

**Abstracts of Theses Accepted for the Award of Post-Graduate Degrees in  
the University of Agricultural Sciences, Dharwad**

**DOCTOR OF PHILOSOPHY**

**AGRONOMY**

**Integrated Nutrient Management in Sunflower - Wheat Sequence Cropping in Northern  
Transitional Zone of Karnataka**

G. P. PALI

2000

MAJOR ADVISOR : Dr. S. I. HALIKATTI

Field investigation was carried out at Main Research Station, UAS, Dharwad during 1997-98 and 1998-99 in a fixed site to study the effect of Integrated Nutrient Management involving organics and inorganics in sunflower - wheat cropping system. The results revealed that application of RDF (35 : 50 : 35 kg NPK ha<sup>-1</sup>) along with glyricidia @ 5 t ha<sup>-1</sup> sunflower recorded significantly higher sunflower seed yield (2558 kg ha<sup>-1</sup>) but was on par with RDF + Pongamia (2492 kg ha<sup>-1</sup>) and were significantly superior over other organics (FYM / Vermicompost / Maize stalk / Cotton stalk along with RDF : 2156, 2130, 1904 and 1866 kg ha<sup>-1</sup>, respectively) and RDF alone (1781 kg ha<sup>-1</sup>). This was attributed to significantly higher values of growth and yield components. The highest total NPK uptake by sunflower was recorded with RDF + glyricidia (134.0, 30.2, 141.8 kg ha<sup>-1</sup>, respectively) followed by RDF + Pongamia > FYM > Vermicompost > Maize stalk > Cotton stalk > RDF alone and lowest with no fertilizer.

The residual effect on wheat was the highest with RDF + glyricidia (1924 kg ha<sup>-1</sup>) followed by RDF + Pongamia

(1834 kg ha<sup>-1</sup>) / FYM (1747 kg ha<sup>-1</sup>) / Maize stalk (1674 kg ha<sup>-1</sup>) / Vermicompost (1661 kg ha<sup>-1</sup>) and RDF + Cotton stalk to kharif sunflower (1525 kg ha<sup>-1</sup>). Application of 100 per cent RDF (50:25 kg NP ha<sup>-1</sup>) to wheat recorded significantly higher grain yield (1974 kg ha<sup>-1</sup>) than 50 per cent RDF (1673 kg ha<sup>-1</sup>) and no fertilizer. Application of RDF + glyricidia to sunflower and 100 per cent RDF to wheat recorded significantly higher values of growth and yield components as compared to other organics + RDF to sunflower. Wheat yield was significantly higher with RDF + glyricidia / pongamia to sunflower and 50 per cent RDF to wheat as compared to RDF alone to both the crops.

Integrated use of organics along with RDF to sunflower improved soil physio-chemical properties (OC, MWHC, BD, IR, Soil porosity) and available NPK in the soil. Application of RDF + green - leaf manures @ 5 t ha<sup>-1</sup> to sunflower and 50 per cent RDF to wheat is the best to get higher net income for low income farmers. But where finance is not limiting, such farmers can increase fertilizer upto 100 per cent RDF to wheat.

**Integrated Nutrient Management for Sustainable Production of Sugarcane**

R. B. KHANDAGAVE

2000

MAJOR ADVISOR : Dr. C. J. ITNAL

Field experiments were conducted at the Karnataka Institute of Applied Agricultural Research, Sameerwadi on Integrated Nutrient Management for Sustainable Production of Sugarcane during 1996-97 and 1997-98 seasons. Five organics viz., Sugarcane trash (@ 8 t/ha), FYM (@ 25 t/ha), Vermicompost (@ 5 t/ha), *Bhumilabh* (@ 10 t/ha) and green manuring (*Sunn hemp*) along with no organic were tried in main plots and three levels of chemical fertilizers (100, 50 per cent RDF and control) in subplots in a split plot design with four replications. Another experiment consisting of two levels of pressmud (@ 12.5 and 25.0 t/ha) and *Bhumilabh* (@ 2.5 and 5.0 t/ha) and also no organic were tried with four levels of fertilizers (100, 75, 50 and no fertilizer) in a split plot design and replicated thrice.

Organic manures viz., *Bhumilabh*, FYM, Green manuring, Trash incorporation and Vermicompost increased the cane yield significantly by 35.75, 18.04, 17.85, 8.98 and 7.88 per cent respectively over control. Further, application of these organics facilitated for higher soil fertility and microbial population over fertilizers applications. *Bhumilabh* in conjunction with 50 per cent RDF produced cane yield on par with 100 per cent RDF, which helped to save 50 per cent of fertilizers.

In the second experiment also, application of *bhumilabh* @ 5.0 t/ha recorded significantly higher cane and sugar yield (26.95 and 32.98%, respectively) over other organics. Pressmud applied @ 25.0 t/ha exhibited favourable

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influence on cane yield. It was observed that reduction in the level of fertilizers application had substantial effect in decreasing the yield of sugarcane besides affecting the

soil fertility status and juice quality. Application of pressmud and *bhumilabh* improved the juice quality parameters.

### Investigation on the Rice Based Farming System in Tungabhadra Project of Karnataka

A. C. CHANNABASAVANNA

2000

MAJOR ADVISOR : Dr. C. J. ITNAL

A field experiment was conducted at Agricultural Research Station, Sirguppa, University of Agricultural Sciences, Dharwad to investigate on the Rice Based Farming System in Tungabhadra Project of Karnataka from 1996-97 to 1998-99. The study had broadly two aspects i.e., the rice based farming system, consisting of rice-rice system with fish, poultry, dairy and horticultural crops like banana, drumstick + curry leaf and forage crops like cowpea + paragrass grown in rice field bunds, recycling of organic manures obtained from crop (rice straw), poultry (Poultry manure) and dairy (FYM) in the respective system and secondly, the rice based cropping system (rice-sesamum, rice-chilli and rice-wheat-green manuring). The rice based cropping systems were evaluated against the conventional system of rice-rice. The treatments were replicated thrice in a randomised block design.

The present investigation revealed the feasibility

and profitability of integrating fish, poultry, dairy with rice-rice cropping. Among the farming system components, rice (Ri) + fish - Rice + fish (RFRF) with poultry recorded the highest production of 11133 kg/ha. The net returns and B:C ratio were low in this system during 1996-97 due to high initial cost of cultivation, but it decreased over years. During 1998-99, RFRF with poultry recorded the highest net returns (Rs. 57687/ha) and B:C ratio (2.73). The next best system was rice - rice with dairy.

With respect to horticultural crops on rice field bunds, growing banana was found profitable and showed an increase in total productivity by 25% over rice - rice system. Among the alternate crops, rice - wheat - GM recorded on par rice - grain equivalent yield and net returns with rice - rice system and rice - sesamum. Recycling of crop and animal residues improved the physical and chemical properties of soil. Among the various organic manures, poultry manure was found to be the best.

### Effect of Genotypes, Sowing Time of Cotton and Soybean Intercropping in Chilli and Cotton Mixed Cropping System

B. S. LINGARAJU

2000

MAJOR ADVISOR : Dr. C. J. ITNAL

A field experiment was conducted to study the effect of genotypes, sowing time of cotton and soybean intercropping in chilli and cotton mixed cropping system in Chilli + Cotton mixed cropping system during 1996 and 1997 at Main Research Station, University of Agricultural Sciences, Dharwad. The experiment comprised of two cotton genotypes, two sowing time of cotton, four cropping systems and six sole crops. In all there were 22 treatments including sole crops. The experiment was laid out in a Factorial RBD design with three replications.

Across cotton sowing time and cropping system, *hirsutum* genotype Abhadita recorded 7.4 per cent higher kapas yield over *herbaceum* genotype Jayadhar. Regardless of cotton genotypes and cropping systems, cotton sown early during July second fortnight recorded 32.2 per cent higher kapas yield over cotton sown late during August second fortnight.

Irrespective of row proportions, intercropping of

soybean in Chilli + Cotton mixed cropping system resulted in a significant reduction of both chilli and cotton yield. The reduction in chilli yield was 6.8, 44.5 and 10.7 per cent whereas, reduction in kapas yield was 8.3, 34.7 and 10.5 per cent with 1:1, 1:2 and 2:2 row proportions, respectively. However, reduction in chilli and cotton yield in intercropping system was better compensated by intercrop yield of soybean as seen in equivalent yield and monetary returns.

Intercropping one row of soybean with chilli and early sown Abhadita cotton ( $G_2T_1C_1$ ) recorded significantly higher chilli equivalent yield ( $1508 \text{ kg ha}^{-1}$ ) over chilli mixed with early planted Abhadita ( $1168 \text{ kg ha}^{-1}$ ) or Jayadhar ( $1051 \text{ kg ha}^{-1}$ ) cotton alone. Similarly,  $G_2T_1C_1$  gave higher net returns (Rs.33812  $\text{ha}^{-1}$ ) compared to chilli mixed with early planted Abhadita (Rs.24937  $\text{ha}^{-1}$ ) or Jayadhar (Rs.22306  $\text{ha}^{-1}$ ) cotton. Among sole crops, chilli recorded significantly higher net returns (Rs.19144  $\text{ha}^{-1}$ ) compared to soybean (Rs.17449  $\text{ha}^{-1}$ ) and early sown Abhadita cotton (Rs.11870  $\text{ha}^{-1}$ ).

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Studies on Phosphorus Enriched Organic Manures on P-Availability to Maize - Bengalgram Cropping Sequence in Vertisol

BASAVARAJ

2000 MAJOR ADVISOR : Dr. H. M. MANJUNATHAIAH

A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad on chromic haplusterts during kharif and rabi of 1997-98 and 1998-99, to investigate the effect of phosphorus enriched organic manures on soil properties and crop yield of maize and their residual effect on bengalgram under irrigated condition. The experiment consisted of three main plots : no P-fertilizer, HRDF-P (37.5 kg  $P_2O_5$ /ha) and 100% RDF-P (75 kg  $P_2O_5$ /ha) and 9 sub-plots : no organic manure, FYM @ 5 t/ha, vermicompost @ 2 t/ha, biogas slurry @ 3 t/ha, poultry manures @ 2 t/ha, P-enriched FYM @ 2.5 t/ha, P-enriched vermicompost @ 1 t/ha, P-enriched FYM @ 2.5 t/ha, P-enriched vermicompost @ 1 t/ha, P-enriched biogas slurry @ 1.5 t/ha and P-enriched poultry manure @ 1 t/ha, with 3 replications in split plot design.

Application of P-enriched organic manures at all levels of P-fertilizers, either individually or in combination significantly increased the growth and yield of maize and bengalgram. The highest grain yields of maize (59.80 q/ha) and bengal gram (24.30 q/ha) were obtained due to addition of P-enriched poultry manure @ 1 t/ha plus 100% plus 100% RDF-P, which were found superior to all other

treatments. The increase in yield over control (no organic manure) was 27.50 and 118.92% in maize and bengalgram, respectively.

Higher uptake of N, P, K and Zn by both the crops were observed due to increased availability of these nutrients in soil with the addition of P-enriched organic manures and P-fertilizer. Among different P-enriched organic manures, poultry manure gave highest uptake and available status of N, P, K and Zn. All the added P-enriched organic manures and P-fertilizer in soil significantly decreased soil pH and increased EC and organic carbon content.

In P-enriched organic manures at all levels of P-fertilizer, either individually or in combination, significantly increased the transformation of applied P into A1-P, Fe-P, Ca-P, Red-Sol-P, Occl-P, total mineral-P and organic-P and similar trend was also noticed in residual effect on bengal gram. Addition of P-enriched poultry manure with HRDF-P found beneficial and yielded higher monetary returns (Rs.49318.0/ha) and B:C ratio (6.19) from maize-bengal gram cropping system.

Studies on Yield and Quality of Byadagi Chilli (*Capsicum annuum* L.) in Relation to Soil Properties in Transitional Zone and Part of Dry Zone of North Karnataka

B. I. BIDRI

2000 MAJOR ADVISOR : Dr. P. A. SARANGAMATH

Studies made on yield and quality of Byadagi chillies in relation to soil properties in Dharwad, Haveri and Gadag districts of Karnataka indicate that, deep black soils produced highest yield and first grade fruits, while red soils produced lowest yield and third grade fruits and medium black soils were intermediate in influencing the yield and quality of fruits. Nutrient status of soils, moisture availability and other soil properties influenced the root growth and nutrient uptake by plants leading to variation in the yield and quality of Byadagi chillies.

Different grade Byadagi chilli fruits were analysed for physico-chemical characters, quality attributes and minerals separately, to study their partitioning in fruit components and to establish relationship between quality attributes and mineral status of whole fruits / fruit

components. Non significant difference existed between different grades of fruits for capsaicin and oleoresin contents, but significant difference existed for colour value of fruits with first grade fruits recording highest quality attributes followed by second and third grade fruits.

Mineral concentration in whole red fruits followed the order  $K > N > Ca > Mg > S > P > Fe > Mn > Zn > Cu$  and significant difference existed between different fruit grades for K concentration in whole fruit / pericarp component with highest concentration in the first grade fruits. Partitioning of minerals in fruit components revealed that, irrespective of fruit grade, all minerals except K and Ca gets partitioned more in seed than in pericarp.

Correlation studies revealed that, yield / quality

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attributes of chillies are negatively related to bulk density of soil, while other soil physico-chemical properties are positively related. Similarly, organic carbon, available N and K had significant positive correlation with yield/quality of

fruits. Significant positive relationship between colour value of fruits and K concentration in whole fruit / pericarp components was observed.

### Transformation of Phosphorus in a Vertisols in Sunflower - Jowar Cropping Sequence

PRAVEEN T. GOROJI

2000

Major Advisor : Dr. P. A. SARANGAMATH

An investigation was carried out to know the effect of Diammonium Phosphate (DAP), Single Super Phosphate (SSP), Mussoori Rock Phosphate (MRP) with pyrite, P solubilizers and their combination with FYM on P availability, P transformation and crop yield under sunflower - jowar cropping sequence in a vertisol of Agricultural Research Station, Annigeri during 1996-97. An incubation study with 18 treatments combination comprising of P-sources and P-solubilizers was also conducted to assess the extent of release of P with time.

Incubation study revealed that recovery of P from DAP applied at the rate of 50 kg  $P_2O_5$  ha<sup>-1</sup> at 30, 60 and 90 days was 31.74, 19.34 and 18.08 per cent, respectively, whereas recovery of P from MRP with same rate of application at corresponding period was low and it was 2.54, 4.26 and 4.50 per cent, respectively. Incorporation of FYM increased available P at all the periods of incubation.

Phosphorus transformation study revealed that the

dominance of different P forms among the mineral P fraction is in the following order : saloid - P < Fe-P < A1-P < Occl-P < RS-P < Ca-P. The content of saloid-P, A1-P and Fe-P, RS-P, Occl-P was higher in the soils receiving water soluble P sources, while MRP treated plot was dominated by Ca-P and organic P. The content of saloid-P, A1-P and organic-P were significantly higher and Ca-P, RS-P and Occl-P were significantly lower with FYM treated plot irrespective of P-sources.

DAP treatment recorded highest seed yield of sunflower (14.38 q/ha) and grain yield of jowar (14.15 q/ha) which worked out to 23.43 and 16.07 per cent, respectively over MRP treatment. In FYM treatment, grain yields of sunflower and jowar were 14.29 and 14.18 of per ha, respectively and it was 22.55 and 20.47 per cent increase over no FYM treatment. Diammonium phosphate is the best P fertilizer in vertisol and however, it can be substituted either with MRP + pyrite + PSB or in combination with MRP which can replace DAP partially in a vertisol.

### Effect of Flyash on Growth and Yield of Crops Nutrient Uptake and Soil Properties with Special Emphasis on Toxic Elements and Radionuclides

G. R. RAJKUMAR

2000

MAJOR ADVISOR : Dr. C. V. PATIL

Field experiment was conducted at RRS, Raichur during 1996-97 and 1997-98 with different levels of flyash and pondash to study the effect on growth and yield of sunflower, groundnut and maize crops in Alfisol and vertisol.

Application of flyash / pondash @ 30 t/ha to red and black soil under irrigated condition increased the growth and yield of sunflower significantly during kharif. Further, combined application of flyash / pondash @ 30 t/ha and FYM @ 20 t/ha increased seed yield to 36.6 and 29.0 per cent over control in red and black soil, respectively. Flyash / pondash had significant residual effect on groundnut in red soil and maize in black soil. The maximum pod yield of groundnut (17.78 q/ha) and grain yield of maize (22.50 q/ha) was recorded in T<sub>7</sub> (Pondash plus FYM) treatment in red and black soil, respectively.

Application of flyash / pondash increased the uptake of nutrients significantly in sunflower, groundnut and maize crops. However, combined application of flyash / pondash and FYM decreased the concentration of heavy metals / radionuclides in plants as compared to individual application, which was far below the critical limit specified by WHO.

Addition of flyash / pondash either individually or in combination with FYM increased the moisture holding capacity and available nutrient status of soils, significantly. Further, significant increase in the microbial population and enzymatic activity was recorded in both soils due to the above treatment. The total content of heavy metals / radionuclides in both the soils decreased due to the above treatment than the maximum dose. However, the increased concentration of heavy metals / radionuclides was far below the critical limit specified by WHO / FAO for normal soils.

Present investigation clearly indicated that application of pondash @ 30 t/ha along with FYM @ 20 t/ha was economical in increasing the higher returns in

sunflower groundnut cropping system in red soil and sunflower - maize cropping system in black soil.

## AGRICULTURAL ENTOMOLOGY

### Ecofriendly Approaches for the Management of *Spodoptera litura* (F.) in Groundnut

RAJASHEKHAR K. PATIL

2000

MAJOR ADVISOR : Dr. I. G. HIREMATH

Ecofriendly methods for the effective management of *Spodoptera litura* (F.) in groundnut were studying during 1996 to 1998 at Main Research Station, University of Agricultural Sciences, Dharwad. The EIL computed for third instar larvae of *S. litura* at flowering (30 DAS), peg formation (45 DAS) and pod development (60 DAS) stages was 1.04, 2.18 and 3.59 larvae per plant. At the corresponding stage, the egg load required to cause economic damage was 1.32, 2.90 and 8.74 egg masses per 7.5 m<sup>2</sup> or 25 m row, respectively. *Annona squamosa*, NSKE (5%) and *Allium sativum* (5%) exhibited good ovicidal property causing around 30 per cent mortality as compared to cent per cent in methomyl *in vitro*. The aqueous extract of NSKE (5%), *Vitex negundo* and *A. squamosa* caused more than 52 per cent mortality in neonate larvae. Among various combinations of plant products, NSKE + SINPV, *V. negundo* + SINPV, NSKE + *Nomuraea rileyi* and *V. negundo* + *N. rileyi* proved equally as recommended insecticides in reducing damage and recording higher yield with better B:C ratios. *Vitex negundo* and *A. mexicana* in combination with monocrotophos (0.025%) and *V. negundo* followed by monocrotophos (0.05%) recorded equal yield compared to recommended packages.

The entomopathogenic fungus, *N. rileyi* occurred in epizootic form on *S. litura* in groundnut during the rainy season. Persistence of *N. rileyi* on groundnut foliage during kharif was upto ten days. *In vitro* studies on compatibility of entomopathogen with fungicides, insecticides and botanicals indicated that fungicides were highly detrimental followed by insecticides and plant products. Soil application of the pathogen @  $2.5 \times 10^{12}$  conidia per ha followed by foliar spray @  $1.2 \times 10^{11}$  conidia per ha followed by spraying monocrotophos (0.05%) mixed with cyperconazole (0.1%) were the most effective combined applications.

All the groundnut genotypes under the study exhibited moderate to high degree of resistance or tolerance to the defoliator. Among the different histological parameters, higher laminar thickness, cuticular thickness and low water content were attributed for imparting resistance. Low growth index in Dh-52, Dh-53 and Dh-74 indicated the antibiosis mechanism operating in imparting resistance to *S. litura*. Difference in yield between unprotected and protected condition in selected genotypes was less compared to susceptible check (JL-24) indicating the tolerance mechanism.

### Investigation on the shothole borer, *Xyleborus perforans* (Wollaston) (Coleoptera : Scolytidae) on Pomegranate

S. B. JAGGINAVAR

2000

MAJOR ADVISOR : Dr. L. KRISHNA NAIK

Shothole borer infesting pomegranate was identified as *Xyleborus perforans* (Coleoptera : Scolytidae). The insect was noticed in all the gardens surveyed irrespective of source of varieties, type of soil and irrigation systems followed by the farmers. The per cent pomegranate plant wilting at northern Karnataka districts were ranged from 11.33 to 47.20 at Bagalkot, 11.22 to 29.68 at Bijapur, 2.00 to 6.66 at Belgaum, 4.48 to 8.13 at Koppal, 2.66 to 5.46 at Bellary, 2.28 to 5.60 at Raichur and 0.17 at Gulbarga. The plant wilting without shothole borer incidence was observed in the gardens less than 3 years age and ranged from 0.0 to 3.57 per cent as evidenced by the presence of the fungus,

*Verticillium* sp. The correlation between age of the plant and total number of shotholes indicated significantly positive relationship.

The external visible symptoms of infestation comprised of yellowing, followed by sudden drooping of leaves and ultimate death of the plants. The whitish yellow powder was seen coming out of the bored holes at the base of stem. In freshly infested plants, the powdery material was pushed out from the bored holes by the beetle which appeared like "burnt incense stick". Further, around the bored holes blackening of tissues were seen and the holes



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were in the horizontal plane of the entrance tunnels. The shotholes were often crowded at the collar region of the stem towards the shaded sides and the number declined towards the apical side. The density of immature stages and adults were maximum on primary roots followed by stem hidden in the ground and secondary roots whereas it was maximum at the collar region of the pomegranate plant.

The per cent plant drying due to shothole borer incidence with vascular tissues discolouration was observed throughout the year. Maximum wilting of pomegranate plants were observed in the month of August to November and peak active shotholes (5.26) were in November month.

Of the 19 pesticides applied as preventive control

measures, drenching with chlorpyrifos (3 ml/l) + carbendazim (1 g/l), carbaryl (6 g/l) + carbendazim (1 g/l), monocrotophos (1.5 ml/l) + carbendazim (1 g/l) and quinalphos (2.5 ml/l) + carbendazim (1 g/l) were found as best treatments during Ambe and Mrig bahars by recording higher reduction in per cent live shotholes and higher fruit yield without death of the plant at harvest.

Of the 12 pesticides applied as curative measures, drenching with chlorpyrifos (3 ml/l) + carbendazim (1 g/l) and monocrotophos (1.5 ml/l) + carbendazim (1g/l) emerged as the best treatments in recording, respectively 92.08 and 77.23 (Ambe bahar), 97.58 and 87.61 (Mrig bahar) per cent reduction in live shotholes, increased fruit weight, fruit number and absolutely no death of plants was seen till the harvest of fruits.

## CROP PHYSIOLOGY

### Physiological Indices for Higher Productivity in Greengram (*Vigna radiata* (L.) Wilczek)

RATNA KINKOR GOSWAMI

2000

MAJOR ADVISOR : DR.S.M. HIREMATH

Field experiments were conducted at Main Research Station, University of Agricultural Sciences, Dharwad during kharif seasons of 1998 and 1999 to find out the physiological indices for higher productivity in greengram genotypes. During kharif, 1998, 30 genotypes were taken and out of these, 20 genotypes belonging to different yield groups, i.e., high, medium and low yielding were selected for indepth studies during kharif, 1999. The experiments were laid out in randomized block design with three replications on medium black soil. Significant differences were observed for various morpho-physiological, biophysical and biochemical parameters, yield and yield components between the genotypes belonging to different yield groups and within the group.

The high yielding genotypes possessed significantly higher number of leaves and primary branches as compared to other genotypes besides having higher values for LAI, CGR, LAD and BMD. These genotypes were also efficient with respect to production and partitioning of total dry matter,

particularly in reproductive parts. Significantly higher photosynthetic rate and nitrate reductase activity were also recorded in the genotypes belonging to high yielding group. The important yield components, i.e., number of fruiting clusters, pods, seeds per plant and harvest index were significantly higher in high yielding genotypes. All the above traits recorded significant positive association with seed yield.

The important morpho-physiological traits associated with higher productivity in greengram are higher number of leaves, higher TDM, LAI, CGR, LAD, BMD, photosynthetic rate, nitrate reductase activity, higher number of fruiting clusters, pods, seeds per plant and higher harvest index. These traits may be considered important for developing an ideotype concept in greengram. Among the genotypes, M-446 and M-100 were found physiologically efficient and possessed significantly higher values for all the above traits and may be used as a genetic source for improvement of yield potential in greengram.

**Physiological Indices for Higher Productivity in Foxtail Millet (*Setaria italica* (L.) Beauv.)**

A. G. BHOITE

2000

MAJOR ADVISOR : Dr. M. B. CHETTI

Field experiment was conducted at College of Agriculture, University of Agricultural Sciences, Dharwad during kharif seasons of 1998 and 1999 to find out the physiological indices for higher productivity in foxtail millet. Experiments were laid out in randomised block design with three replications on medium black soil under rainfed conditions. During kharif, 1998, 56 genotypes were screened for various morphological, growth, phenological, yield and yield components. On the basis of results of first season experiment, seven genotypes each in low, medium and high yielding group along with national check were subjected for detailed analysis of physiological, biophysical, biochemical, nutritional and quality parameters. It was observed that the crop performance was better during kharif, 1998 as compared to kharif, 1999 owing to better rainfall, but the behaviour of genotypes did not change between the two years.

Genotypes GPM-14, SIA-2652 and GPM-12 recorded significantly higher grain yield and these genotypes

had more number of tillers and green leaves per plant, higher LA, leaf, stem earhead and total dry matter. Among growth parameters, LAI, LAD, CGR, RGR, SLW and BMD were found to have significant positive correlation with grain yield. The high yielding genotypes possessed higher stomatal frequency (abaxial), veinload frequency, photosynthetic rate, total chlorophyll content, NRA and stomatal conductance and moderate transpiration rate.

Higher contents of crude protein, moisture and ash coupled with low fat, crude fibre and carbohydrates and minimum cooking time with higher water imbibing capacity and grainy textural quality after cooking were evident in the high yielding genotypes. They also had higher grain yield, panicle number per plant, panicle length, grain number per panicle, 1000 grain weight and per day biomass and grain productivity. Results thus revealed that for higher productivity in foxtail millet, such traits can be incorporated successfully in breeding for an ideal plant type.

**GENETICS AND PLANT BREEDING**

**Genetic and Physio-Biochemical Analysis of Pod Shattering and Productivity Related Traits in Soybean (*Glycine max* (L.) Merrill)**

AJAY PRAKASH AGRAWAL

2000

MAJOR ADVISOR : Dr. S. A. PATIL

A collection of 196 germplasm lines was evaluated in three seasons for pod shattering as well as productivity. Observations were made on plant growth, pod characters related to shattering and yield attributes. Plant growth and pod characters showed low to moderate genotypic coefficient of variation except pod weight, seed to pod shell ratio, pod shattering and yield attributing traits. Habitability and genetic advance was high for all the traits except days to maturity, seeds per pod, pod length and pod width. Characters contributing towards pod shattering resistance were pod weight, pod length and pod thickness. Following Mahalanobis D<sup>2</sup> analysis, shattering resistant genotypes identified were grouped in five clusters, of which EC-14396, CGP-268 and GP-2340-A were also promising for seed yield.

A diallel set of crosses was made using five genotypes representing the variation in pod shattering. Yield attributing traits were under the control of both additive and

non-additive gene action. Plant growth and pod characters along with pod shattering were governed by additive gene action except for degree of indeterminate growth habit, seeds per pod, pod width and pod shell thickness. Pod shattering susceptibility was partially dominant over resistance and the data indicated the possibility of developing shattering resistant genotypes by crossing resistant parents.

Physiological parameters related to pod development indicated that growth rate and dry matter accumulation in pod and seed were negatively correlated with pod shattering. However, pod shell growth rate was positively correlated with pod shattering. Assay of four cell wall degrading enzymes in shattering and non-shattering zones of resistant and susceptible varieties indicated that cellulase play an important role in pod shattering process. The action of polygalactouranase was opposite to cellulase,

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but did not exhibit clear involvement. Peroxidase and polyphenol oxidase did not show any trend in either the pod shattering resistant or susceptible genotypes. The study

was able to identify Bragg x JS-335 as potential combination worth handling for developing pod shattering resistant as well as high yielding genotypes.

### Genetic Analysis of Heat and Drought Tolerance in Tetraploid Wheat

V. RUDRA NAIK

2000

MAJOR ADVISOR : Dr. R. R. HANCHINAL

Investigation were carried out to study the genetic of heat and drought tolerance in tetraploid wheat. The study involved, evaluation of 200 germplasm lines, parents and the hybrids developed using selected lines from germplasm evaluation and 12  $F_2$  populations of selected  $F_1$  hybrids. All the evaluation were done both under irrigated and rainfed conditions during the rabi season 1996-1998 at MRS, Dharwad. Observations recorded on days to 50% flowering, spikes / meter, grains / spike, peduncle length, days to maturity, plant height, grain yield / plant, 1000 grain weight, total biomass / plant, harvest index, root length, root weight, canopy temperature depression and total chlorophyll content.

Evaluation of germplasm material indicated the presence of considerable variability for various morphological characters including yield components as well as root characters related to drought and physiological

characters including canopy temperature and chlorophyll contents. Evaluation of  $F_1$ 's indicated, DWR-2006 x DWR-1006, NP-200 x DWR-185 and DWR-2006 x DDK-1001, are to be potential crosses as far as variability is concerned for important characters like: GPS, TBP and HI. Combining ability studies indicated the preponderance of additive variance for majority of the characters related to drought and heat tolerance. B. Yellow, DWR-2006, DDK-1009, DWR-185 and DWR-1006 were identified as good general combiners. Four hybrids viz., B. Yellow x DDK-1001, B. Yellow x DDK-1009, NP-200 x DDK-1001 and DWR-2006 x DWR-185 were identified as the potential material for using them for further breeding program to isolate the lines combining high yield and better tolerance to drought. The path analysis indicated TBP to be the most important character followed by HI and RW under both stress and stress free conditions.

### Heterosis and Combining Ability Studies in Intra-Hirsutum Crosses of Cotton (*Gossypium hirsutum* L.)

R. K. PATNAIK

2000

MAJOR ADVISOR : Dr. S. A. PATIL

Cotton has gained more global importance than ever before as a major textile fibre. At present, *Gossypium hirsutum* is the predominant species having relatively high productivity and wide adaptability. The present investigation was aimed to identify the best boll worm tolerant hybrids having high standard heterotic potential for yield and fibre quality parameters for rainfed condition under both protected and completely unprotected situations and to assess the potentiality of  $F_2$  population of popular hybrids for commercial exploitation.

Association studies revealed that most of the characters displayed highly significant positive correlation with seed cotton yield. Path coefficient analysis reveal that boll number, plant height, number of sympodia and lint yield were the most important characters determining yield. Nine hybrid combinations exhibited significant heterosis over commercial check for most of the characters. The cross CPD-448 x RAMPBS-155 was the best hybrid under

protected condition but CPD-420 x LRA-5166 recorded significant standard heterotic effect in both protected and completely unprotected condition for most of the characters. Sca variance was higher than gca for all characters except tannin content in boll rind, boll weight and internodal distance.

An improved per cent gca method of determining pooled score was compared with the simple gca method. In order to overcome the inherent disadvantage in simple pooled score analysis, differential weightages were attached to each character based on their importance. The best general combiners were LRA-5166 and CPD-420. Among the  $F_2$  populations, Savita  $F_2$  was found to be productive and utilized for commercial exploitation.

Based on gca status good general combiners and their combinations were identified for developing superior population and further exploitation.



**An Analysis of Mutational Origin of Genetic Diversity in Groundnut (*Arachis hypogaea* L.)**

R. SHESHAGIRI

2000

MAJOR ADVISOR : Dr. M. V. C. GOWDA

An investigation into nature and utility of Mutational Origin of Genetic Diversity in Groundnut (*Arachis hypogaea* L.) was carried out during 1995-1999. The material consisted of the mutants derived from Dharwad early runner (DER).

The mutagenic treatment of DER with gamma-rays and ethyl methane sulphonate (EMS) generated high frequency of mutants representing all four botanical types of groundnut viz., Spanish bunch (SB), Valencia (VL), Virginia bunch (VB) and Virginia runner (VR). A detailed analysis of the breeding behaviour of these mutants revealed several unusual features such as, homozygous mutations, multiple character mutations, germinal reversions, segregation distortions, non-random mutations etc. The non-Mendelian turnover mechanisms such as transpositions, retropositions, DNA methylation, gene conversion, unequal crossing overs etc. were invoked as possible causes of mutations. Treatment of DER with 5-Azacytidine, a demethylating agent also induced such sub specific and botanical changes indicating a role for methylation in the botanical differentiation of the crop. The mutagens EMS, gamma rays and 5-Azacytidine might have triggered the non-Mendelian turnover mechanisms.

Selected DER mutants representing four botanical types were assessed for morphological, cytological and biochemical variability. The analysis of variance and principal component analysis revealed abundant morphological variability, which was

comparable to the natural variation existing in the crop. The karyotypic analysis did not showed any significant variation among the mutants except the number and location of asymmetric chromosomes and secondary constrictions. A very low sterility in parents but high pollen sterility in  $F_1$  and  $F_2$  plants was observed in the crosses between mutants belonging to different botanical groups. However, the meiotic analysis indicated normal chromosome pairing except the appearance of a quadrivalent in both, the parents and hybrids. The glutamate oxaloacetate transaminase (GOT) isozyme analysis showed three banding patterns, which were specific to the botanical groups viz., SB, VL and VB/VR. Three polymorphic bands were identified from the seed protein analysis (SDS-PAGE), which distinguished the mutants belonging to two subspecies. Thus, the mutants representing different botanical types at morphological level might be mere expression syndromes at molecular / physiological level.

The mutagenesis of DER has resulted in identification of several useful mutants resistant to foliar diseases. Recurrent mutagenesis of selected resistant mutants with EMS and gamma-rays revealed the mutagen and genotype specifically in their mutagenic response. The recurrent mutagenesis was found to be a potential tool to improve for other characters, retaining resistance in these mutants. The use of resistant mutants along with a resistant germplasm line in three way crosses was found to be a potential approach to improve resistance and productivity, simultaneously.

**Genetics of Yield, Yield Components and Fruit Quality Parameters in Chilli (*Capsicum annum* L.)**

R. C. JAGADEESHA

2000

MAJOR ADVISOR : Dr. S. J. PATIL

Investigations were carried out to know the combining ability, heterosis and to study the gene effects for quantitative and qualitative characters in chilli during kharif 1997-99. The study involved the evaluation of 45 hybrids along with 18 parents to assess combining ability of parents, estimation of heterosis over better parent and to identify the potential hybrid combination for 17 growth, yield, quality and resistance traits. The combining ability studies indicated that the parents kaddi, VN-2, Jwala, LCA-312, KDC-1 and Arkalohit could be utilised in breeding

programme since they expressed highly significant positive GCA effects for dry fruit yield per plant. The parents VN-2, LCA-301, PMR-5 and CA-219 for thrips and VN-2, Hissar shakti and Arkalohit for mites were found good general combiner. Evaluation of  $F_1$ s indicated that the crosses VN-2 x B-24, Kaddi x KDC-1 and Kaddi x PMR-5, VN-2 x Arkalohit, VN-2 x Jwala and Kaddi x Arkalohit are found promising could be exploited. The hybrid combination Kaddi x Phule-5, Hissar Shakthi, VN-2 x LCA-312, Dabbi x LCA-312, Dabbi x Arkaabir and Kaddi x BC-14-2 were identified

## Abstract of Theses

as potential material for further breeding programme, promising recombinants are derived from the cross Kaddi x LCA-312 and Dabbi x LCA-312 could be advanced to derive pure lines.

To understand the nature and magnitude of gene effects nine crosses were analysed through generation mean analysis for 15 character. The study indicated that the growth related traits were found to be under the control dominance and additive x additive type of gene interaction.

Fruits related traits were under the control of additive, additive x additive type of gene interaction.

Resistance to thrips and mites was under the control of non-additive gene effects i.e. dominance, additive x additive and additive x dominance. It suggests that inclusion of parents having high level of resistance for the development of hybrids or to derive pure lines. Dry fruit yield was under the control of dominant and additive x additive type of gene interaction.

In order to exploit non-additive gene action development of hybrids is suggested. For the development variety recurrent pedigree selection programme is suggested involving the parents having high level of resistance with high fruit quality traits.

## PLANT PATHOLOGY

### Biological Control of Charcoal Rot of Sorghum (*Sorghum bicolor* (L.) Moench) Caused by *Macrophomina phaseolina* (Tassi) Goid.

SUNIL A. DESAI

2000

MAJOR ADVISOR : Dr. SRIKANT KULKARNI

Biological control of charcoal rot of sorghum caused by *Macrophomina phaseolina* was undertaken utilizing 26 native and 12 commercial isolates of antagonists.

Native isolates of *Pseudomonas fluorescens*, *Trichoderma harzianum*, *T. viride* and *Gliocladium virens* exhibited high antagonistic potential. Talc formulation, wheat bran : saw dust : tap water, papaya ripe fruit, farm yard manure, coffee berry skin, gobar gas slurry, mushroom spent bed, pigeonpea husk, press mud and dung were superior substrates for mass multiplication of test antagonists. Ammonium sulphate and diammonium phosphate additives enhanced multiplication. *Pseudomonas fluorescens* grew well on dung. Combined application of *P. fluorescens* with species of *Trichoderma* and *Gliocladium* as seed treatment @ 4 g per kg and soil application (150 kg/ha) method was most effective to reduce charcoal rot. Soybean, wheat, tagase, pigeonpea and sorghum seeds supported quick multiplication of test antagonists. Storage temperature of 15°C was congenial for prolonged shelf life and milky white polythene bags enhanced population of antagonists. Sclerotial

germination and disintegration was higher in coconut and sesamum oil cake extracts, respectively. Sclerotia remained viable upto 36 months. Extracts of garlic clove, camphor, leaf extracts of bitter melon, pongamia, amaranthus, periwinkle, ashoka, mosambi, lakki and oils of eucalyptus, tulsi and karanj were inhibitory to pathogen. Neem flower extract was inhibitory to pathogen and stimulatory to test antagonists. Triazoles were lethal whereas metalaxyl and carbofuran exhibited mycotoxic effect of test antagonists at lower concentration. Integration of antagonists with biofertilizers was confirmed.

Carbendazim, thiram, urea, chlorpyrifos, glyphosate, alachlor, trifluralin were inhibitory to fungal antagonists and pathogen. Copper ore tailings and fly ash were safer to antagonists. Non fungicides recorded fungistatic inhibition.

Integrated management of sorghum charcoal rot disease was achieved through combined application of native isolates of antagonists resulting in 13.56 per cent increased thousand grain weight.