20.8	21
28.	Information on drudgery reduction technologies	21.7	22
29.	Information on fodder crops	16.7	23
30.	Calculation methods	12.5	24
31.	Information on rabbit rearing	12.5	25
32.	Information on tie & die	8.3	26
33.	Information on pisciculture	3.3	27

**Table 3. Distribution of the respondents by their Agreement on the information provided in Vyavasaya Panchangam**

N=120

S.No.	Statements	Percentage	Rank
1.	Information provided was timely	85.0	1
2.	Information provided was specific	80.8	2
3.	Information provided was need based	72.5	3
4.	Information provided was practicable	47.5	4
5.	Information provided was complete & comprehensive	11.7	5
6.	Information provided was suitable to local conditions	10.8	6

**Table 4. Distribution of the respondents by their Usefulness of the topics covered in Vyavasaya Panchangam as in text:**

N=120

S.No.	Items	Percentage	Rank
1.	Postal addresses of Research Stations & Extension Centres	99.2	1
2.	Description of symptoms of damage caused by pests & diseases	94.2	2
3.	Seed rate, spacing & seed treatment	93.3	3
4.	Traditional Panchangam	90.0	4
5.	Agricultural implements	89.2	5
6.	Dairy Animals	88.3	6
7.	Cropping seasons & time of sowing	85.0	7
8.	Agriculture operations as per Telugu calendar	83.3	8
9.	Sheep & goat	81.7	9
10.	Soil & soil types	78.3	10
11.	IPM strategies	72.5	11
12.	Introduction for each crop	71.7	12
13.	Contact address for each crop and allied aspect to get additional information	70.0	13
14.	Poultry Birds	66.7	14
15.	Control measures of pests & diseases	65.0	15
16.	Information on fuel for cooking in rural areas	59.2	16

S.No.	Items	Percentage	Rank
17.	Information on foods and nutrition	55.8	17
18.	Information on low cost production technologies	38.3	18
19.	Varieties & their description	38.3	18
20.	Water management	37.5	19
21.	Information on drudgery reduction technologies	35.8	20
22.	Information on agro – climatic zones	34.2	21
23.	Information on tie and die	27.5	22
24.	Weed management	25.8	23
25.	Fertilizer recommendations	24.2	24

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## EFFECT OF MANURES, INORGANICS AND BIO-FERTILIZERS ON YIELD, JUICE QUALITY, NUTRIENT CONTENT AND UPTAKE OF SWEET SORGHUM (*Sorghum bicolor* (L.) Monech) IN PONGAMIA BASED AGRISILVICULTURE SYSTEM

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A field experiment was conducted during *rabi* 2008-09 at Agroforestry Research block, Acharya N.G Ranga Agricultural University campus, Rajendranagar, Hyderabad, on sweet sorghum grown in the inter spaces of two year old Pongamia grafts with a spacing of 5 x 4 m. The soil of the experiment site was red sandy loam in texture, neutral in reaction (6.93), non-saline (0.16 dS m<sup>-1</sup>), low in organic carbon (0.41%), available nitrogen (160.85 kg N ha<sup>-1</sup>), phosphorus (10.13 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and potassium (166.42 kg K<sub>2</sub>O ha<sup>-1</sup>). The experiment consisted of 9 treatments and replicated thrice in a randomized block design. The treatments are: T<sub>1</sub> - Control (without manure and fertilizer); T<sub>2</sub> - FYM 10 (t ha<sup>-1</sup>); T<sub>3</sub> - 100 percent RDF (80-60-40 kg ha<sup>-1</sup> NPK); T<sub>4</sub> - 75 percent RDN + 25 percent N through Vermicompost; T<sub>5</sub> - 75 percent RDN + 25 percent N through FYM; T<sub>6</sub> - 75 percent RDN + 25 percent N through Poultry manure; T<sub>7</sub> - 75 percent RDN + Azospirillum @ 5 kg ha<sup>-1</sup>; T<sub>8</sub> - 75 percent RDN + VAM @ 5 kg ha<sup>-1</sup>; T<sub>9</sub> - 75 percent RDN + Azospirillum + VAM each @ 5 kg ha<sup>-1</sup>. Recommended doses of phosphorus and potassium (60 and 40 kg ha<sup>-1</sup>) were applied uniformly to all treatments in the form of single super phosphate (SSP) and muriate of potash (MOP) respectively as basal except Control and FYM 10 (t ha<sup>-1</sup>).

Nitrogen was applied as per the treatments as scheduled in the form of urea in 3 equal splits (1/3 basal, 1/3 at knee high and 1/3 at ear head emergence stage). Plant samples were collected and analyzed at harvest for nutrient concentration and uptake by following standard analytical procedures.

Grain yield and stover yield of sweet sorghum were higher, when the nutrients were applied through fertilizers (RDF). More or less similar yields could be realized, when poultry manure was used along with

reduced dose of fertilizers. Grain yield of sweet sorghum was on a par with the above, when FYM or VC was applied along with 75% RDF. However, the stover yield decreased significantly when FYM and VC were used as substitutes to fertilizers. Bio-fertilizers tested *viz.*, azospirillum and VAM were not as effective as fertilizers. The grain yield and stover yield decreased sharply, when part of the fertilizers was substituted with these bio-fertilizers, either singly or combinedly. The results are in accordance with the earlier findings of Kange *et al.*, (2008).

The effect of poultry manure on the juice quality of sorghum on the juice quality of sorghum stalks as estimated in the form of brix and sucrose was distinctly evident. The brix and sucrose values were higher with the use of poultry manure. However, the effect of the use of recommended dose of NPK fertilizers was on par with the above. Bio-fertilizers were not effective in influencing the juice quality.

The nutrient concentration in the plant tissue and the uptake of these major nutrients by the crop were favourably influenced by the combined use of poultry manure and fertilizers. Higher values were recorded with this treatment. The other organic sources *i.e.* VC and FYM were less effective when compared to PM. Substitution of fertilizers through bio-fertilizers appeared to be less effective and not to any advantage. The results of the present investigations are in close agreement with the findings of Arbad *et al.*, (2008).

Based on the data on grain and stover yield, quality of juice and nutrient uptake, it is evident that integrated use of PM and fertilizers to supply the required plant nutrients to sweet sorghum is a good practice compared to total dependence on fertilizers alone.

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## INTEGRATED APPROACH FOR WEED CONTROL IN RABI GROUNDNUT (*Arachis Hypogaea L*)

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Groundnut (*Arachis hypogaea L.*) is an important oil seed crop of Andhra Pradesh, which has low productivity and high cost of production. Area, production and productivity of groundnut during *rabi* in India were 6.41 Mha, 9.18 MT, and 1432 kg ha<sup>-1</sup> during 2008. In Andhra Pradesh, the area, production, and productivity of groundnut were 2.64 Mha, 5.07 MT and 1921 kg ha<sup>-1</sup> respectively (Department of Agriculture, AP, 2008-2009). Weed infestation is considered as one of the major factors in *rabi* groundnut production. Weed interference resulted in yield losses ranging between 74 and 92 percent (Agostinho *et al.*, 2006). Critical period of crop weed competition for groundnut crop was reported to be upto 45 DAS and weed free environment during this period registered higher pod yield (Rao, 2000). Usually, in groundnut, weeds are controlled by physical methods and these cannot be used at all times and all stages of crop growth. Further, the labour availability for weeding is scarce and expensive. Use of pre and post emergence herbicides is the best alternative for weed control at critical periods. Combination of physical and chemical methods by use of post emergence herbicides like Imazethapyr or Quizalofop-p-ethyl (Bhatt *et al.*, 2008) were suggested for controlling weeds effectively at later stages of crop growth and maintenance of weed free environment at critical stage of crop growth (Sailaja *et al.*, 2002). Therefore field experiment was initiated to find out an effective and economical integrated weed management practice in *rabi* groundnut.

Field experiment was conducted at College Farm, Rajendranagar of Acharya N.G. Ranga Agricultural University. The soil was sandy loam (Available N, P and K 252.9, 28.6 and 223 kg ha<sup>-1</sup> respectively) with slightly alkaline reaction. The experiment was laid out in randomized block design with 12 treatments replicated thrice. The N, P<sub>2</sub>O<sub>5</sub> and

K<sub>2</sub>O @ 30, 40 and 50 kg ha<sup>-1</sup> were applied as basal through urea, single superphosphate and muriate of potash respectively. The groundnut cv. K 134 (Vemana) was sown at a spacing of 22.5 cm X 10 cm on 16<sup>th</sup> November 2008. Pre emergence herbicide pendimethalin was applied on second day after sowing and post emergence herbicides were applied at 20 DAS. Weed flora of the experimental field consisted of grasses, sedges and broadleaved weeds.

Among the weed control treatments, significantly lesser number of weeds were recorded at harvest in treatments of handweeding twice (T<sub>2</sub>), Quizalofop-p-ethyl fb handweeding at 40 DAS (T<sub>12</sub>), pendimethalin fb handweeding at 40 DAS (T<sub>10</sub>), intercultivation with star weeder fb handweeding at 40 DAS (T<sub>4</sub>) and imazethapyr fb handweeding at 40 DAS (T<sub>11</sub>) (54 m<sup>-2</sup>, 55 m<sup>-2</sup>, 59 m<sup>-2</sup>, 60 m<sup>-2</sup>, 62 m<sup>-2</sup> respectively). Pendimethalin fb imazethapyr (T<sub>8</sub>) recorded higher weed density of 145 m<sup>-2</sup> (Table 1). Unweeded check recorded highest total weed density (T<sub>1</sub>) (353 m<sup>-2</sup>). Lower weed drymatter was obtained under T<sub>2</sub>, T<sub>4</sub>, T<sub>10</sub>, T<sub>11</sub>, T<sub>12</sub> and T<sub>8</sub> treatments (33, 35, 36, 38, 40 and 51 g m<sup>-2</sup> respectively) and weed control efficiency (WCE) also exhibited the same trend (85.5%, 84.1%, 83.2%, 83.2%, 81.3% and 76.1%). The weed index was very low under treatments T<sub>4</sub>, T<sub>8</sub>, T<sub>10</sub> and T<sub>11</sub> due to application of pre-emergence herbicide which might have reduced the broad leaved weeds and certain grasses at early stage of crop growth (20 DAS). At 40 DAS, effective control of grasses, sedges and broad leaved weeds was noticed with hand weeding, intercultural operations and post emergence application of herbicides. Imazethapyr acts by inhibiting the enzyme (AHAS) activity and causes the disruption of protein synthesis and other subsequent bio-chemical reactions, which in turn inhibits the plant growth. These findings are in agreement with the results of Sasikala *et al.* (2002), Chandrika, (2004). Highest pod and haulm yields were





obtained with the treatment hand weeding twice ( $T_2$ ). The other treatments that recorded more or less similar yields include intercultivation fb handweeding ( $T_4$ ), pendimethalin fb imazethapyr ( $T_8$ ), pendimethalin fb handweeding ( $T_{10}$ ) and imazethapyr fb handweeding ( $T_{11}$ ). It is evident from these results, while the effect of pre-emergence pendimethalin is as good as that of initial handweeding, with the effect of early post emergence use of imazethapyr is similar to that of second handweeding. Lower pod and haulm yields were recorded with unweeded control, due to heavy weed infestation which had adverse effect on crop growth and development. Similar results were obtained by Sailaja *et al.* (2002) and Walia *et al.* (2007).

Highest N, P and K uptake by weeds was observed when no weeding ( $T_1$ ) was practiced in the crop (Table 2). The lowest nutrient (N, P and K) uptake by weeds and highest uptake of N, P and K (84.1, 19.7 and 43.6 kg ha<sup>-1</sup>, respectively) by crop was observed when hand weeding was practiced at 20 and 40 DAS ( $T_2$ ). The nutrient status of soil (N, P and K) after crop harvest was comparatively lower in the treatments where removal by crop was higher. The benefit-cost ratio was higher with application of pendimethalin fb imazethapyr as well as pendimethalin fb handweeding treatments (Table 2). This was due to low cost of the chemicals as compared to other practices. The study indicated the need for integrated approaches such as combination of pre and post emergence herbicides or herbicides followed by physical weed control practices to check the weed growth during crop growth period and to reduce weed competition for nutrients and to realize higher yields and economic returns.

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## STUDIES ON EFFECT OF ORGANIC AGRICULTURAL INPUTS ON SOIL NUTRIENT AVAILABILITY AND PLANT DEVELOPMENT IN GREEN GRAM (*Phaseolus aureus* Wilczek)

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In the present investigation, the problem of low productivity in green gram has been sought to be improved by the use of organic agricultural inputs certified as "agri inputs" (www.Prathista.com). These agri inputs, which have been recently introduced into market, show high bio availability and readily absorbable nature as compared to inorganic fertilizers. Hence, the present investigation has been taken up, to evaluate the effect of agri inputs on soil nutrient availability, crop development and productivity.

Pot culture study was taken up in the College of Agriculture, Rajendranagar, during *kharif* 2009. Organic agricultural inputs viz., Bio-PhosG and Bio-PotashG granules @ 75 Kg ha<sup>-1</sup> along with Bio-ZincG @ 12.5 kg ha<sup>-1</sup> + FYM @ 5 t ha<sup>-1</sup> were added to pots as given in table 1. Nitrogen basal dose was applied as urea @ 20 kg ha<sup>-1</sup>. Treatments with twelve pots each were maintained, with three replications. WGG-37 greengram variety was selected for the study. Effect of organic inputs was quantified in terms of OC (Walkley and Black, 1934) SPAD chlorophyll content and number of effective nodules. N, P, K and Zn were estimated in soil following standard procedures. Data recorded was analyzed in two factorial randomized block design. Seed yield and its regression on soil nutrient content, was calculated following Gomez and Gomez (1984).

Soil organic carbon estimated after harvest of crop increased significantly (Table 1). The highest mean organic carbon content of 1.44% was recorded in treatment (20N-40P-20K) where K was applied through Bio-Potash followed by the treatment where P, K and Zn were applied through organic inputs which recorded 1.33%. Inorganic fertilizer application resulted in lower value (1.00%) and was on par with control (1.06%). The mean organic carbon content increased from 30 to 45 days and then decreased at

60<sup>th</sup> day after sowing. In any case the soil organic carbon content can be rated as high as per soil test data values of >0.75% (Prasad Rao and Bhupal Raj, 2001). M/S Prathista products Bio-PhosG, Bio-PotashG, Bio-ZincG themselves contain 3.24, 3.98 and 4.42% OC respectively improved soil OC. Improvement in OC content was recorded also upon application of urban garbage compost (Poornesh *et al.*, 2004).

Application of inorganic fertilizers alone and along with organic agricultural inputs improved the soil N. The interaction between treatments and DAS was also found significant (Table 1). The highest soil available nitrogen (179.17 kg ha<sup>-1</sup>) was recorded where 20N-40P-20K were applied through inorganic fertilizers, followed by the treatment, where K was substituted by Bio-PotashG (151.43 kg ha<sup>-1</sup>) and the lowest (82.22 kg ha<sup>-1</sup>) was recorded in control. With increase in days after sowing from 30 to 60 there was decrease in soil available nitrogen from 152.09 to 137.27 kg ha<sup>-1</sup>. Use of Bio-PhosG improved the soil N when used in combination, as Bio-PhosG contains 3.5 to 4% ammonical N readily available to crops and hence most effective than inorganic salts applied alone (Prathista.com). The N value reported were in the low range for soils of <280 kg ha<sup>-1</sup> (Prasad Rao and Bhupal Raj, 2001). Similar improvement in N availability in soil was reported by the application of fertilizers in combination with vermin compost (Rajkhowa *et al.*, 2003) and enhanced availability of N,P,K and S with the application of FYM 10 t ha<sup>-1</sup> + 50% recommended dose of N (Dikshit and Khatic, 2002).

From 30 to 60 DAS there was decrease in soil available phosphorous from 133.02 to 91.29 kg ha<sup>-1</sup> though, treatment where BioPhosG alone was used as organic source, maximum of 127 kg ha<sup>-1</sup> P was recorded. Fertilizer x DAS interaction revealed a

maximum of 165.91 P at 30 DAS. The P values reported were in high range of  $>560 \text{ kg ha}^{-1}$  (Prasad Rao and Bhupal Raj, 2001). To make P, more available, phosphate solubilising and P mobilizing strains are generally recommended. The concepts are not well picked up because of lack of shelf life of such formulations. Hence, Bio-PhosG has been a choice fertilizer.

The availability of soil potash was influenced with the organic inputs used. Bio-Phos alone or in combination with Bio-PotashG +Bio-ZincG resulted in higher K in soil and plant. The highest available potassium ( $531.13 \text{ kg ha}^{-1}$ ) was recorded by the treatment where N, P, K and  $\text{ZnSO}_4$  were applied through inorganic fertilizers followed by the treatment where P was substituted by Bio-PhosG  $523.01 \text{ kg ha}^{-1}$ . Lowest K content was recorded control ( $336.81 \text{ kg ha}^{-1}$ ). K content in soil increased from 30 to 45 DAS ( $379.53$  to  $553.43 \text{ kg ha}^{-1}$ ) and later on decreased from 45 to 60 DAS ( $553.43$  to  $508.00 \text{ kg ha}^{-1}$ ). Interaction effect revealed a maximum soil K of  $576.50 \text{ kg ha}^{-1}$  at 30 DAS. The K values reported in soil were in high range of  $>288 \text{ kg ha}^{-1}$  (Prasad Rao and Bhupal Raj, 2001). In other studies, use of peanut cake registered maximum organic C, Bray-P and exchangeable K (Rutherford and Juma, 1992).

The highest available zinc (9.40 ppm) was recorded with addition of inorganic N, P and K fertilizers followed by the treatment where inorganic Zinc sulphate @  $5 \text{ kg ha}^{-1}$  was supplemented (6.31 ppm). Lowest value was recorded in control (1.78 ppm). P-Zn interaction and their antagonism are well known in soil and plant systems. The products of Prathista namely Bio -Potash and Bio-Zinc contain glucose as carrier material which helps the crops to absorb potash and zinc and also simultaneously improve soil microflora due to its organic nature. Soil preconditioned with glucose humic acid and cellulose has been reported to shift the microbial eco-physiology community structure, biomass, substrate induced respiration and ATP content. (Dilly *et al.*, 2004). Interaction effect recorded a maximum soil Zn of  $17.49 \text{ ppm}$  at 30 DAS.

Agri inputs influenced plant parameters equally as soil. Significant variation in SPAD chlorophyll content of leaves was observed among different treatments. Addition of fertilizers either inorganic or

organic increased the SPAD value. Among the treatments where N,P,K and Zn were supplied through inorganics recorded the highest SPAD value (41.14) and was on par (40.24) with treatment where P and Zn were applied through organic source (table 2). The chlorophyll content increased from 30 to 45 DAS (36.27 to 44.2) and there after decreased. The decrease in SPAD units was correlated with the decrease in leaf area noticed at 60 DAS. The maximum chlorophyll values coincided with the maximum leaf area present in the plants. Maximum SPAD values of 47.01 TO 47.05 with fertilizer application as inorganics or substituted as BiophosG + BiopotashG.

The effective of root nodules number increased from 30 to 45 DAS. The mean increase was from 5.25 to 8.12. The highest number of effective nodules (12.0) was recorded in the treatment where P, K and Zn were substituted by organic sources (table 2) and was followed by the treatment where Zn was substituted by Bio-ZincG (9.03) and N, P, K were supplied through fertilizers.

Significant variation was noticed because of treatments on yield attributing characters and seed yield. The mean pod number varied from 3.66 to 10.23. Treatment with phosphorous application as Bio-PhosG, recorded the maximum pods. Similar to pod number, mean seed number per pod varied significantly among different treatments. Treatment which included P and K application through Bio-PhosG and Bio-PotashG recorded highest number of seeds per pod (10.64). The highest 100 seed weight (4.76 g) was recorded by the treatments where P and K were supplied through Bio-PhosG and Bio-PotashG . Mean maximum pod length (7.40 cm) was recorded where P, K and Zn were applied through organic inputs. The mean seed yield per pot varied significantly among different treatments. The highest seed yield ( $1425.6 \text{ kg ha}^{-1}$ ) was recorded by the treatment as with 100 seed weight in treatments where P and K were supplied through Bio-PhosG and Bio-Potash G (table 2).

Multiple linear regression (MLR) equation was fitted for seed yield on the nutrient uptake at 30, 45 and 60 DAS. The coefficient of regression equation and the corresponding t values, Multiple Coefficient Correlation (R) and  $r^2$  values are presented in Table

3. The over all regression was found to be significant at 1% level. The Multiple co-efficient of correlation was found highly significant at all the days of observation. R value at 30, 45 and 60 DAS explained the variation to an extent of 75, 67 and 41% respectively. At 30 DAS two nutrients i.e Bio-Potash and Bio-ZincG showed significant correlation. At 45 DAS two other nutrients N and Bio-PhosG affected the seed yield. At 60 DAS Zinc alone influenced the seed yield. The favourable effect of use of organic products can be explained by the presence of aminoacids, amino nitrogen (chelated proteins) in Bio-PhosG, glucose in Bio-PotashG which makes the input readily available to roots and bioavailable to plants, besides improvement in the soil microflora due to their intrinsic organic properties. Farm productivity improved substantially because of zinc application as Bio-ZincG contained 50-52% organic zinc with 6-7% bioavailable zinc. High yields in green gram were obtained with the use of organic sources vermicompost also reported in greengram by Rajkhowa *et al.*, (2003) and in blackgram by Vasanthi and Subramanian (2004).

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**Table 2. Effect of Organic Agricultural Inputs on plant physiological and yield parameters**

Treatments	SPAD chlorophyll content				Effective nodules			Pods / plant	Seed s per pod	100 seed weight (g)	Pod length (cm)	Seed yield kg ha <sup>-1</sup>
	30	45	60	Mean	30	45	Mean					
T1	34.95	39.60	26.06	33.53	2.00	4.00	3.00	3.66	6.01	2.59	4.04	297.1
T2	35.58	47.50	23.06	35.38	2.33	6.00	4.16	4.30	8.64	4.34	6.48	771.2
T3	36.38	46.60	28.86	37.28	3.00	6.33	4.66	10.23	7.64	2.99	6.55	501.6
T4	37.33	43.31	20.83	33.82	4.66	7.33	6.00	8.62	8.64	4.39	6.52	1343.1
T5	33.71	47.01	31.93	37.55	5.66	8.00	6.89	8.11	10.64	4.76	6.45	1425.6
T6	41.11	45.85	36.46	41.14	5.33	8.66	7.00	8.40	10.00	3.58	7.32	1138.5
T7	34.46	37.80	28.80	33.75	8.33	11.33	9.03	7.10	10.61	3.03	6.87	1141.8
T8	34.46	45.96	30.30	40.24	10.66	13.33	12.00	8.82	7.65	3.50	7.40	1026.3
Mean	36.27	44.20	29.29		5.25	8.12		7.41	8.73	3.65	6.45	
			SE±	CD5 %		SE±	CD5 %	SE±	SE±	SE±	SE±	SE±
F			0.470	0.941		0.411	0.823	1.457	1.040	0.492	0.661	9.07
DAS			0.287	0.576		0.205	0.411	<b>CD 5%</b>	<b>CD 5%</b>	<b>CD 5%</b>	<b>CD 5%</b>	<b>CD 5%</b>
F XDAS			0.814	1.631		0.501	1.165	0.231	0.032	0.036	0.043	23.8

**Table 3. Regression between yield and nutrient uptake**

	Intercept (bo)	b1 (N)	b2 (P <sub>2</sub> O <sub>5</sub> )	b3 (K <sub>2</sub> O)	b4 (Zn)	R	r <sup>2</sup>
30 DAS coefficients	0.15	46.14	7.15	-14.57**	1.44**	0.87**	0.75
t value	0.38	5.07	0.26	-3.91	3.94		
45DAS coefficients	0.74	22.56*	8.11*	-5.29	0.22**	0.81**	0.67
t value	1.61	4.66	0.80	-3.83	0.15		
60 DAS coefficients	-3.71	-1.70	-34.20	6.95	5.40*	0.64*	0.41
t value	-1.76	-0.30	-1.59	2.84	2.89		

## INTEGRATED NITROGEN MANAGEMENT IN AEROBIC RICE (*Oryza sativa* L.)

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Aerobic rice is a contemporary concept of growing rice with reduced water requirements where fields remain unsaturated throughout the season like an upland irrigated crop. Nitrogen is an essential component of any fertilizer management programme and particularly it is more so, for the rice crop. The interaction of chemical fertilizers with the soil is considered less favourable to the soil environment in comparison with organic sources of nutrients. Therefore the need for supplementary and cheaper organic sources of nitrogen is recognized. Organic manures like farm yard manure and green leaf manure would play an important role in crop nutrition and soil fertility in association with chemical fertilizers. Hence, the present study involving different combinations of N to find out its influence on aerobic rice was undertaken.

A field experiment was conducted at the wetland farm of S.V. Agricultural College, Tirupati during late *rabi*, 2008-09 to study the effect of supplementation of nitrogen through organic sources on aerobic rice. The pre-germinated seeds were sown during 13<sup>th</sup> of November, 2008 and harvested in 7<sup>th</sup> April of 2010. The recorded rainfall was 373.3 mm in 12 rainy days and total number of irrigations given was 32. The soil of the experimental site was sandy clay loam in texture, slightly alkaline  $P^H(8.1)$ , medium in available nitrogen ( $214 \text{ kg ha}^{-1}$ ), available phosphorus ( $21.9 \text{ kg ha}^{-1}$ ) and available potassium ( $130 \text{ kg ha}^{-1}$ ). The experiment was laid out in a randomized block design replicated thrice with ten treatments comprising two organic sources of nitrogen namely Farm Yard Manure (FYM) and Neem Leaf Manure (NLM) to supplement 25, 50, 75 and 100% of recommended dose of nitrogen ( $65, 130, 195$  and  $260 \text{ kg N ha}^{-1}$ ) in comparison with 100% N through urea and control i.e. no nitrogen. The organic sources of N were incorporated 15 days before sowing of rice. Nitrogen content in different organic manures was taken into consideration to adjust the quantities of

different organic sources to supply nitrogen on equal nitrogen basis as with urea. Nitrogen content of different organics used *viz.*, farm yard manure and Neem Leaf Manure were 0.67 and 0.50 per cent, respectively. The test variety was NLR -145. Pre-germinated seeds were sown @ two seeds per hill at  $15 \times 10 \text{ cm}$  spacing.

It was found that the different organic and inorganic sources of nitrogen significantly influenced the yield attributes, yield and quality of aerobic rice where in the effective tillers  $\text{m}^{-2}$ , total grains panicle<sup>-1</sup>, test weight, grain and straw yields of aerobic rice were higher with the 100% N through fertilizer but comparable with those under 25% substitution either with FYM or NLM (Table 1). The lowest values were recorded with no nitrogen. Increased availability of nitrogen with these treatments would have coincided with the peak nitrogen demand of crop growth stages (basal, active tillering, panicle initiation and heading) due to which more effective tillers were produced. Better vegetative growth resulted in efficient dry matter accumulation and effective partitioning to the panicle resulted in more number of total and filled grains panicle<sup>-1</sup>, test weight as well as grain and straw yields. The present investigation corroborates the findings of Bandyopadhyay and Puste (2002) and Surendra Singh *et al.* (2006).

Higher values of milling per cent and head rice recovery were associated with 100% N through fertilizer, which were on par with those of 25% N through FYM + 75% fertilizer N, and 25% N through NLM + 75% fertilizer N and these were significantly superior to rest of the treatments (Table 1). Though the milling and nutritional characters are genotype dependent, they can be altered to a marginal extent by management practices. This might be due to the fact that higher nutrient availability from 100 per cent N through fertilizer, and organic manures in combination with higher inorganic sources resulted in perfect grain filling process without air vacuoles.

Kernel length and kernel breadth did not vary to an appreciable extent due to different nitrogen management practices.

The highest protein and amylose content were registered with 100% N through fertilizer, which was comparable with the other N management treatments. Protein content is dependent on N content of grain thereby increased the protein synthesis under adequate supply of nitrogen.

The present study on integrated nitrogen management in aerobic rice revealed that supply of 100% N through fertilizer urea, or conjunctive use of 75% recommended N through fertilizer and 25% N through either Farm Yard Manure or Neem Leaf Manure is required for better yield attributes, grain and straw yields and quality characters of aerobic rice.

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## STRESS OF PROFESSRS WORKING IN ANGRAU, RAJENDRANAGAR, HYDERABAD.

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All of us rich and poor, young and old, big and small - are experiencing one or the other kind of stress. Teaching is identified as a particularly stressful occupation. Some aspects of the job such as disciplinary problems, student apathy, over crowded class rooms, involuntary transfers, excessive paperwork, inadequate salaries and lack of administrative support are among the stressors that confront teachers. Teachers in the cadre of the Professor may be having more stress because of lot of work & responsibilities it may lead to lower job satisfaction. Keeping this in view the present research was undertaken to compare the level of stress among the professors of College of the Agriculture, Rajendranagar, Hydearabad.

Out of 90 samples selected, 30 Professors returned the filled up questionnaire and these were taken for this study. Ex-post facto research design was used for the study. The collected information

was processed and tabulated. Appropriate statistical tools were used for interpreting the data.

Table 1 reveals that 70 percent of the respondent professors (teachers) belonged to old age group of 56 years and above. Ninety per cent of Professors belonged to nuclear family. It was found that 73.3 per cent of the respondents had annual income ranging from Rs 4.01 to 6.00 lakhs while the remaining members earned more than Rs. 6.01 lakhs. Majority of the respondents (46.67%) had medium teaching experience Whereas 26.67 per cent of the respondents received less training and 23.38 per cent received high training. Majority (60.0%) of them had medium achievement motivation. In case of merits and awards, 26.6 per cent of Professors had awards at ICAR level followed by National level (13.3%), university level (96.6%), state level (6.6%) and other awards (6.6%). (Annapurna, R.P., 1998).

**Table 1. Profile of Professors of ANGRAU**

S.No.	Profile	Frequency	Percentage
<b>1.</b>	<b>Age</b>		
	Young Age	-	-
	Middle Age	9	30.0
	Old Age	21	70.0
<b>2.</b>	<b>Sex</b>		
	Male	30	100.0
	Female	-	-
<b>3,</b>	<b>Educational Qualification</b>		
	M.Sc	-	-
	Ph.D	30	100.0
<b>4.</b>	<b>Family Type</b>		
	Joint Family	3	10.0
	Nuclear Family	27	90.0
<b>5.</b>	<b>Monthly Income</b>		
	Between		
	15000- 22000	-	-
	22001- 2 9000	-	-
	29001-36000	30	100.0

S.No.	Profile	Frequency	Percentage
<b>6.</b>	<b>Annual Income</b>		
	2.00-4.00 lakhs	-	-
	4.01-6.00 lakhs	22	73.33
	6.01 lakhs & above	8	26.67
<b>7.</b>	<b>Experience in Teaching</b> (years)		
	Low «9)	7	23.33
	Medium (9-18)	14	46.7
	High (18-27)	9	30.0
<b>8.</b>	<b>Training Received</b>	-	-
	Low Training	8	26.67
	Medium Training exposure	15	50.0
	High Training exposure	7	23.33
<b>9.</b>	<b>Achievement Motivation</b>		
	Low A.M	-	-
	Medium A.M	18	60.0
	High A.M	12	40.0
<b>10.</b>	<b>Merits &amp; Awards</b>		
	University level	2	6.67
	State level	2	6.67
	ICAR level	8	26.67
	National level	4	13.33
	Any other	2	6.67
	None	12	40.00

Family Income of respondents was found to have negative significant correlation with personal stress ( $r=0.3694$ ) at 5 per cent level. Similar shown negative and significant relation was also noticed with

family stress ( $r=0.3787$ ) at 5 per cent level. Job stress was negatively and strongly correlated with experience and training received. Overall stress was strongly and negatively related with experience.

**Table 2. Relationship between stress of Professors in the College of Agriculture and Independent variable**

S.No	Independent variables	Personal stress	Family stress	Job stress	Overall stress
1.	Age	0.1035	0.0853	-0.1300	-0.0805
2.	Family size	-0.0604	-0.1188	-0.0257	-0.0938
3.	Family income	- 0.3694*	-0.3787*	-0.0258	-0.3294
4.	Experience	-0.0590	-0.1256	-0.6765**	-0.4528**
5.	Training received	-0.2014	-0.1324	-0.6476**	-0.5203**
6.	Achievement motivation	-0.0173	-0.1260	-0.0149	-0.0752
7.	Merits and Awards	-0.1748	-0.0107	-0.3092	-0.2818

● Significant at (0.05%) ( $r > 0.361$ ) \*\* Significant at (0.01 %) ( $r > 0.463$ )

Majority of Professors (73.3%) were categorized as medium with reference to overall stress.

**Table 3. Distribution of the respondents based on Overall stress.**

S.No	Overall stress	Frequency	Percentage
1.	Low	5	16.67
2.	Medium	22	73.33
3.	High	3	10.0

## **ENTERPRISES TAKEN UP BY THE WOMEN ENTREPRENEURS IN RANGA REDDY, CHITTOOR AND GUNTUR DISTRICT OF ANDHRA PRADESH**

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A study on planning, production and marketing dimensions in women led enterprises in Andhra Pradesh was made in three districts of A.P. namely, Ranga Reddy, Guntur and Chittoor. The entrepreneurs were selected based on PPs sample of sixty nine (69) from Ranga Reddy, forty four (44) from Guntur and thirty seven (37) from Chittoor. Thus a total of 150 entrepreneurs were selected for the study. An open ended schedule was developed to know the different enterprises taken up by the women entrepreneurs.

Then, frequencies and percentages of each enterprise were calculated. The enterprises were categorized into thirteen types (Table 1).

Majority (22.67%) of the women entrepreneurs undertook food enterprise like swagraha foods, sauces, extruded products, sweet shops, canteens etc., as the field is very familiar to them, hence they have more confidence in running the enterprise and it has high market potential. All these factors contributed for it to be highly chosen enterprise by women entrepreneurs. Apparel enterprises namely; garment making, tailoring, muggam work, patch work, boutiques etc., was selected as second best (21.33 %) by the women entrepreneurs. The reason might be that the entrepreneurs considered apparel as most prosperous enterprise always with a scope of development and more demands during festive and marriage seasons.

The other enterprises preferred were agarbatti making (10.00 %), beauty parlour (10.00%), paper plate making (7.33 %), paper bag making (6.67%), paper cup making (5.33 %), phenyl making (4.67 %), cloth bag making (3.33%), leather bag making (3.33%), and plaster of paris doll making (3.33%). Footwear production (1.33%) and printing press (0.67%) enterprises were selected by less number of entrepreneurs. This might be due to the reason that foot wear enterprise had more competitors in the market, whereas printing press needs high investment and more skill.

The reasons perceived by the women entrepreneurs for selecting the enterprises were categorized as individual, family and enterprise related. Among food entrepreneurs, majority (88.24%) of them selected the enterprise to gain recognition, importance and social status and other important factors include, by interest and success of other women entrepreneurs. The important family related reasons include financial stability to children and supplementation of family income. High market demand and proximity to market were the important enterprise related reasons.

Self interest, zeal to exploit innate talents and potentials in the profession, supplementation of family income, need to ensure financial stability to children and high market demand of the product were the factors that motivated women towards apparel enterprise .

The agarbatti making entrepreneurs perceived ample leisure time and to do something creative as major individual related reasons. Supplementing family income and poor financial conditions of the family were the important family related reasons. Possession of needed skill and high market demand of the product were the most favourable enterprise based factors.

The same factors that favored women to adopt agarbatti making were also found to be equally important with beauty parlour enterprise.

Self interest, success of other women entrepreneurs and to gain recognition were the most favoured individual related reasons. Supplementation of family income and ensuring financial stability to children were the important family related reasons to select paper plate, paper bag and paper cup making entrepreneurs. Eco-friendly nature of the product and uniqueness were the major enterprise related reasons were motivating factors for paper bag and paper cup entrepreneurs.

*ENTERPRISES TAKEN UP BY THE WOMEN ENTREPRENEURS IN RANGA REDDY*

Self interest, success of other entrepreneurs, financial stability to children, poor financial conditions of the family and to supplement family income, needed skill in the enterprise, nearness to market

were the individual, family and enterprise related reasons were the motivating factors commonly found among phenyl, cloth bag, leather bag making, plaster of paris, footwear and printing press entrepreneurs.

**Table 1. Enterprises taken up by the women entrepreneurs n=150**

<b>S.No.</b>	<b>Enterprise</b>	<b>Frequency</b>	<b>Percentage</b>
1.	Food	34	22.67
2.	Apparel	32	21.33
3.	Agarbatti Making	15	10.00
4.	Beauty parlour	15	10.00
5.	Paper plate Making	11	7.33
6.	Paper bag Making	10	6.67
7.	Paper cup Making	8	5.33
8.	Phenyl Making	7	4.67
9.	Cloth bag Making	5	3.33
10.	Leather bag Making	5	3.33
11.	Plaster of Paris doll Making	5	3.33
12.	Footwear Production	2	1.33
13.	Printing Press	1	0.67
	<b>Total</b>	<b>150</b>	<b>100.00</b>







## STRESS OF ASSISTANT PROFESSORS IN ANGRAU, RAJENDRANAGAR, HYDERABAD

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The teachers were assumed to be under a constant stress due to their multiple roles. Keeping this in view the present research was undertaken to compare the level of stress among the assistant professors of College of the Agriculture, Rajendranagar, Hyderabad.

Only 22 Assistant Professors returned the filled up questionnaire out of 90 persons contacted and these were taken for this study. Ex-post facto research design was used for the study. The collected information was processed and tabulated.

Among the respondent Assistant Professors, majority (86.3%) belonged to middle age group of 35 to 55 (table1). Whereas Annual Income 45.4% per cent of respondents ranged from to Rs 4.01 to 6.00 lakhs and 18.11% per cent had above Rs. 6.01 lakhs of annual income. Majority of the respondents (72.7%) had medium teaching experience. Majority of the respondents (63.6%) had low training exposure Majority (68.19%) of respondents had medium achievement motivation. Incase of merits and awards, majority (27.2%) had ICAR level awards followed by National level (18.19%), University level (4.54%).(Achamamaba and Kumar 1993).

**Table 1. Profile of the respondent Assistant Professors**

S.No	Profile	Frequency	Percentage
1.	<b>Age</b>		
	Young Age	2	09.1
	Middle Age	19	86.3
	Old Age	1	04.5
2.	<b>Sex</b>		
	Male	16	72.7
	Female	6	27.2
3.	<b>Educational Qualification</b>		
	M.Sc	7	31.8
	Ph.D	15	68.1
4.	<b>Family Type</b>		
	Joint Family	2	9.1
	Nuclear Family	20	90.9
5.	<b>Monthly Income</b>		
	Between		
	15000- 22000	7	31.8
	22001- 29000	10	45.4
	29001-36000	5	22.7
6.	<b>Annual Income</b>		
	2.00-4.00 lakhs	8	36.3
	4.01-6.00 lakhs	10	45.4
	6.01 lakhs & above	4	18.1

S.No	Profile	Frequency	Percentage
6.	<b>Annual Income</b>		
	2.00-4.00 lakhs	8	36.3
	4.01-6.00 lakhs	10	45.4
	6.01 lakhs & above	4	18.1
7.	<b>Experience in Teaching</b>		
	(years)		
	Low «9)	6	27.2
	Medium (9-18)	16	72.7
	High (18-27)	-	-
8.	<b>Training Received</b>		
	Low Training	14	63.6
	Medium Training exposure	8	36.3
	High Training exposure	-	-
9.	<b>Achievement Motivation</b>		
	Low AM	-	-
	Medium AM	15	68.1
	High AM	7	31.8
10.	<b>Merits &amp; Awards</b>		
	University level	1	4.5
	State level	1	4.5
	ICAR level	6	27.2
	National level	4	18.1
	Any other	-	-
	None	10	45.4

From the above table-1 amount Assistant Professor majority (34%) of the respondents belonged to middle age group followed by young age group (9.10%) and old age (4.55%) groups. where as Annual Income of the respondents (45.45%) belonged to Rs. 4.01 to 6.00 lakhs followed by (36.36%) Rs. 2.00 - 4.00 lakhs and (18.18%) above Rs. 6.01 lakhs. Coming to experience in teaching majority of respondents (72.78%) had medium teaching experience followed by low (27.22%). Where as Training received majority of the respondents (63.63%) of them had low training exposure followed by medium (36.37%). In Achievement motivation

majority(68.19%) of them had medium achievement motivation followed by high (31.81%). In case of merits and awards majorities (20.00%) of had at ICAR level followed by National level (18.19%), University level (4.54%), State level (4.54%). (Annapurna, 1989).

Personal stress was negatively and significantly correlated with training received ( $r=-0.4370$ ). Family stress was positively correlated with experience in teaching ( $r=0.4980$ ). Experience of the assistant professors in teaching ( $r=-0.4176$ ) and training received ( $r=-0.5141$ ) have shown negative and significant influence on job stress (Rayal and Singh 1996).

**Table2. Relationship between Stress of Assistant Professors in ANGRAU and Independent variables**

S.No.	Independent variables	Personal stress	Family stress	Job stress stress	Overall
1.	Age	-0.0142	0.2658	-0.1650	-0.0671
2.	Monthly income	0.1454	-0.0380	0.0113	-0.0506
3.	Education	0.1587	-0.0292	0.1813	0.1926
4.	Family size	0.0056	-0.1891	0.7318	0.0576
5.	Family income	-0.0904	-0.2780	-0.0729	-0.1575
6.	Experience	0.3245	0.4980*	-0.4176*	-0.0765
7.	Training received	-0.4370*	-0.1362	-0.5141*	-0.5950**
8.	Ach. Motivation	-0.2263	-0.0659	-0.1172	-0.1921
9.	Merits and Awards	-0.0407	-0.2872	-0.0861	-0.1524

\* Significant at (0.05%) ( $r > 0.413$ )

\*\* Significant at (0.01) ( $r > 0.526$ )

Overall stress was found to be negatively correlated with training received

Majority of the respondent Assistant Professors (59.9%) were categorized as with reference to medium overall stress.

**Table3. Distribution of Respondents based on Overall Stress**

S.No	Overall stress	Frequency	Percentage
1.	Low	6	27.27
2.	Medium	13	59.09
3.	High	13	13.63

## MANAGEMENT OF *CHROZOPHORA ROTTLEI* IN CHICKPEA (*Cicer arietinum L*)

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*Chrozophora rottleri* is commonly called as *suryavathi* or *lingamirapa* or *erramiriyamu*, it is an erect annual broad leaf weed in uplands and rice fallows, blossoms profusely from January to April. Plant has silky hairs, lower part of the stem is naked and upper part is hairy. It has slender tap root, leaves densely hairy on both sides. In recent years the chickpea crop became popular in upland areas of kurnool, Guntur and Praksam districts of Andhra Pradesh due to crop holiday to tobacco. Chickpea grown as winter crop, at the same time *Chrozophora rottleri* is also associated with this crop. Manual removing is very difficult due to its hairyness which causes the allergy to labour, hence the present investigation was conducted to manage the *Chrozophora rottleri* in chickpea by adopting suitable weed management practices under upland situation.

The experiment was laid out at RARS, Lam, Guntur during rabi 2006-07, 2007-08 & 2008-09. After thorough preparation of land the treated chickpea seed was line sown by adopting the spacing of 30 x 10 cm. The collected seed of *Chrozophora spp* was inoculated in the experimental plots to attain the uniformity in *Chrozophora spp* population. The pre and post emergence herbicide treatments were imposed as per schedule respectively. All the recommended package of practices except weed control were followed in raising the crop. The crop was irrigated at 40 DAS. There were no major pests and diseases during the season but during the initial stage of the crop Spodoptera was noticed and it was corrected by spraying chloripyriphos and indoxcarb.

In the experimental plots, *Chrozophora rottleri* was the dominating weed (> 75%). Besides this weed, grasses (*Echinochloa spp*, *Dinabra spp*, *Panicum spp*, *Sporobolus* and *Cynodon dactylon*), sedges (*Cyperus rotundus*) and broad leaf weeds (*Phyllanthus niruri*, *Aristolochia bracteata*, *Trianthema portulacastrum*, *Portulaca oleratia*, *Digera arvensis*, were also observed but their presence was negligible.

*Chrozophora rottleri* density was recorded at 30, 60 DAS and at harvest and weed dry weight was recorded at harvest. All the integrated treatments significantly reduced the *Chrozophora rottleri* density and dry weight over weedy check at all stages of observation and were on par with hand weeding at 15 and 30 DAS. Among the individual herbicides, post emergence application of imazethapyr 63 gha<sup>-1</sup> applied at 15 DAS was slightly effective and reduced the density of *Chrozophora spp* over weedy check at all stages of observations (Table.1). The pre emergence herbicides pendimethalin, pretilachlor, oxyfluorfen were failed to prevent the germination of *chrozophora spp* and were as good as un weeded check.

Based on the three years study it can be inferred that hand weeding at 15 and 30 DAS reduced density and dry weight of *Chrozophora spp*. The post emergence application of imazethapyr 63 gha<sup>-1</sup> at 15 DAS though reduced density and dry weight of *Chrozophora spp*, it caused 20 % crop injury. Further research is needed in this direction.

**Table 1. Effect of different weed management treatments on the control of *Chrozophora rottlери* in chickpea (mean of 3 years)**

Treatments	Dose ( gha <sup>-1</sup> )	Time of application	Density of <i>Chrozophora spp</i> (No/m <sup>2</sup> )			Dry Weight Of <i>Chrozophora spp</i> (gm <sup>2</sup> ) at harvest	WCE(%) at harvest
			30 DAS	60 DAS	Harvest		
T1-Unweeded Check	-	-	5.8 (34.1)	5.3 (28.9)	5.8 (34.5)	5.6 (31.9)	-
T2-HandWeeding	-	15 &30 DAS	2.5 (6.3)	1.7 (3.4)	1.4 (2.5)	1.0 (1.5)	82
T3-Pendimethalin	1500	3 DAS	4.4 (19.9)	4.4 (19.9)	3.8 (14.9)	4.7 (22.6)	16
T4- Oxyflurofen	100	3 DAS	4.5 (20.8)	3.7 (14.2)	3.6 (13.6)	4.1 (17.3)	27
T5- Pretilachlor	500	3DAS	4.2 (18.1)	3.6 (13.5)	3.3 (11.4)	3.9 (15.7)	31
T6- Imazethapyr	63	15 DAS	3.4 (12.1)	3.5 (12.8)	3.2 (10.7)	3.6 (13.5)	36
T7- T3 f.b HW	1500	3 &30 DAS	2.3 (5.8)	1.7 (3.4)	1.8 (3.6)	1.6 (3.1)	71
T8- T4 fb HW	100	3 &30 DAS	1.8 (3.7)	2.0 (4.5)	1.8 (3.7)	1.5 (2.8)	73
T9- T5 fb HW	500	3 &30 DAS	2.8 (8.3)	2.8 (8.3)	1.5 (2.8)	1.6 (3.2)	71
T10-T6 fb HW	63	15 &30 DAS	2.1 (4.9)	2.0 (4.4)	1.7 (3.3)	1.4 (2.5)	75
CD at 5 %	-	-	1.90	1.85	1.51	2.31	-

Note : DAS: days after sowing Data transformed to "x+0.5 transformation, figures in parentheses are original values

***Abstracts of Theses Accepted for the Award of Post-Graduate and Doctorate Degrees in the Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad - 500 030***

**Phenology of Chickpea (*Cicer arietinum* L.) in terms of thermal times under coastal conditions of Andhra Pradesh**

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Major Advisor: Dr. Y. Ashoka Rani

**Department of Plant Physiology**

The present investigation entitled "Phenology of Chickpea (*Cicer arietinum* L.) in terms of thermal times under coastal conditions of Andhra Pradesh" was undertaken at the Agricultural College Farm, Bapatla during rabi 2007-08. It was found that plant height, number of branches of effective branches, leaf area and leaf area index were significantly influenced by dates of sowing and varieties.

The correlation analysis between yield and phenophase wise heat units revealed that yield of KAK-2 was positively and significantly correlated with GDD and PTU accumulated during podding stage. In JG-11, yield was positively and significantly correlated with the HYTU during flowering and negatively and significantly correlated with GDD, PTU and PYTU accumulated during vegetative stage and also with HYTU accumulated during podding stage. In Annegiri, positive significant correlation with HYTU during flowering and negative significant correlation with HYTU during vegetative stages was observed. The correlation between TDM and phenophasic heat indices indicated that in KAK-2, TDM production correlated negative and significantly with HTU during flowering.

The HUE, PTUE and HTUE were found higher under second DOS than the subsequent sowings and it was higher for JG-11 than KAK-2 and Annegiri.

For each unit of GDD, PTU, HTU and HYTU accumulated the yield of chickpea in terms of both biological and economical was found higher under 18<sup>th</sup> November sowing. From this it can be concluded that the requirement of GDD, PTU, HTU and HYTU for chickpea crop in 2247 °C d, 2871°C d<sup>-1</sup> h<sup>-1</sup>, 11596 °C d<sup>-1</sup> h<sup>-1</sup> and 176244 respectively. The maximum yield of three varieties was obtained under 18<sup>th</sup> November sowing. This indicates that the requirement of GDD, PTU, HTU and HYTU KAK-2 is 2332 °C d, 26441 °C d<sup>-1</sup> h<sup>-1</sup> 12183 °C d<sup>-1</sup> h<sup>-1</sup> and 178857 respectively; for JG-11 2162 °C d 25590 °C d<sup>-1</sup> h<sup>-1</sup>, 11175 °C d<sup>-1</sup> h<sup>-1</sup> and 176916 respectively. Hence, it can be concluded that under coastal conditions of Andhra Pradesh, sowing of chickpea during 3<sup>rd</sup> week of November would give better productivity. JG-11 is more suitable as it is the high yielder. M.Sc (Ag), 2008

**Factors influencing the disease development of purple blotch of onion and effect of certain plant extracts, fungicides and biocontrol agents on the causal organism of the diseases.**

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Major Advisor: Dr. K. V. M. Krishna Murthy

**Department of Plant Pathology**

*Alternaria Porri* (Ellis) Cif. Causing purple blotch diseases on onion was isolated and identified, and the effect of host age, inoculum concentration temperature, relative humidity and light on diseases development, effect of certain plant extracts, bio-control agents and fungicides on spore germination and growth of the casual organism were studied.

Onion plants were found to be susceptible to *Alternaria porri* at different ages. Maximum percent diseased index (PDI) was recorded in 60 days old plans when inoculated artificially. There was an increase in the per cent diseases index (PDI) with increase in the plant age. Maximum per cent diseases index (PDI) of 57.03 was recorded on plant

inoculated with  $10^8$  spores/ml inoculum concentration. There was an increase in the infection of onion by *Alternaria porri* with the increase in the inoculum concentration. The infection of onion by *Alternaria porri* was maximum when inoculated leaves were incubated at 25°C. The infection of onion by *Alternaria porri* was maximum when inoculated leaves were incubated under continuous light (24 h) followed by alternate darkness and light. The infection of onion by *Alternaria porri* was maximum when inoculated leaves were incubated at 95 per cent relative humidity followed by 90 and 100 per cent. The infection of onion by honge (*Pongamia pinnata*) and Kashmir bouquet (*Clerodendron inerme*) were the most effective in inhibiting the mycelia growth and spore germination of *Alternaria porri*, whereas leaf extract of sitaphal (*Annona squamosa*) was found to be less effective. Increase in the inhibition of growth and spore

germination of *Alternaria porri* was observed with increase in the concentration of the plant extracts used.

*Trichoderma viride* was most effective in inhibiting the growth and spore germination of *Alternaria porri*. This was followed by *Trichoderma harzianum*, *Trichoderma koningii*, *Trichoderma resei* and *Pseudomonas Flurecenes*.

All the four fungicides viz., difenonazole, mancozeb, copperoxychloride and chlorothalonil were significantly effective in inhibiting the mycelia growth and spores germination of *Alternaria porri* under *in vitro* conditions.

Difenconazole at 200 ppm, mancozeb at 100 ppm, copper oxychloride and chlorithalonil at 1000 ppm were effective in inhibiting the mycelia growth and spore germination of the *Alternaria porri*. M.Sc (Ag), 2008

### Stability analysis for yield and yield component characters in soybean (*Glycine max (L.) Merrill*)

Student: V. Saida Naik

Major Advisor: Dr. M. V. Ramana

#### Department of Genetics and Plant Breeding

The present study was conducted during Kharif (E1), rabi (E2) and late rabi (E<sub>3</sub>), 2006 at Regional Agricultural Research Station, Lam, Guntur with 12 genotypes of soybean (*Glycine max (L.) Merrill*) over three environments to study the genotypes – environment interaction, variability, heritability and genetic advance, the association between yield and its component traits and direct and indirect effects of different component traits on seed yield per plant.

The analysis of variance revealed significant difference among the genotypes for all the characters studied. The heritability values were high for days to maturity in environment I, II and III, biological yield per plant in environment II and III, seed yield per plant in environment I and II and plant height in environment II and III, whereas expected genetic advance was high for seed yield per plant in environment I and II, biological yield per plant in environment II and III, number of branches per plant in environment I and II.

The analysis of variance (Eberhart & Russell, 1966) revealed that mean sum of squares due to genotypes was significant for all characters except for number of pods per plant, 100 seed weight, protein content (showed significant when tested against pooled

deviation) and harvest index (showed significant when tested against pooled error) when tested against both pooled error and pooled deviation. Genotypes – environment interaction was significant for all the characters studied, except for number of seeds per pod 100 seed weight, protein content, oil content and harvest index when tested against both pooled error and pooled deviation.

The mean sum of squares due to environment was also highly significant for all characters, except number of seeds per pod, 100 seed weight and oil content when tested against pooled error and pooled deviation. The genotypes – environment interaction was non significant for all the characters except for plant height (when tested against both pooled error and pooled deviation). The mean sum of square due to environment (linear) was significant for all the characters except number of seeds per pod, 100 seed weight and oil content when tested against both pooled error and pooled deviation. While genotypes – environment (linear) component on interaction was non significant for all characters except days to 50% flowering, days to maturity and plant height (when tested against both pooled error and pooled deviation). Non linear component of G X E

interaction was significant for all the characters except number of branches per plant, pod length, number of seeds per pod, 100 seed weight, protein content and harvest index.

None of the genotypes showed stable performance for all the characters studied according to

Eberhart and Russell (1966) model. Based on stability parameters L sp 13, MRSB 345, LSb 36 and PK 1029 were found to be stable for days to 50% flowering. While, JS 335, LSb 13, LSb 36 and RKS 18 were found to be stable for day to maturity. M.Sc (Ag), 2008

## Genetic divergence in soybean (*Glycine max* (L.) Merrill) genotypes

Student: Pushpa Reni. Y

Major Advisor: Dr. Y. Koteswar Rao

### Department of Genetics and Plant Breeding

An investigation was conducted during *Kharif*, 2007 at Regional Agricultural Research Station, Lam Guntur, Andhra Pradesh.

The analysis of variance revealed significant differences among the genotypes for all the characters studied. The genotypes coefficient of variation for all characters studies was lesser than phenotypic coefficients of variation indicating the masking effects of the environment. High PCV coupled with high GCV, observed for branches per plant pods per plant, biological yield, harvest index and yield per plant indicate the presence of wider adaptability for these traits in the genotypes studied. High heritability coupled with high genetic advance as presence of mean was observed for days to 50% flowering plant height, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, 100 seed weight, biological yield, harvest index and seed yield per plant indicating operation of additive gene action in these traits is possible through simple selection.

The results of multivariate analysis indicating the presence of considerable genetic divergence among the 45 genotypes studied. The 45 genotypes were grouped into 6 clusters. Clustering pattern of genotypes did not follow geographical origin, suggesting that geographical isolation may not be the only factor causing genetic diversity. Based upon the divergence studies, crosses may be made between the genotypes the genotypes of cluster III

(PS 1421) and cluster VI (VLS 69) to be isolate good recombinants.

Out of 13 characters studied day to maturity followed by pods per plant contributed maximum towards divergence. The principal component analysis identified 5 principal components with eight value more than one. The contribution by the first ( $PC_1$ ) is maximum and loaded with maximum contributing variables *i.e* days to maturity, pods per plant and days to 50% flowering.

The clustering pattern is in accordance with the PCA analysis during *Kharif*, 2007. Hierarchical cluster analysis revealed the subgroups in the major group of genotypes through Ward's minimum variance dendrogram.

Correlation studies indicating that the seed yield per plant was positively correlated with, biological yield per plant (g), number of pods per plant and harvest index (%). The results of path coefficient analysis further suggested that selection of the characters biological yield per plant (g) number of pods per plant and harvest index (%) will have positive influence on seed yield per plant. As these characters exhibits both direct effects and positive correlation with seed yield. Thus, the present study, revealed that major emphasis should be laid on selection for more number of pods per plant with simultaneous improvement of biological yield per plant (g) and harvest index (%) through their component traits for yield improvement of seed yield in soybean. M.Sc (Ag), 2008

## Genetic divergence in Sesame (*Sesamum indicum* L.)

Student: J. Swapna

Major Advisor: Dr. P. V. Rama Kumar

### Department of Genetics and Plant Breeding

The present study was carried out with 60 sesame genotypes (*Sesamum indicum* L.) to evoke information on nature and extent of genetic variability, heritability, genetic advance, genetic divergence, character association and path analysis. The experiment was laid out at Agricultural College Farm, Bapatla in a randomized block design with three replications during *Kharif* 2007-08. Observations were recorded on 10 quantitative characters *i.e.*, days 50% flowering, plant height (cm), days to maturity, number of primaries, number of secondaries, capsules per plant, seeds per plant, seeds per capsules, 1000-seed weight (g), oil content (%) and seed yield per plant (g).

All the characters studied showed less genotypic coefficients of variation than the phenotypic coefficients of variation, revealing the masking effect of the environment. High genetic variability coupled with high heritability and genetic advance as per cent of mean was observed for seeds per capsule, 1000-seed weight and seed yield per plant, indicating the role of additive gene action governing the inheritance of these traits and these traits can be improved by simple selection.

The correlation studies revealed that days to 50% flowering, days to maturity number of primaries, numbers of secondaries, capsules per plant, seeds per capsule, 1000-seed weight and oil content (%) were found to have significant positive association with seed yield and among themselves.

Path coefficient analysis showed high positive direct effect of seeds per capsule, capsules per plant, 1000-seed weight and oil content on seed yield. Therefore, simultaneous selection for these traits is suggested for improvement of seed yield in sesame.

The result of multivariate analysis revealed the presence of considerable genetic divergence among the 60-sesame genotypes studies and were grouped into 7 clusters as per  $D^2$  analysis. Clustering pattern of genotypes did not follow geographical origin, suggesting that geographical isolation may not be the only factor causing genetic diversity. Based on  $D^2$  analysis, crosses may be effective between the genotypes of cluster VI (E8) and cluster VII (VZM-23) followed by cluster IV (VSP-14) VI (E8).

Out of 10 characters studies, 1000-seed weight (g) (48.02%) contributed maximum towards diversity followed by plant height (19.27%), seed yield per plant (12.82%), number of secondaries (9.32%), capsules per plant (4.75%). The character number of primaries (3.67%), oil content % (1.19%), seed per capsule (0.57%), days to 50% flowering (0.28%) and days to maturity (0.11%) contributed less towards genetic diversity.

Principal component analysis recognized four principal component (PCs) eigen values more than one contributed 90.55 per cent cumulative variance. The contribution by the first PC was maximum and is loaded with maximum contributing variables *viz.*, 1000-seed weight, seed yield per plant, oil content (%), capsules per plant, plant height, number of primaries and seed per capsule. This analysis identifies that genotypes (JCS-9426, TMV- 4, Swetha Til, EC-355653, AKT-132, TMV-5, Vinayak and VRI-1 have maximum variance for the above characters.

The clustering pattern is in accordance with the principal component analysis. Hierarchical cluster analysis revealed the sub groups in the major group of genotypes through Ward's minimum variance method. M.Sc (Ag), 2008

## Genetic divergence in chilli (*Capsicum annuum L.*)

Student: P. Kiran Kumar

Major Advisor : Dr. V. Chenga Reddy

### Department of Genetics and Plant Breeding

The present study was conducted during *kharif* 2007 at Regional Agricultural Research Station, Lam Farm, Guntur with 57 genotypes of chilli (*Capsicum annuum L.*)

The genetic variability studies indicated that the material investigation possessed variability which provides sufficient basis for selection by the breeder. High heritability coupled with high genetic advance as per cent of mean was observed for all the characters except days to 50 % flowering, days to maturity and 1000-seed weight.

Correlation between dry fruit yield per plant and its determining characters inferred that plant height, plant spread, number of fruits per plant, fruit length, fruit girth and number of seeds per fruit had positive significant correlation with yield suggesting that effective improvement in yield can be achieved through selection based on these characters.

Path analysis revealed high positive direct effect of fruit girth, fruit length, plant height, days to maturity, number of seeds per pod, plant spread and capsanthin content (EOA colour value). Hence, taller

plants with more plant spread, fruit length, fruit girth, number of seeds per fruit and early maturity should be preferred while breeding for high dry fruitlet yield in chilles.

Based on  $D^2$  statistic, crosses are proposed to be attempted in future breeding programmes between cluster IX (LCA-825) and XVII (LCA-809), followed by cluster XVII (LCA-809) and IV (LCA-851) and cluster IV (LCA-851) and VIII (LCA-846) to obtain desirable segregates.

Agglomerative cluster analysis revealed wide genetic distance between clusters IV (LCA-815, LCA-847, LCA-334, LCA-850) and V (LCA-802, LCA-835, LCA-809, LCA-826) followed by clusters II (LCA-819, LCA-829, LCA-816) and V (LCA-802, LCA-835, LCA-809, LCA-826). Hence, hybridization among these clusters would produce superior segregants.

Based on the agglomerative cluster analysis, principal component analysis and  $D^2$  statistic, the genotypes LCA-816, LCA-815 and LCA-809 were from diverse groups and can be utilized in future hybridization programmes to produce superior segregants. M.Sc (Ag), 2008

## Genetic divergence in chickpea (*Cicer arietinum L.*)

Student: P. V. Padmavathi

Major Advisor : Dr. S. Sreemannarayana Murthy

### Department of Genetics and Plant Breeding

The present investigation entitled "Genetic divergence in chickpea (*Cicer arietinum L.*)" was carried out at Regional Agricultural Research Station, Lam Farm, Guntur with 30 *desi* and 30 *kabuli* genotypes. The analysis of variance revealed significant differences among the genotypes for all the characters studied in both *desi* and *kabuli* genotypes of chickpea.

In both *desi* and *kabuli* groups, high PCV and GCV were observed in respect of biological yield per plant and seed yield per plant while high heritability coupled with high genetic advance as per cent of mean was observed for number of primary branches, number of secondary branches, number of pods per plant. Hence,

improvement in these characters is possible through direct phenotypic selection.

The correlation study indicated positive association of plant height, number of primary branches, number of secondary branches, number of pods per plant, 100-seed weight, harvest index and biological yield per plant with seed yield and both in *desi* and *kabuli* genotypes. Hence, simultaneous improvement of these characters along with seed yield is possible. Protein content showed negative association with seed yield in both *desi* and *kabuli* genotypes which denotes that simultaneous improvement of this trait along with seed yield is not possible.

The path analysis indicated high and direct effect of biological yield per plant (g) and number of pods per plant on seed yield in both *desi* and *kabuli* genotypes. Direct selection through these traits for improvement of seed yield would be highly effective.

Of 11 characters studied, 100-seed weight, days to maturity and days to 50% flowering contributed maximum towards divergence in both *desi* and *kabuli* genotypes.

The principal component (PC) analysis identifies 4 principal components for both *desi* and *kabuli* genotypes with eigen values exceeding one. The

contribution by the first PC is maximum for both the groups. Characters like days to maturity, 100-seed weight and number of primary branches contributed more in *desi* genotypes, while in *kabuli* genotypes, seed yield per plant, 100-seed weight and biological yield per plant contributed more in first PC.

Therefore, hybridization among the parents selected from these clusters will produce superior segregants. Dendrogram obtained by cluster analysis showed the sub grouping of genotypes within the cluster, which is not possible through D<sup>2</sup> analysis. MSc. (Ag) 2008.

## Characterization of cotton germplasm (*Gossipium hirsutem* L.)

Student: P. Padmavathi

### Department of Genetics and Plant Breeding

The present investigation was carried out during *kharif* 2007 at Agricultural College Farm, Bapatla to characterize 60 genotypes of cotton (*Gossipium hirsutem* L.), using International Bureau of Plant Genetic Resources (IBPGR) descriptors and 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 15 yield component traits with seed cotton yield per plant.

The morphological descriptors indicated variability for 17 characters out of 27 characters studied and these traits are helpful for the identification of these germplasm lines from others and some of the characters like medium stem hairiness can be exploited for breeding pest resistant genotypes.

Correlation study indicated that plant height, number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight, seed index, lint index and lint yield per plant had positive significant association with seed cotton yield per plant. While number of bolls per plant and boll weight showed negative significant association with each other indicating economic balance among these traits has to be made to get improvement in seed cotton yield per plant.

The path analysis indicated that number of sympodia per plant, number of bolls per plant, boll weight, seed index and lint yield per plant had positive

direct effects on seed cotton yield per plant as correlation of these parameters was positive and significant, direct selection through these characters for improvement in seed cotton yield per plant should be highly rewarding.

By Mahalanobis "D<sup>2</sup> statistic, it could be inferred that number of monopodia per plant, seed index, number of sympodia per plant and plant height contributed maximum towards genetic divergence. Based on intra- and inter-cluster distance among the groups, suggestions to obtain better and desirable segregants were made to attempt crosses after confirming their general combining ability between cluster XIII (G 204-13) and cluster X V (TXORHY1-78).

Principal component analysis identified six principal components (PCs), which contributed 87.315 per cent of cumulative variance. The significant factors loaded in PC1, number of sympodia per plant, number of monopodia per plant, plant height, seed index and bundle strength, contributed maximum for divergence.

Agglomerative cluster analysis revealed that wide genetic distance exists between cluster III (CPD 478, Tx Lama, TXORHY-1-78 and CCH-05-1) and VIII (TSH 332, L 713 and GSHV-01/35).

The genotypes, TXORHY-1-78, GJHV-01//35, CCH-05-1 and GSHY-01/ 1338 showed maximum inter-cluster distance in Mahalanobi' D<sup>2</sup> analysis, principal component analysis. So these can be exploited for the development of desired heterotic hybrids. M.Sc (Ag), 2008

## **Character association and genetic divergence in Italian millet (*Setaria italica* (L.) Beauv)**

Student: A.B.M. Sirisha.

Major Advisor: Dr. C. Panduranga Rao

### **Department of Genetics and Plant Breeding**

The present investigation was carried out separately during two consecutive seasons of 2007-2008, namely *Kharif 2007* and *Rabi 2008* at Agricultural college Farm, Bapatla, with 52 genotypes of Italian millet [*Setaria italica* (L.) Beauv] to elicit information on the capture and extent of variability, heritability, genetic advance, character association, the magnitude of direct and indirect effects of yield components on field and genetic divergence based on 13 characters viz.. productive tillers, tillers per plant, days to maturity, flag leaf area, ear length, ear weight, straw weight, 1000 grain weight, crude protein%, calcium content and carotene. High PCV coupled with high GCV were observed for ear weight, straw weight, calcium content, carotene and grain yield per plant during both seasons indicated the presence of wider variability for these traits in the genotypes studied. The correlation study revealed that plant height, flag leaf area, ear length, ear weight and straw weight during *Kharif*, days to maturity, ear weight and calcium content in *Rabi* had positive association with seed yield indicating simultaneous improvement of these characters is possible. The results of D2 analysis indicated the presence of considerable genetic divergence among the 52 genotypes studied. The genotypes were grouped into nine clusters during *Kharif* and ten clusters during *Rabi*. Clustering pattern of genotypes did not follow geographical origin, suggesting that geographical isolation may not be the only factor causing genetic diversity. Based upon the divergence studies crosses may be made between the genotypes of cluster V (GS 446) and IX (GS 448) during *Kharif* and between clusters IX (GS 442) and X (GS 458) during *Rabi* for improvement of 1000 grain weight, productive tillers per plant, plant height, flag leaf area,

ear length, straw weight and crude protein%. Out of 13 characters studied, straw weight followed by days to maturity, carotene content, calcium content, crude protein, 1000 grain weight, ear weight and ear length during *Kharif* and flag leaf area followed by calcium content, straw weight, carotene content, grain yield per plant, productive tillers per plant, ear weight and 1000 grain weight during *Rabi* contributed maximum towards divergence.

Thus, the present study during *Kharif 2007* and *Rabi 2008* revealed that ear weight, straw weight, calcium content, carotene and grain yield per plant recorded wider variability in the genotypes studied, which can be used in the breeding programme. Based on the results of path and correlation analysis profuse plants with large panicles and more grain weight may result in higher yield in Italian millet. Quality characters like calcium, crude protein and carotene on the whole, may be improved independently of the yield. Whereas calcium and yield may be improved together as indicated by results in *Rabi*. Straw weight followed by days to maturity, carotene content, calcium content, crude protein, 1000 grain weight, ear weight, ear length during *Kharif* and flag leaf area followed by calcium content, straw weight, carotene content, grain yield per plant, productive tillers per plant, ear weight, 1000 grain weight during *Rabi* contributed maximum towards divergence. The genotypes GS 446 and GS 448 during *Kharif* and GS 442 and GS 448 in *Rabi* as resulted from D2 analysis, and genotypes GS 442, GS 443, GS 455, GS 441, GS 439 in *Kharif* and GS 459, GS 475, GS 479, GS 458 in *Rabi*, as resulted from PCA are more divergent and can be used in hybridization programme. M.Sc (Ag), 2008

## **Genetic Divergence in Cotton (*Gossypium hirsutum* L.)**

Student : G. Eswara Rao

### **Department of Genetics and Plant Breeding**

The present investigation was carried out during *Kharif 2007-2008* at Regional Agricultural

Research Station, Lam Farm, Guntur with 60 genotypes of cotton (*Gossypium hirsutum* L.) to study the genetic

## ABSTRACTS

variability, heritability, genetic advance as per cent of mean, genetic divergence, character association and the magnitude of direct and indirect effects of yield component traits with seed cotton yield in respect of 16 characters 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/g), lint index (g), 2.5% span length (mm), micronaire (10-6 g/in), bundle strength (g/tex), uniformity ratio (%), fibre elongation (%), lint yield per plant (g) and seed cotton yield per plant (g).

The genotypic coefficients of variation for all the characters studied were lesser than the genotypic coefficients of variation indicating the masking effect of the environment. Number of monopodia per plant, number bolls per plant, lint yield per plant and seed cotton yield per cent exhibited moderate to high variability. High heritability coupled with high genetic advance observed in the case of number of monopodia per plant and lint yield per plant indicate the predominance of additive gene action and hence, simple selection might play a role to some extent. High heritability coupled with moderate genetic advance was observed in case of plant height, 2.5% span length and seed cotton yield per plant revealing the role of both additive and non additive gene action. The other traits viz., number of sympodia per plant, number of bolls per plant, boll weight, seed index and uniformity ratio showed moderate heritability and low genetic advance indicating major role of non additive gene action.

The correlation studies revealed that plant height, number of sympodia per plant, number bolls per plant, boll weight, seed index, lint index, micronaire, uniformity ratio, elongation and lint yield per plant had significant positive association with seed cotton yield per plant. The path coefficient analysis revealed that plant height, days to 50% flowering, number of monopodia per plant, number of bolls per plant, seed index, lint index, uniformity ratio, and lint yield per plant exerted direct positive effect on seed cotton yield per plant. Selection based on these attributes may be helpful in evolving high yielding varieties of upland cotton.

Principal component analysis identified six principal components (PCs), which contributed 78.21 per cent of cumulative variance. The population with high PC 1 values were characterized by high number of monopodia per plant and bundle strength whereas, population with high PC2 values were characterized by lint yield per plant and number of bolls per plant. In PC3, characters like 2.5% span length and elongation showed maximum weightage.

Therefore, major emphasis should be laid on selection process with more number of bolls per plant and simultaneous selection of other traits viz., boll weight, seed index, number of sympodia per plant and lint index for realizing higher seed cotton yield with desirable fibre quality. M.Sc (Ag), 2008

### **Impact of Krishi Vigyan Kendra on Farmers in Srikakulam District of Andhra Pradesh**

Student : Manoj. A

Major Advisor : Dr. G. Sivanarayana

#### **Department of Extension Education**

The Krishi Vigyan Kendras are designed to impart the latest knowledge to the farmers through work experience by employing the principles of "Teaching by doing and Learning by doing". The activities of the KVK include technology assessment, refinement and transfer, aiming to bridge the gap between the technology developed at the research institutions and its adoption at the field level by the farmers.

Detailed analysis of profile characteristics of farmers indicated that majority of the respondents were illiterates and small farmers with medium social participation and medium exposure to mass media and extension contact showing medium and high risk

orientation followed by low scientific orientation, medium economic orientation along with medium achievement motivation and medium level of innovativeness.

Majority of the respondents of adopted villages experienced medium direct changes followed by more and less direct changes, whereas, majority of the farmers of non-adopted villages experienced less direct changes followed by more and medium direct changes.

Nine out of ten independent variables such as the education, social participation, mass media exposure, extension contact, risk orientation, scientific orientation, economic orientation, achievement

motivation and innovativeness of farmers showed significant relationship with direct changes of adopted and non-adopted villages.

Suggestions given by the farmers of adopted villages to overcome the constraints were: awareness programmes should be conducted about advanced methods, selection of the real beneficiaries for training without any political intervention, off campus training programmes should be conducted and demonstration units need to be maintained properly.

Political influence should be reduced in the supply of inputs, provision of marketing and storage facilities and provision of fertilizers on subsidized rates

were the important suggestions given by the farmers of non-adopted villages.

Strategy was given for the effective implementation of KVK towards overall development of the farmer as providing required knowledge and skill by conducting more training programmes and demonstrations, involving practicing farmers from sample communities with proper selection of technologies, improve the contact with state department of agriculture to produce fertilizers on subsidized rates, soil testing facilities should be carried out on priority, conducting more vocational training programmes and income generation activities.

### **“A study on Entrepreneurial Behaviors of Sugarcane growers in Mandya district of Karnataka”**

Student : Abhishik Gowda. T

Major Advisor: Dr. CH. Ramesh Babu

#### **Department of Extension Education**

Entrepreneurship has now been recognized as a concept not only vital for industries but also in the development of agriculture. Entrepreneurship stands as a vehicle to improve the quality of life for individuals, families and communities and to sustain a healthy economy and environment. By a simple definition, doing new things or doing things that are already being done in a new way is a part of entrepreneurial behavior. With the said backdrop, a study was conducted to assess the entrepreneurial behavior of sugarcane growers in Madhya district of Karnataka.

The data was collected from the sugarcane growers through a well structured interview schedule, which was developed keeping in view the objectives of the study. The data thus collected was coded, tabulated and analyzed. Finally, the statistical tools like Arithmetic mean, Standard deviation, frequency, Percentage, Correlation and Multiple linear regression were used for meaningful interpretation of findings and for drawing conclusions.

The findings of personal, socio-economic and psychological characteristics indicated that majority of

sugarcane growers were middle aged, educated up to high school, dependent only on agriculture, operating small size holdings, medium in social, extension and mass media participation and had low level of credit orientation. Further they had medium scientific and management orientation.

The multiple linear regression analysis indicated that all the nine sub-components of entrepreneurial behavior put together explained 93 per cent of variation. The most important three components in order of their importance were innovativeness, Information seeking behavior and Decision making ability, while the three least important components found in the study were cosmopolitans, risk orientation leadership ability.

Successful case lets of sugarcane growers reflected that the farmers orientation with the variables such as membership in social organizations, contact with extension agency, participation in agricultural programmes and favorable attitude towards innovations were significantly contributed to become an entrepreneur. M.Sc (Ag), 2008

**“Reaction of Urdbean [*Vigna mungo* (L.) Hepper] genotypes to thrips and their seasonal occurrence”**

Student : P. Nagaraju

Major Advisor: Dr. G. Raghavaiah

**Department of Entomology**

Studies on the “Reaction of urdbean (*Vigna mungo* (L.) Hepper) genotypes to thrips and their seasonal occurrence” were undertaken during *Kharif*, 2007 and *Rabi* 2007-2008 at Regional Agricultural Research Station, Lam farm, Guntur. Seventy six genotypes of urdbean were selected for screening and replicated 4 times in a simple Randomized Block Design.

The plant height (cm) varied from 11.8 (IC281990) to 34.6 (IC343936) per plant and differed significantly. Number of leaves on different genotypes varied from 6.2 (IC26179) to 11.6 (IC436509). Nine genotypes viz., IC43 6789, IC398993, IC436585, IC281981, IC261179, IC436543, IC436922, IC281975, and /wBG37 showed moderate preference to thrips and moderate resistance to PBNV. Eight genotypes viz., IC519684M IC519678,

IC436638M IC436734, IC519685, showed high preference to thrips and moderate resistance to PBNV.

The seasonal incidence of thrips during *Kharif* 2007, indicated that July and August months were favorable for the multiplication of *T. palmi*. The peak incidence of *T. palmi* was recorded during the 33<sup>rd</sup> standard week (i.e., Aug 13-19, 2007) in *Kharif* while in *Rabi* 2007-2008, December and January months were favourable for the multiplication of *T. palmi* and the peak incidence was during 52<sup>nd</sup> standard week (i.e., at Dec 24-31m 2007).

The colour preference of thrips as the mean catches of *T. palmi* in different colour traps was studied during *Kharif*, 2007. The trap catches of thrips was highest in pink trap followed by white, blue, yellow, orange and green traps. M.Sc (Ag), 2008

**“Evaluation of some plant extracts against pest complex of cauliflower (*Brassica oleracea* var. *botrytis* L.)”**

Student : B. Viswanadha Rao

Major Advisor : Dr. G. Ramachandra Rao

**Department of Entomology**

A field experiment entitled “Evaluation of some plant extracts against pest complex of cauliflower (*Brassica oleracea* var. *botrytis* L.)” was undertaken during *Rabi* 2007-2008 at Agricultural College Farm, Bapatla as well as in the Department of Entomology.

The evaluation of efficacy of insecticides revealed that NSKE 5% was found highly effective against *S. litura*, *P. xylostella* and *L. erysimi*. The next best treatment was *M. azedarach* leaf extract 5% followed by *P. glabra* leaf extract 5% and were found highly effective against *S. litura* and *P. xylostella*. In case of *L. erysimi* the next best treatment was *P. glabra* leaf extract 5% followed by *M. azedarach* leaf extract 5%. All the remaining treatments viz., 5% leaf extracts of *C. inermis*, *A. squamosa*, *P. hysterophorus*, *L. camera*, *M. koenigii*, *I. cornea*, *E. officinalis* have showed poor performance against *S. litura*, and *P. xylostella* *L. erysimi* but were significantly superior over untreated check. The effect of these treatments (at different concentrations viz., 0.1,

.5, 1.0, 3.0 and 5.0%) was also tested on the growth and development of third instar larvae of *S. litura* in the laboratory. The repellent and antifeedant property of all the plant extracts viz., 5% leaf extracts of *C. inermis*, *P. glabra*, *A. squamosa*, *P. Hysterophorus*, *M. azedarach*, *L. camera*, *M. koenigii*, *E. officinalis* and neem seed kernel extract was enhanced with increase in their concentration (0.1 to 5.0%) and maximum efficacy was observed at 5.0 per cent concentration.

Among the different plant extracts, NSKE was highly inhibitive and suppressed the growth and development of *S. litura* followed by *M. azedarach* leaf extract and *P. glabra* leaf extract. Similarly the developmental period increased and the adult emergence, growth index, survival index, weight of larva and pupa, larval weight index and pupal weight index decreased as the concentration of plant extracts increased from 0.1 to 5.0 per cent. M.Sc (Ag), 2008

## “Seasonal occurrence and evaluation of eco friendly insecticides against pest complex of sunflower”

Student : Sanjaya Topagi

Major Advisor : Dr. G. Ramachandra Rao

### Department of Entomology

Studies on the seasonal occurrence and evaluation of eco-friendly insecticides against pest complex of sunflower were undertaken during *rabi*, 2007-2008 at Agricultural College Farm, Bapla.

The seasonal occurrence of the pest complex on sunflower was recorded at weekly intervals on 50 plants from five different locations @ ten plants per location while for evaluation of eco-friendly insecticides and their safety to natural enemies the data were recorded one day prior to application of treatments and at one, five, ten and fifteen days after spraying on ten randomly selected and tagged plants per plot. The data with regard to seasonal occurrence indicated that December, January and February months were favourable for the multiplication of *Spodotera litura* (Fabricius), *Amrasca biguttula biguttula* (Ishida), *Bemisia tabaci* (Gannadius) and *Aphis craccivora* (Koch).

The peak occurrence of *S. litura* was recorded during the second week of February while, sucking pests viz., *A. biguttula biguttula* and *B. tabaci* was observed during third week of January and for *A. craccivora* during the first week of January.

Pertaining to field evaluation of eco-friendly insecticides, spinosad 0.015% and *B.t.k* 0.2% were highly effective in reducing the population of *S. litura* on sunflower.

Pertaining to sucking pests viz., *a. biguttula biguttula*, *B. tabaci* and *A. craccivora* the data revealed that Neemazal 0.03% and Nivaar 0.2% were highly effective in reducing the pest population.

Nimbecidine 1%, *N. rileyi*  $1.2 \times 10^4$  spores ml<sup>-1</sup> and *B. bassiana*  $1 \times 10^{13}$  conidia ml<sup>-1</sup> were relatively sare to both coccinellids and spider population on sunflower, where as spinosad 0.015% and *B.t.k* 0.2% were found highly toxic to coccinellids and spiders. Spinosad 0.015% and *B.t.k* 0.2% recorded higher yields. M.Sc (Ag),2008

## Seasonal incidence and management of pink bollworm *Pectinophora gossypiella* (Saunders) on cotton

Student : Sandhya Rani. B

Major Advisor: Dr. N.V.V.S.D. Prasad

### Department of Entomology

Cotton 'white gold' is and important mainstay of Indian economy. The pest spectrum of the cotton is quite complex, bollworms being the major biological constraints in cotton cultivation. Among the bollworms, pink bollworm is more serious and challenging with the destructive larval stage usually secluded with in the cotton fruiting bodies and not accessible to traditional control measures.

Field and laboratory investigations were carried out to elicit information on seasonal incidence, biology and management of pink bollworm, at the Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh, India during 2007-2008 crop season for evolving implementable and sustainable management strategies.

Studies on seasonal occurrence of pink bollworm by pheromone monitoring revealed that the catches of male moths of pink bollworm on cotton started from the months of September with a peak level of pest activity in the 2<sup>nd</sup> fortnight of December and again in last week of January to first fortnight of February.

Studies on biology and bionomics under laboratory conditions revealed that eggs were laid mostly in small groups which were creamy white in colour initially and turned to pink colour before hatching. The egg period varied from 4-6 days with an average of 5.2 days. The neonate larva was semi-translucent, light yellowish with distinctly dark brown head and thoracic shield. The larvae completed development in 5 stages of growth (instars) and herved to pink colour in third instar.

## ABSTRACTS

The pupal period varied from 7-9 days with an average of 7.8 days. The adult longevity varied from 8-11 days with an average of 9.8 days. The total life cycle of pink bollworm varied from 31 to 40 days with an average of 36.2 days.

Among insecticides tested Spark (deltamethrin + triazophos) was the best followed by triazophos, deltamethrin, thiodicarb and lamda cyhalothrin, while chlorpyrifos, neem formulation, novaluron and

emamectin benzoate were found ineffective recording high green boll locule damage and larval incidence in addition to open boll and open locule damage at harvest.

The highest seed cotton yield was obtained in Spark (deltamethrin+triazophos) followed by triazophos, transgenic *Bt* cotton, deltamethrin, lamda-cyhalothrin and thiodicarb and the lowest yields were recorded in emamectin benzoate and novaluron which were on par with the control. M.Sc (Ag) ,2008

### **“Studies on relative toxicity of certain insecticides to spotted pod borer, *Maruca vitrata* (Geyer) (pyralidae: Lepidoptera)”**

Student : Manjunath Chouraddi

Major Advisor : Dr. (Mrs.) T. Madhumathi

#### **Department of Entomology**

Experiments were conducted in the laboratory of the Department of Entomology, Agricultural College, Baatla during *Kharif* 2007 to find out sensitive method of bioassay for *Maruca vitrata* (Geyer) and to study the relative toxicity of certain commonly used insecticides viz., chlorpyrifos, profenofos, endosulfan and carbaryl and newer insecticides viz., indoxacarb, methomy1, thidicarb, spinosad and emamectin benzoate against *M. vitrata*.

The dipping of infested flower of blackgram with larvae was found to be the sensitive and less labourious method of bioassay for *M. vitrata* with LC50\*\* and first at LC90\*\* in its toxicity against *M. vitrata*. Order of toxicity of conventional insecticides at LC50\*\* level was profenofos > endosulfan> quinalphos> carbaryl and at LC90\*\* level it was chlorpyrifos > endosulfan > profenofos > quinalphos > carbaryl1.

Among the newer insecticides, emamectin benzoate was first in the order of toxicity at both LC50\*\* and Lc90\*\* level , shich was 78, 27. 75, 24.5, 22 and 18.25 times more toxic than carbaryl, quinalphos, chorpyrifos, endosulfan and profenofos at LC50\*\* level and it was 60.3, 32, 26.4, 23.45 and 17.85 times more toxic than carbaryl, quinalphos, profenofos, endosulfan and chlorpyrifos at LC90\*\* ldelvel at 72 HAT, respectively. Methomyl was second in the order of toxicity at Lc50\*\* level which was found to be 26, 9.25, 8.17, 7.34 and 6.08 times more toxic than carbaryl, quinalphos, chlorpyrifos, endosulfan and profenofos and third at LC90\*\* with 11.38, 6.03, 4.98, 4.42 and 3.37 times more toxic than te above conventional insecticides, respectively. The order of toxicity of newer insecticides at LC50\*\* level was emamectin benzoate > methomyl > indoxacarb > spinosad > thiodicarb and at LC90\*\* level it was emamectin benxoate > spinosad > methomyl >indoxacarb > thiodicarb. M.Sc (Ag) ,2008

### **Insecticide Resistance and its management in rice Leaf folder *Cnaphalocrocis medinalis* (Guenee) (Pyralidae: Lepidoptera)**

Student : S.S.A. Venkateswarao

Major advisor : Dr. P. Raja Sekhar

#### **Department of Entomology**

Experiments were conducted in the laboratory of the Department of Entomology, Agricultural college, Bapla during *Kharif* and *rabi* seasons, 2007-08 to study the insecticide resistance and its management in rice leaf folder *Cnaphalocrocis medinalis* (Guenee) Pyralidac: Lepidoptera).

The *C. medinalis* showed 0.8996, 0.596 and 4.7.725 fold resistance in *kharif* season and 0.864, 0.5497 and 4.109 fold resistance in *rabi* season to chlorpfihos, endosulfan and cypermethrin respectively at LC90\*\* in comparision with field recommended concentrations.

The rice leaf folder population acquired 3.703, 3.386, 0.6035 and 0.6350 fold resistance in *kharif* season and 4.249, 3.559, 0.5605 and 0.6630 fold resistance in *rabi* season to cartap hydrochloride, fipronil, triazophos and lambda cyhalothrin respectively at LC90\*\* in comparison with field recommended concentrations.

The present study clearly exhibited profound influence of insecticide usage in resistance development. Less used chemicals recorded low resistance factor. However, the effectiveness of new molecules was in the

order of lambda cyhalothrin, cartap hydrochloride, triazophos and fipronil respectively at SD50\*\* level in both *kharif* and *rabi* seasons. While at LD90\*\* level it was lambda cyhalothrin, fipronil, triazophos and cartap hydrochloride in *kharif* season, while in *rabi* season it was lambda cyhalothrin, triazophos, fipronil and cartap hydrochloride. Regarding the conventional insecticides, the larvae were found resistant to cypermethrin with no trace of resistance development to chloropyrifos and endosulfan. M.Sc (Ag), 2008

## **“Studies on seasonal incidence and Evaluation of different spray schedules against spotted pod borer, *Maruca vitrata* (Geyer) (Pyralidae: Lepidoptera) on blackgram”**

Student : Chitti Babu Giddi

Major Advisor : Dr. (Mrs.) T.Madhumathi

### **Department of Entomology**

A field experiment entitled “Studies on seasonal incidence and evaluation of different spray schedules against spotted pod borer, *Maruca vitrata* (Geyer) (Pyralidae: Lepidoptera) on blackgram” was conducted at Agricultural College farm, Bapatla during *rabi* 2007-08.

The larval incidence of *M. vitrata* started during the third week of December (15.12.2007) *i.e.* at the early flowering stage of the crop (30 days after sowing) and reached a peak level (37 larvae per %0 plants) during the second week of January (12.01.08) coinciding with the maximum flowering stage of the crop.

Among the chemical schedules (F1\*), the profenofos schedule (C3\*0) was found effective which recorded the lowest mean number of *M. vitrata* larvae (1.24) and damaged flowers/pods (1.61) per five plants. Among the spray interval schedule (F2\*) the four days

interval spray schedule (D1\*) was found effective and has recorded the lowest number of *M. vitrata* larvae per five plants (0.80) and mean number of damaged flowers./pods per five plants (0.93). The interaction between the profenofos schedule and four days interval spray schedule *i.e.* C3D1\*\* was found effective and has recorded the lowest mean number of *M. vitrata* larvae (0.73) and damaged flowers /pods (0.67) per five plants.

The grain yield was highest (2.08 kg per plot) in the profenofos schedule and in for days interval spray schedule (2.10 kg per plot) as well as in the interaction between profenofos and four days interval spray schedule (C3D1\*\*) *i.e.* 2.e. 2.40 kg per plot. However, the CB ratio was highest in neem schedule and ten days interval schedule (1:208) because of low cost of plant protection. M.Sc (Ag) ,2008

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Hu, J., Yue, B and Vick, B.A. 2007. Integration of trap makers onto a sunflower SSR marker linkage map constructed from 92 recombinant inbred lines. *Helia*. **30** (46) :25-36.

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AOAC. 1990. Official methods of analysis. Association of official analytical chemists. 15<sup>th</sup> Ed. Washington DC. USA. pp. 256

Federer, W.T. 1993. Statistical design and analysis for intercropping experiments. Volume I: two crops. Springer – Verlag, Cornell University, Ithaca, New York, USA. pp. 298-305

### Thesis

Ibrahim, F. 2007. Genetic variability for resistance to sorghum aphid (*Melanaphis sacchari*, Zentner) in sorghum. Ph.D. Thesis submitted to Acharya N.G. Ranga Agricultural University, Hyderabad.

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Naveen Kumar, P.G and Shaik Mohammad 2007. Farming Systems approach – A way towards organic farming. Paper presented at the National symposium on integrated farming systems and its role towards livelihood improvement. Jaipur, 26 – 28 October 2007. pp.43-46

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Bind, M and Howden, M. 2004. Challenges and opportunities for cropping systems in a changing climate. Proceedings of International crop science congress. Brisbane –Australia. 26 September – 1 October 2004. pp. 52-54  
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