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

DOCTOR OF PHILOSOPHY

AGRONOMY

Studies on Weed Management in Rainfed Chilli + Cotton Intercropping System

M.B. PATIL 1999 MAJOR ADVISOR: Dr. V.C. PATIL

A field experiment was conducted during 1991-92 and 1992-93 under rainfed conditions at Main Research Station, University of Agricultural Sciences, Dharwad. In, this experiment, the effect of weed management treatments on the growth, yield and quality of cotton (DCH-32) and chilli (Byadagi kaddi) under chilli + cotton intercropping system was studied. Randomized complete block design was adopted with from replications.

Among different weed management treatments, higher weed density at all the stages of crop growth during both the years was observed with weedy check and pendimethalin + oxyfluorfen (tank mix). Owing to the season long weed-free conditions, cent per cent weed control efficiency (WCE) was recorded with weed free check. The weed control efficiency showed an increased trend with two hand weeding + two hoeings (30, 60, 90 and 120 DAT) and oxyfluorfen (0.2 kg a.i. ha-1) followed by glyphosate (1.0 kg a.i. ha-1) up to 120 DAT and thereafter it declined. The WCE at 30 and 60 DAT was comparatively lower with pendimethalin or fluchloralin each at 1.0 kg a.i. ha-1 or oxyfluorfen at 0.1 kg a.i. ha supplemented with one hoeing and it was effectively brought up at 90 DAT due to hoeing at 75 DAT. The dry matter production and nutrient depletion by weeds also followed a similar trend. Number of weeds, dry matter production and uptake of nutrients by weeds were negatively correlated with chilli seed cotton yield.

Significantly higher dry chilli yield was obtained from the plots which were kept weed-free through out the crop growth period (907 kg ha^{-1}) that received two hand weedings and two hoeings (870 kg ha^{-1}) than in all other treatments except oxyflorfen followed by glyphosate. Similarly, weed-free check plots that received multiple intercultivations and hand weedings out yielded all other treatments in seed cotton yield. Seed cotton yield per ha obtained with two hand weedings and two hoeings (1284 kg ha^{-1}) was on par with oxyfluorfen followed by glyphosate (1188 kg ha^{-1}). However these treatments were superior to all other treatments in seed cotton yield. The increase in the dry chilli and seed cotton yield with oxyfluorfen followed by glyphosate or conventional method than other treatments may be ascribed to the increase in growth and yield attributing characters of both chilli and cotton due to effective control of weeds.

Due to higher economic yield and market price of chilli and seed cotton, higher net income and benefit to cost ratio was obtained with weed free check, two . hand weedings + two hoeings and oxyfluorfen followed by glyphosate.

HORTICULTURE

Studies on Mutants Vis a Vis Drought Tolerance in Acid Lime Cv. Kagzi

ANAND N. MOKASHI 1999 MAJOR ADVISOR: Dr. G.S. SULIKERI

Experiments on field performance of induced non-systemic mutants of acid lime Cv. Kagzi (Citrus aurantifolia Swingl.) were carried out at the Main Research Station, University of Agricultural Sciences, Dharwad during the years 1994-97 for their drought tolerance and drought acclimation potential of selected mutants through morpholoical, physiological and biochemical parameters at seedling stage.

Irradiation as mutagen helped in creating variability as revealed by Mahalanobis D^2 analysis. The genetic diversity reflected in the distribution of the mutants into six clusters, with highest genetic diversity between cluster II and cluster IV (51.94). Among the mutants tested for field performance, mutants M_1-2 and M_1-22 topped for their yielding ability. The different yielding ability of the mutants is primarily ascribed to the number of fruits retained per shoot and the fruit size.

In the drought acclimation potential studies, it was found that the parameters that could be adopted to screen the mutants for drought resistance are length and density of roots, root shoot ratio, leaf area and duration among the morphological parameters; total dry matter, stomatal frequency, relative water content (RWC), chlorophyll content, chlorophyll stability index (CSI) among the physiological parameters and free proline, epicuticular wax

content, sugars, starch, protein and nitrate reductase activity among biochemical parameters. The combination of these parameters would be more appropriate to isolate than using them independitly.

The fruit quality of M_1-2 and M_1-22 was also not inferior in comparison to others with higher juice volume, weight and thin papery peel. Considering the yield potentialities, tolerance to drought and the fruit quality parameters, M_1-2 and M_1-22 mutants were found promising.

Studies were also conducted on standardization of protocol for micropropagation of the drought tolerant mutant M_1-22. The highest number of shoots per explant was observed in MS medium containing 0.5 mg/l BAP and 0.1 mg/l NAA. Better rooting of micro-shoots was observed in the basal MS media containing 1.0 mg/l IBA.

Water and Nutrient Management Studies in Cabbage (*Brassica oleracea* L. Var. capitata) cv. Pride of India

K.H. BHAGAVANTAGOUDRA 1999 MAJOR ADVISOR: Dr. A.K. ROKHADE

Studies on the effect of irrigation schedules and methods of irrigation, levels and sources of sulphur, levels of nitrogen and methods of *Azospirillum* inoculation on growth, yield and quality of cabbage cv. Pride of India were conducted at University of Agricultural Sciences, Dharwad in red sandy clay loam soils during the rabi seasons of 1997-98 and 1998-99.

Scheduling of irrigation at 1.6 IW/CPE ratio resulted in significantly highest yield of 34.40 t ha-', which is 28.76 per cent more than that obtained with irrigation at 1.0 IW/ CPE ratio (25.94 t ha-'). Furrow method of irrigation has resulted in significant increase in cabbage head yield (31.28 t ha-^{1}) by 9.21 per cent over alternatively alternate furrow method (28.40 t ha).

Based on the economics of irrigation methods, the quantity of water saved by irrigating through alternatively alternate furrow method was 38 per cent compared to furrow method. By utilizing the water saved, an additional area of 0.61 ha can be irrigated to get an additional yield of 14.44 t by which an extra income of Rs.57,760 can be realised by following alternatively alternate furrow method in place of furrow method.

Application of sulphur in the form of single super phosphate, gypsum and elemental sulphur at two levels viz., 20 and 40 kg S ha-^{1} showed a mean increase in cabbage head yield by 9.99 to 26.60 per cent over control. Based on the economics and other merits of gypsum, application of S at 40 kg ha-^{1} in the form of gypsum was found to be economical for higher productivity.

Inoculation of Azospitillum through soil + seedling dipping recorded significantly highest yield of cabbage (41.61 t/ha^{-1}) which is 33.67 per cent more than that obtained in control (31.13 t ha^{-1}). The highest B:C ratio of 4.29 was obtained by application of *Azospirillum* through soil + seedling dipping along with 100 per cent RDN. Application of *Azospirillium* through soil + seedling dipping along with 100 per cent RDN produced 31.76 per cent higher yield over only RDN (100%) without Azospirillum.

Clonal Multiplication of Black Pepper (*Piper nigrum* L.)

HEMANT G. HEGDE 1999 MAJOR ADVISOR : Dr. N.C. HULMANI

Studies were conducted to develop a protocol for micropropagation of black pepper (Piper nigrum) through axillary shoot multiplication. Also different plant propagation structures and season of planting for rooting of cuttings were evaluated. The studies were conducted at the Agricultural Research Station (Pepper), Sirsi and laboratories of the College of Forestry, Sirsi, University of Agricultural Sciences, Dharwad during 1995-99.

Surface disinfection of shoot tip or nodal bud explants with sodium hypochlorite (2%) for ten minutes was found optimum. The explants collected during February to May gave better establishment. The young buds from the tip to the sixth nodal segment gave better establishment of cultures.

MS semisolid medium with half the strength of its inorganic salts supplemented with BA 2 mgl^{-1} and 30 gl^{-1}

sucrose was suitable for shoot establishment as well as shoot multiplication (5.13 buds/culture). The multiplication rate increased with repeated subculturing on media of same composition at. 15 days interval. Rooting of in vitro derived shoots was achieved in *in vitro* as well as *ex vitro* conditions. Cent per cent rooting was obtained under in vitro conditions in medium supplemented with NAA 1 mgl^{-1} and 30 gl^{-1} sucrose. Quick dipping the cut ends of shoots in 1000 ppm IBA enhanced *ex vitro* rooting up to 68 per cent.

Pre-hardening treatments enhanced establishment of micropropagated plantlets. A potting mixture containing 1:1 sand + coir pith was superior for establishment of plantlets. The application of 10 ml of $^1/_2$ MS or Hoogland nutrient solution at weekly intervals was beneficial for vigorous growth of transplanted plantlets.

The propagation of black pepper by conventional means through cuttings was best in propagation frame or polyhouse during summer (94%).

AGRICULTURAL ENTOMOLOGY

Studies on Rock Bee, *Apis dorsata* F. and Management for Honey Harvest

H.N. SATTIGI 1999 MAJOR ADVISOR : Dr. K.A. KULKARNI

Investigations on the seasonal abundance, nesting behaviour, comb structure, colony strength, was recovery and management of *Apis dorsata* F. revealed the following.

The colonization of rock bee was significantly high during August and October and least during January on both nesting sites. Similarly, de-colonization was more during December and less during March. The abundance was more during October and least during February on both types of nesting sites. The rock bees preferred to nest on terrestrial (84.1 1 %) than on arboreal sites. On terrestrial sites, maximum colonies were found on light coloured horizontal supports on eastern side and at 5 to 10 meter height from ground level with maximum orientation in northsouth direction. On arboreal sites the slanting support recorded maximum colonies.

Though, the terrestrial comb measured more than the arboreal comb. the comb thickness and different cell number per unit area did not vary. The honey cell depth was more followed by queen, drone and worker cell. The diameter of honey cells was more than the worker and drone cells. The deserted terrestrial and arboreal comb weighted 683.42 and 441.60 g, respectively. The per cent wax recovery was, 48.50 and 48.46 from deserted terrestrial and arboreal combs, respectively. The C:B ratio for wax extraction was high from deserted arboreal combs.

The sap from wild cardamom and smoke produced by burning the gaurage waste was effective in repelling the rock bees. Among the techniques, the cutting and removal of honey area from rock bee colonies with saw edged knife was highly effective without much wastage of honey and damage to the comb. The rock bees settled back on the same comb immediately and continued to stay and rebuilt the honey area. The honey yield per colony from single harvest was 1356.33 g.

AGRICULTURAL ECONOMICS

Economic Evaluation of Gulbarga Milk Union, Karnataka State

SURESH S. PATIL 1999 MAJOR ADVISOR : Dr. G.K. HIREMATH

The present study aimed at the economic evaluation of dairy units and performance of Gulbarga Milk Union operating in Bidar and Gulbarga districts of Karnataka State. A multi-stage sampling technique was employed in the selection of districts, taluks, villages and target groups for the study.

The population of cows and buffaloes in Bidar and Gulbarga districts grew at 0.85 and 3.65 per cent for cows and 8.28 and 3.16 per cent for buffaloes respectively, from 1951 to 1990 indicating a scope for dairy activities.

In general, sample dairy owners had an average of

3.0 milch animals comprising of 28.53 per cent crossbred cows 20.72 per cent local cows and 50.75 per cent buffaloes. The net return was maximum in the high milk producing group (Rs.11,806/-) followed by medium (Rs.8,287/-) and low dairy group (Rs.7,315/-). The benefit cost ratio was the highest from the crossbred cows (1.99) followed by local cows (1.74) and buffaloes (1.71).

Taluks of Bidar and Gulbarga districts were clustered into regions of potential and market driven dairy development based on rainfall, irrigation, fallow land, intensity of cropping and the extent of industrialisation. The per litre cost of milk production was Rs.4.74 in corossbred cow, Rs.6.39 in local cow and Rs.6.54 in buffaloes. The corresponding net returns were Ws.0.62, 1.32 and 0.55 per litre of milk.

The performance of the dairy units is judged by the important parameters viz., the number of crossbred cows, milk productivity, grazing land, area under fodder, availability of green fodder, concentrates and veterinary services in all the groups which was revealed by the principal component analysis. Financial ratio analysis indicated that the'milk union' had not performed well on account of increase in liability due to investment in fixed assets, low rate of liquidity lower networth position and declining trend in profitability overtime. The state of poor performance of the union was reflected in terms of the problems faced by the union in poor resource management, low infrastructural facilities, low capacity utilization due to high fluctuation in the milk procurement, high procurement cost, high overhead cost and cutthroat competition from the private milk agencies.

The important policy measures suggested were to increase operational efficiency to reduce cost, strengthening dairy co-operatives, improve capacity utilization of dairy plants and prompt delivery system of milk to consumers.

Yield Gaps and Constraints in Production of Major Crops in North Karnataka - An Economic Analysis

G.M. GADDI 1999 MAJOR ADVISOR: Dr. S.M. MUNDINAMANI

The present study was conducted to ascertain the yield gaps and constraints in the production of jowar, groundnut and cotton in north Karnataka. Primary data from 240 sample farmers and secondary data from ' concerned research station were collected for the agricultural year 1996-97. Tabular, Cobb-Douglas and Frontier production function, Path and Decomposition Analyses were used for the analysis of data.

The index of yield gap worked out to be 58.83 per cent, 57.43 per cent and 56.55 per cent for jowar, groundnut and cotton, respectively. Nearly 70 per cent of potential farm yield in jowar and groundnut and 65 per cent of the potential farm yield in cotton was realised by the sample farmers. The significance of the dummy (technique of production) coefficients confirmed the structural difference in the production surfaces between the demonstration plots and the farmers field.

Path analysis revealed that input gaps have a high degree of association with the yield gaps. Plant nutrient excerted the maximum direct effect on the observed yield gap in jowar and groundnut, whereas, it was human labour in cotton. Decomposition analysis also showed that difference in cultural practices between farmers field and demonstration plots was the major contributing factor to the yield gap, in jowar (21.42%) and cotton (27.79%), while input gap contributed for the highest share in groundnut (18.58%). Among the various inputs, plant nutrient (Jowar and groundnut)'and human labour (cotton) accounted for the major portion of the yield gaps.

In the study area jowar sample farmers achieved about 70 per cent frontier output, whereas, slightly greater (>80%) efficiency was recorded by groundnut and cotton sample farmers. The Kopp measure of allocative efficiency analysis showed a very high degree of inefficiency in the use of resources for all the three crops. The resource use efficiency analysis revealed that profitability ratio, for most of the crops differed from unity. Thus, there is a need for reallocation of expenditure among different resources so as to optimise the crop production.

GENETICS AND PLANT BREEDING

Genetic Investigations, Characterisation and Fibre Colour Development Studies in Naturally Coloured Cottons (*Gossypium* spp.)

SIDHARATHKUMAR S. SHIRSAT 1999 MAJOR ADVISOR : Dr. B.M. KHADI

Significant genetic variation, moderate to high heritability and genetic advance were observed in 22 genotypes and 10 hybrids. Some of the brown linted G. *hirsutum* and G. *arboreum* genotypes were high performing and could be used directly for commercial cultivation whereas green linted genotypes were poor in performance. No colour cotton genotype was having long, extra long staple length and all genotypes were very poor in fibre strength. The per se performance of colour cotton hybrids was better than their colour linted parents. Some of the colour cotton hybrids were on par with DHH-1 1 and NHH-44. Similar trend was observed for heterosis.

When only colour and white classes were considered it was observed that fibre colour was incompletely dominant and governed by single gene in *G. hirsutum* and by two-gene interaction (dominant epistasis) in *G arboreum* and colour class could be divided into six overlapping classes indicating presence of continuous variation.

In colour cotton genotypes significant positive association of seed cotton yield (SCY) and lint yield (LY) was observed with all growth parameters, except for seed index (SI) and boll weight (BW). In hybrids, indirect relation between SCY, LY, LI, GOT and BW and SI made correlations very complex. The fibre fineness was most important fibre quality parameter as it had significant negative relation with all other characters. Its importance was confirmed by path analysis of fibre length.

In colour cotton genotypes BW, SI, GOT, LI and in hybrids BW, number of bolls (NB) and GOT were important contributors to seed cotton yield. Lint yield path analysis indicated the importance of SCY, LI, SI in colour cotton genotypes and SCY, LI and BW in hybrids. Path analysis for fibre quality index (FQI) indicated that fibre length, fibre fineness and fibre strength were most important and for counts strength product (CSP) FQI was found most important. Six generation analysis revealed that gene effects like dominance and interaction (DS-28 x DGH-95, DS-28 x DBH-95), additive, dominance and additive x dominance (DBH-95 x DGH-95), additive and interaction (Abadhita x DGH-95), additive and dominance x dominance (DBA-95 x A-82-1-1) were predominant. The EMS treatments of 0.2 and 0.3 per cent were best for *G. arboreum* and *G. hirsutum* respectively as they could yield high number of desirable mutants and high variation for yield fibre quality and fibre colour shades.

The number of days required for development of colour in fibre varies with genotypes and species. It was 33-37 days after pollination (DAP) in *G. hirsutum* green, 35-38 DAP in *G. hirsutum* brown cotton and 48-51 DAP in *G. arboreum* brown Cotton. It was possible - to characterise electrophoretically *G. arboreum* colour cotton from white ones as it had only one band as compared to three bands in white linted genotypes. In case of *G. hirsutum* colour and white linted genotypes characterisation was difficult as both had two bands nearly same Rm distance. The actual pigments responsible for fibre colour in *G. hirsutum* and *G. arboreum* were different but pigments belonged to general class of flavonoids.

AGRICULTURAL MICROBIOLOGY

Studies on *Azospirillum* Isolates of Ornamental Plants and Their Effect on *Gaillardia pulchella* var picta Fouger

RAVI GADAGI 1999 MAJOR ADVISOR : Dr. J.H. KULKARNI

Investigations were carried out on the isolation, identification, genetic diversity, screening of *Azospirillum* and their inoculation effect on the growth and flowering of Gaillardia. Attempts were made to improve the nitrogen fixing efficiency of *Azospirillum* through mutagensis.

From the present investigation, it can be concluded

that *Azospirillum* is common inhabitant of roots of ornamental plants. From the 88 isolations made, 55 per cent of isolate were *Azospirillum lipoferum* while *Azospirillum brasilense* represented 41.57 per cent. The nitrogen fixation by *Azospirillum* isolates in the semi solid medium ranged from 1.40 (OAD-36 and OAD-72) to 20.54 (OAD-2) mg g-' of malate. Further, ability to fix dinitrogen was also confirmed by acetylene reduction assay. Although all the *Azospirillum* isolates could produce variable quantity of IAA and GA, Strain OAD-57 produced the highest plant growth promoting substances. Genetic diversity of *Azospirillum* isolates was analyzed through intrinsic antibiotic resistance, protein and plasmid profile. The isolates showed wide diversity with respect to intrinsic antibiotic resistance. However, using the protein finger printing the two definite groups of *Azospirillum* could discerned. All the isolates contained only one plasmid (22 kb).

Seven efficient isolates were selected for further field study, based on preliminary screening of all the isolates under pot culture. From the field experiment, it can be concluded that OAD-2 can play an important role in the Nnutrition of Gaillardia pulchella. Further 25 Azi^R and EDA^R mutants were obtained through NTG mutagenesis. These mutants had higher nitrogenase activity and in vitro N fixed g^{-1} malate. The Azi^R OAD-904 and EDA^R OAD-209 performed better than their respective wild type, in pot cultures in augmenting plant growth and N-uptake of *Gaillardia pulchella*.

FOODS AND NUTRITION

Nutritional and Processing Qualities of Diococcum (*Triticum dicoccum* schrank, 'suhulb) Wheat Varieties

BHUVANESWARI, G. 1999 MAJOR ADVISOR : Dr. NIRMALA B. YENAGI

Interest towards utilization of.hulled dicoccum wheat has been increased in, agriculture due to the low input techniques used for their management. Since quality is the most important criterion in the promotion of dicoccum wheat genotypes, eight dicoccum wheat varieties along with one each check varieties of durum and bread wheat were studied for nutritional, technological and therapeutic qualities for gainful utilization. Physico-chemical, carbohydrate profile, in-vitro protein and carbohydrate digestibility were analyzed by standard procedures. Fractionation of glutenin and gliadin proteins was carried out by sodium dodecyl sulfate Polyacrylamide gel electrophoresis. Varieties were also evaluated for milling, buigurisation, popping, baking, pasta making and extrusion qualities. Glycemic index of dhalia and semolina of commercially available dicoccum wheat, DDK-1001 was determined to assess the therapeutic quality. Visual observation revealed that almost all the dicoccum wheats were reddish in colour and elongated with pointed ends. Thousand Kernel Weight of dicoccum wheats was lower than durum wheat. The hardness values of dicoccum wheats were ranged from 3.1 9 to 6.60 kg/grain. Nutritionally, dicoccum wheats were rich in protein, total sugar and dietary firbre contents and good source of ash and β-carotene contents. Dietary fibre and low carbohydrate digestibility were the contributing factors for low glycemic index of dicoccum wheat products. Good semolina milling potential of dicoccum wheats and good cooking qualities were found to be highly suitable for preparation of pasta products and extrudates. -45 gliadin band was the contributing factor for better pasta quality. Dicoccum wheats also showed a good popping quality. Buigurisation was the most suitable processirfg method for dicoccum wheats as it improved the mililing, popping and cooking qualities. Dicoccum wheats showed potential for bread making quality due to the presence of 1^1, 1 and 7+8 glutenin bands. Nutritionally superior and good processing potential dicoccum wheat varieties were DDK-1001, DDK-1016, DDK-1009, NP-200 and 278-13.

Promotion of Vitamin a Status Through Horticulture Intervention

KASTURIBA, B. 1999 MAJOR ADVISOR: Dr. RAMA K. NAIK

The investigation focused on vitamin A status and impact of synthetic and horticulture intervention on vitamin A status. Vitamin A status of 153 school children of Dharwad taluk was assessed by dietary, anthopometry, clinical and biochemical analysis. Children with serum retinol level less than 20 g/100ml were included in intervention

study. Children from group-I formed the control, a single massive oral dose of 2,00,000 IU of vitamin A was given to group-II, horticultural intervention was given to group-III daily for 3 months, where standardized receipes (fenugreek chapathi, drumstick leaves chapathi and carrot bhaji) met days's vitamin A allowance (2400 / g/day). 'Serum retinol level, haemoglobin level, anthrigometric parameters and morbidity pattern were recorded before and after supplementation period.

The intake of all the nutrients of sample was less compared to recommended dietary allowances. The adequancy of iron and β-carotene was less than 50 per cent. As per Waterlow's, classification, 29.41, 62.09, 5.23 and 3.27 per cent were in normal, stunting, wasting and stunting and wasting group, respectively. Majority fell in the category of low level of serum retinol and anemic group. The prevalence of xerosis, night blindness and bitot's spots was 4.58, 0.65 and 0.65 per cent, respectively. Significant association between adequacy of protein, -carotene, fat and serum retinol level and blood forming nutrients and haemoglobin level was apparent. A significant relationship was also evident between haemoglobin level and serum retinol level.

Both synthetic vitamin A and horticulture intervention improved the serum retinol, haemoglobin level and anthropometirc parameters. The synthetic supplementation showed high increment value for serum retinol level compared to horticulture supplementation group. Nevertheless, the increment value for anthropometry and haemoglobin level was high and there was a clear decrease in the episodes of illness in horticulture intervention group. Hence, horticulture intervention is cost effective, long-term, natural and sustainable strategy to solve existing vitamin A dificiency problem.

MASTER OF SCIENCE

AGRONOMY

Response of Dicoccum Wheat to Irrigation Schedules and Sowing Dates in Vertisols of Northern Karnataka

S.A. ANGADI 1999 MAJOR ADVISOR: Dr. A.D. JANAWADE

An investigation to study the response of dicoccum wheat to irrigation schedules and sowing dates was conducted during rabi 1998 at Agricaultural College Farm, Dharwad. The treatments consisted of three irrigation schedules viz., (0.05, 0.07 and 0.9 IW/CPE ratios) as main plots and five sowing dates viz., October 20th, November 5th, November 20th, December 5th and December 20th as sub plots. The treatments were laid out in a split plot design replicated three times.

The results indicated that, scheduling irrigation at 0.9 IW/CPE ratio recorded significantly higher grain yield (4257 kg/ha) and yield components compared to 0.5 IW/CPE ratio and was on par with 0.7 IW/CPE ratio irrigation schedule. The growth components like plant height, leaf area, leaf area index, total dry matter production per m row length were also higher in 0.9 IW/CPE ratio. The data on yield and yield components indicated that sowing on November 20th recorded significantly higher grain yield (4386 kg/ha) over October 20th (3871 kg/ha), December 5th (3623 kg/ha) and December 20th (3215 kg/ha) and was on par with November 5th sowing (4179 kg/ha). Similar trend was observed in yield components.

Consumptive use (cu) of water of wheat linearly increased with increasing frequencies of irrigations. Cu was highest in 0.09 IW/CPE ratio (531 mm) and lowest (344 mm) in 0.5 IW/CPE ratio irrigation schedule. Among sowing dates, the highest (466 mm) Cu was recorded in November 20th sowing over rest of the sowing dates. Water use efficiency was higher in 0.5 IW/CPE ratio (9.68 kg ha mm^{-1}) and closely followed by November 20th sowing (9.56 kg ha mm^{-1}). Moisture extraction pattern revealed higher moisture use from 0-30 cm surface layer in 0.9 and 0.7 IW/CPE ratios as compared to 0.5 IW/CPE ratio irrigation schedule. The highest (2.94) B:C ratio was obtained in sowing carried on November 20th with 0.9 IW/CPE ratio irrigation schedule treatment combination. Interaction effect of irrigation schedules and sowing dates were not significant for all the parameters studied.

The dicoccum wheat in vertisols of Northern Karnataka can be sown from first week of November to third week of November and irrigations can be scheduled at 0.7 IW/CPE ratio for higher productivity.

Response of Soybean (*Glycine max* L. Merrill) o Planting Methods, Plant Density and Number of Seeds per Hill under rainfed Conditions in Vertisols

A.V. TIRAKANNAVAR 1999 MAJOR ADVISOR : Dr. M.N. SHEELAVANTAR

A field experiment was conducted to study the response of soybean to planting methods, plant density and number of seeds per hill during kharif 1998 at Main Research Station, Dharwad under rainfed conditions. The experiment comprised of twelve treatment combinations including two planting methods (Ridge and furrow and flat bed method), two plant densities (0.33 and 0.44 million plants per ha) and three treatments on number of seeds per hill (one, two and three seeds per hill). The experiment was laidout in split plot design with three replications.

The ridge and furrow method of planting recorded significantly higher growth parameters like plant height, total dry matter production and its accumulation in different plant parts and yield parameters like number of pods per plant, hundred seed weight and seed weight per plant. Significantly higher seed yield (21.44 q/ha) was recorded with ridge and furrow method, which was 9.8 per cent higher over flat bed method of planting (1 9.51 qlha).

The seed yield (21.31 q/ha) was significantly higher with higher density of 0.44 million plants per ha and per cent increase was 8.5 per cent over lower density of 0.33 million plants per ha (19.64 qlha).

Among the number of seeds per hill, one seed per hill recorded significantly higher growth and yield attributes. The number of pods per plant, seed weight per plant, hundred seed weight and seed yield were significantly higher with one seed per hill. The increase in seed yield was 10.6 and 21 per cent higher over two and three seeds per hill. Further two seeds per hill was significantly superior over three seeds per hill. The most of the interaction effects between planting methods, plant density and number of seeds per hill were found non-significant.

Studies on Desi Cotton (*Gossypium herbaceum* L.) based Intercropping Systems with Modified Planting Pattern under Rainfed Vertisols

R.NAGANAGOUDA 1999 MAJOR ADVISOR : Dr. V.S. VEERANNA

A field experiment was conducted at the Regional Research Station, Bijapur on medium black soil during 1998-99 to study the performance of desi cotton based intercropping systems with modified planting pattern under the reainfed conditions Experiment was laid out in randomised block design with eleven treatments replicated thrice. Treatment combinations comprising of two intercrops (sunflower and castor); two row proportions (1:1 and 2:1) and two population levels (100:50 and 100:75) in addition to their sole treatments.

The kapas/seed yield of cotton, sunflower and castor in sole cropping were found to be significantly higher (783, 483 and 1003 kg ha-' respectively) than in intercropping system. among the intercropping treatments, cotton + castor (2:1) (100:75) recorded significantly higher seed cotton equivalent yield (935 kg ha-') which was followed by cotton + sunflower (2:1) (100:79) with 905 kg ha-' as compared to sole crop of cotton (783 kg ha-')

Significantly higher net returns of Rs.10704 ha -1 obtained with the treatment, cotton + sunflower (2:1) (100:75) than the sole crop of cotton (Rs.8756 ha-). This was followed by cotton + castor (2:1) (100:75) intercropping system with net returns of Rs.10684 ha-'. The intercropping treatment, cotton + sunflower (2:1) (100:75) recorded significantly higher LER (1.57), ATER (2.46) and B:C ratio (1.77) than the sole crop of cotton (1.00, 1.00 and 1.52 respectively).

Among all the intercropping treatment studied, cotton + sunflower with 2:1 row proportion and 100:75 per cent population level was found to give more returns and which was followed by cotton + castor (2:1) (100:75) intercropping system.

Response of Small Grain Millets to Sowing Dates and Row Spacings on Alfisols

ANNAPPA Y. HUGAR 1999 MAJOR ADVISOR : Dr. S.I. HALIKATTI

Field investigations were carried out during kharif 1998 on sandayloam soil, to study the response of different small grain millets to sowing dates and row spacings at Main Research Station, UAS, Dharwad. The experiment was laid out in split-plot design with two sowing dates as main plot and 12 treatment combinations of six millet crops and two row spacings as sub plots in three replications.

The higher grain yield (1 1.35 qlha^{-1}) of millets was recorded with early sowing in June II fortnight compared to delayed sowing in July I fortnight (9.94 qlha^{-1}). Also, June II fortnight sowing recorded significantly higher values of effective shoots, total dry matter, panicle dry matter, panicle length, panicle weight, grain weight per panicle, threshing percentage and HI. These values were decreased with delayed sowings. Straw yield and 1000-grain weight were unaffected significantly with sowing dates.

Finger millet recorded significantly the highest grain yield (17.69 q/ha^{-1}) compared to little millet (12.93 q/ha^{-1}) q/ha^{-1})barn yard millet (9.82 qlha^{-1}), kodo millet (8.22 q/ ha^{-1}), foxtail millet (7.86 q/ha^{-1}), kodo millet (8.22 q/ha^{-1}), foxtail millet (7.86 q/ha^{-1}) and the lowest in proso millet (7.38 q/ha^{-1}). Finger millet also recorded the highest straw yield, total dry matter, effective shoots, grain weight per panicle and threshing paercentage. While little millet recorded maximum panicle length. But panicle weight was maximum in barn yard millet. Highest 1000-grain weight and HI were recorded in proso and foxtail millet respectively.

Between two row spacings, higher grain yield of 11.12 q/ha^{-1} was recorded with narrower row spacing of 22.5 cm than wider row spacing of 30 cm (10.18 q/ha^{-1}). While wider row spacing (30 cm) recorded higher values of total dry matter, panicle length, panicle weight, grain weight per panicle and threshing percentage than narrower row spacing.

Performance of Soybean (*Glycine max* L. Merrill) Genotypes with Different Plant Densities under Rainfed'Condition

PATIL, R.B. 1999 MAJOR ADVISOR : V.S. GIDNAVAR

Field experiment was conducted at Main Research Station, University of Aricultural Sciences, Dharwad duri ng kharif season of 1998 to study the response of soybean genotypes (MACS-534, MAUS-20, RSC-2, RSC-3, NRC-34, DSb-1, PK-1 029 and JS-335) to different plant densities (0.3, 0.45 and 0.6 million plants per ha) under rainfed condition. Experiment was laid out in split plot design with three replications. The variety JS-335 recorded significantly higher seed yield (24.38 q/ha) over rest of the varieties except NRC-34 which was on par (23.75 q/ha). Whereas, MAUS-20 noticed significantly lower yield. Similarly, yield components viz., seeds per pod, seed weight per plant, 100-seed weight and dry matter accumulation in pods at physiological maturity were significantly superior with JS335 and NRC-34 except NRC-34 has lower number of seeds per pod. Among the population levels, 0.45 million plants per ha recorded significantly higher seed yield (22.97 qlha) as compared to 0.6 and 0.3 million plants per ha. The interaction effects due to varieties and population levels were significant, The variety JS-335 and NRC-34 at 0.45 million plants per ha recorded significantly higher seed yield (25.57 and 25.17 q/ha, respectively). The varieties did not differ significantly with respect to oil content but protein content was significantly higher in Pk-1029 (41.50%) followed by NRC-34. Oil and protein content did not differed with respect to plant densitites. The varieties differed significantly with respect to biochemical parameters. The variety JS-335 recorded significantly higher light transmission ratio (LTR) and relative water content (RWC) as compared to other varieties. the LTR increased significantly with successive increase in population levels. However, the RWC followed reverse trend. The variety JS-335 recorded significantly higher chlorophyll a content (1.62 mg g fr.wt-1) followed by RSC-2 but the chlorphyll and total chlorophyll content was significantly higher in NRC-34 (1.02 and 2.56 mg g fr. wtl), respectively) followed by JS-335. The chlorophyll content did not differed significantly with respect to plant densities.

Response of Pigeonpea (*Cajanus Cajan* L. Milisp.) to Graded Levels of Nitrogen, Phosphorus and Sulphur during rabi under Irrigation

NARANAGOWDA, A. 1999 MAJOR ADVISOR: Dr. B.T. PUJARI

A field - experiment was conducted at Agricultural College Farm, Raichur, to study the response of pigeonpea ot graded levels of nitrogen, phosphorus and sulphur during rabi season of 1998-99 under irrigation. There was 18 treatments comprising combinations of there levels of nitrogen (0,25 and 50 kg ha-1), three levels of phosphorus (0,50 and 75 kg ha-^{1}) and two levels of sulphur (0 and 30 kg ha-'). The experiment was laid out in a factorial randomized block design with three replications.

The seed yield of pigeonpea with the application of 25 kg N (1 7.06 q/ha-1) and 50 kg N ha-' (1 7.25 q/ha-1) were on par with each other and both have recorded significantly higher seed yield when compared to control (14.83 q/ha-1). The higher seed yield with the application 'Of 25 kg and 50 kg N ha-^{1} was mainly attributed to significantly higher yield components viz., number of pods per plant, seeds per pod, seeds per plant and 100 seed weight than the yield components recorded under control.

Application of 75 kg P_2O_5 ha-^{1} recorded significantly higher seed yield which was on par with the treatment receiving 50 kg P_2O_5 ha-^{1} (17.67 q/ha-1) and both have recorded significantly higher seed yield of pigeonpea as compared to control (13.68 q/ha-1). The higher yield of pigeonpea with phosphorus application was attributed to significantly higher yield attributes than the yield attributes recorded under control.

Sulphur application at 30 kg ha-^{1} recorded significant higher seed yield of pigeonpea (1 6.70 q/ha-^{1}) as compared to control (1 6.06 q/ha-^{1}) and was attributed to significantly higher yield attributes.

Application of 25 kg N and 50 kg P_2O_5 ha-^{1} recorded significantly higher gross returns (Rs.37,859 ha-^{1}), net returns (Rs.26,750 ha-^{1}) and benefit cost ratio (3.38) when compared to control. The gross returns (Rs.33,897 ha-^{1}), net returns (Rs.22,790 ha-^{1}) and benefit cost ratio (3.05) of pigeonpea with the application of 30 kg S ha-^{1} were significantly higher when compared to control.

Integrated Nutrient Management in Rainfed Sunflower (*Helianthus annuus* L.) and Pigeonpea (*Cajanus cajan* L. Millsp.) Intercropping System

U.K. SHANWAD 1999 MAJOR ADVISOR : Dr. C.A AGASIMANI

An experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad during kharif season of 1998 to study the effect of integrated nutrient management in sunflower-pigeonpea intercropping system. The experiment was laid out in Randomized Block Design (Factorial) with fifteen treatment combinations, comprising three organic sources and five fertilizer levels. The treatments were replicated three times.

Highest sunflower seed equivalent yield can be obtained with combined application of either vermicompost (4.7 t/ha) or poultry manure (2.7 t/ha) with 100 per cent RDF to both sunflower (35:50:35 kg NPK/ha) and pigeonpea (25:50:0 kg NPK/ha). This is due to higher seed yield of sunflower (13.24 and 12.68 q/ha) and pigeonpea (8.27 and 8.37 q/ha) were recorded in the above treatments. The higher yields of both the crops is due to the better yield attributing characters like head diameter, number of seeds per head, number of pods per plant, seed yield per plant and'1 000 and weight were recorded in the same treatments.

With respect to oil content there is no significant variation among the treatments. But, among the organic sources poultry manure recorded higher (41.41%) oil consent than the other two organic sources.

In sunflower, vermicompost recorded significantly higher N uptake (278 kg/ha) as compared to FYM (255 kg/ ha) and it was on par with poultry manure (276 kg/ha). There is no significant difference with respect to P and K uptake. In pigeonpea, application of 100 per cent RDF to both crops recorded significantly higher N (103 kg/ha), P (40 kg/ha) and K (81 kg/ha) uptake as compared to lower doses of RDF to pigeonpea. Among the organic sources poultry manure recorded significantly higher P (40 kg/ha) and K (81 kg/ha) uptake as compared to other two organic sources.

However, interaction effect of organic sources and inorganic fertilizer levels had no significant effect on the nutrient uptake by both sunflower and pigeonpea crops.

Highest net returns (Rs.10,933/ha) was obtained by the combined application of poultry manure with 100 per cent RDF to both sunflower and pigeonpea than that recorded under FYM with 100 per cent RDF to only sunflower and no RDF to pigeonpea (Rs.8,568/ha).

Application of poultry manure plus 100 per cent RDF to sunflower and without RDF to pigeonpea was found most cost effective and recorded highest B:C Ratio (1.50).

Response of Rainfed Groundnut (*Arachis hypogaea* L.) to Sand Mulching and Organics in vertic Inceptisols

K.N. SUDHA 1999 MAJOR ADVISOR: Dr. C.J. ITNAL

Investigation on the response of rainfed groundnut (*Arachis hypogaea* L.) to sand mulching and organics in vertic inceptisols of Dharwad region was carried out at Main Research Station, Dharwad during kharif 1998. There were 14 treatments consisting of two types of organic manures, three different depths of sand mulch, a treatment on intercultivation practice and with an absolute control of inorganic fertilizers alone. Treatments were replicated three times.

The data revealed that the total drymatter production was high in treatment receiving vermicompost at 2.5 t/ha + sand mulch 7.5 cm depth + RDF (T_{12}) which was followed by the treatment receiving vermicompost at 2.5 t/ha + sand mulch 5 cm depth + RDF (T_{11}). Higher total drymatter production in these treatments are due to more plant height and leaf area. The data on yield components indicated that vermicompost at 2.5 t/ha + sand mulch 7.5 cm depth + RDF (T_{12}) recorded higher values which was followed by vermicompost at 2.5 t/ha + sand mulch 5 cm depth + RDF (T_{11}). Similarly, the highest pod yield was recorded by T_{12} (25.24 q/ha) and was followed by T_{11} (22.64 q/ha). However, the lowest pod yield was in absolute control.

The soil moistrue content (cm) recorded at different stages of the crop clearly showed that the amount of soil moisture store at different depths was more 1 in sand mulched treatments. The amount of soil moisture increased with increase in depth of sand mulch. Available nutrients viz., nitrogen, phosphorus, potassium and carbon were maximum in treatment of integrated nutrient management with FYM at 5 t/ha vermicompost at 2.5 t/ha.+ RDF(T_7).

The economic analysis revealed that the costs were much higher in treatments receiving vermicompost and sand due to higher input costs of vermicompost at 2.5 t/ha + sand mulch 15 cm depth + RDF (28,979 Rs.ha) followed by treatment receiving vermicompost at 2.5 t/ha + sand mulch 7.5 cm depth + RDF (T_{11} 28866 Rs./ha).

Response of Dicoccum Wheat (*Triticum dicoccum* Schrank, Suhulb) to Land Layouts and Micronutrients under irrigated Condition

U.V. SIDNAL 1999 MAJOR ADVISOR: Dr. B.N. PATIL

A field experiment was conducted to study the effect of land layout and micronutrients on dicoccum wheat under irrigated condition at Agricultural Research Station, Arabhavi during rabi season of 1998-99. The experiment was laid out in randomised block design with 24 treatment combinations.

Land layout treatments did not differ significantly between themselves with regard to growth, yield components and grain and straw yields. The highest total dry matter (DM) production (274.25 g/h row length), DM accumulation in leaves (63.70 g/m row length), stem (1 04.60 g/h row length) and ear (105.95 g/m row length) was recorded at harvest due to application of RDF (100:75:50 kg NPK/ha) + vermicompost (2.5 t/ha) + iron 25 kg $FeSo_4$/ha).

Application of RDF, vermicompost and iron together recorded the hirhest leaf area and LAI at 90 DAS (74.95 dM_2/m row length and 3.25 respectively.

Grain yield was- highest (4541 kg/ha) with RDF + vermicompost + iron and it was least (3977 kg/ha) with RDF alone. Fodder yield was highest (6645 kg/ha) with RDF + vermicompost + iron treatment. Application of RDF, vermicompost and iron together recorded maximum protein per cent in grains (14.64%) and highest uptake of N, and K (126.86 and 117.99 kg/ha, respectively). Organic carbon, available soil nitrogen, phosphorus and potassium were higher in pressmued applied plots. Highest net returns (26724 Rs/ha) were recorded with RDF + pressmud + iron treatment.

Effect of Plant Density and Fertilizer Management Practices on Growth, Yield and Quality of Confectionery Groundnut

NAGARAJ, M.V. 1999 MAJOR ADVISOR: Dr. L.H. MALLIGAWAD

In an attempt to find out effect of plant density and fertilizer management practices on growth, yield and quality of confectionery groundnut (cv ICGV 86564), a field experiment was conducted during post rainy/summer season of 1997-98 at Main Research Station, University of Agricultural Sciences, Dharwad. The experiment was laid out in a split plot design with three replications. Experiment consisted of three 'main plots with different plant densities (74, 074, 1, 11, 111 and 1, 48, 148 plants ha-^{1}) and five sub plots with different fertilizer management practices (recommended dose of fertilizer RDF) (25 kg N 32.7 kg P and 20.72 kg K ha-^{1}), RDF + Micronutrients (MN) Fe @ 9 kg ha-^{1} Zn @ 10 kg ha-^{1} and Mo @ 0.5 kg ha-^{1}, RDF + Farm yard manure (FYM) @ 15 t ha-^{1}, RDF + Vermicompost (VC) @ 2 t ha-^{1} and RDF + FYM @ 7.5 t ha-^{1} + VC @ 1 t ha-^{1} + MN (4.5 kg Fe ha-^{1} + 5 kg Zn ha-^{1} + 0.25 kg Mo ha-^{1}).

The results showed that even though plant density of 74, 074 plants ha-^{1} produced more of growth and improved yield components, the pod and kernel yield ha-^{1} were higher at higher plant density of 1,48,148 plants ha-^{1}. Quality parameters like oil content, extra large and large kernels were higher at lower plant density of 74,074 plants ha-^{1}. Economic analysis indicated highert B:C ratio at higher plant density of 1,48,148 plant ha-^{1}.

Among feftilizer management practices, application of RDF in combination with FYm @ 7.5 t ha-^{1}, and Mn (4.5 kg Fe ha-^{1} + 5 kg Zn ha-^{1} + 0.25 kg Mo ha-^{1}) increased growth, yield and yield components. It also recorded improved quality management practices but, B:C ratio ratio was higher with application of only RDF.

Though interaction effects wre not significant, plant density of 74,074 plants ha-^{1} with application RDF + half dose of FYM, VC and MN recorded higher growth and yield components. Application of RDF + half dose of FYM, VC and MN at plant density of 1, 11, 111 plant ha-^{1} resulted in higher pod and kernel yield ha-^{1}.

Response of Barley (*Hordeum vulgare* L.) Varieties to Sowing Dates and Nitrogen Levels in Vertisols under Irrigated Condition

S.B. YELEDAHALLI 1999 MAJOR ADVISOR: Dr. M.N. SHEELAVANATAR

A field investigation to study the response of barley varieties to different dates of sowing and nitrogen levels under irrigated condition was conducted at Main Research Station, University of Agricultural Sciences, Dharwad. During rabi 1995-96. The experiment was laid out in a split plot design consisting dates of sowing (October II fortnight, Nuvember I fortnight and November II fortnight) in main plots, varieties (UBDL-22 and UBDL-32) in sub-plots and nitrogen levels (0, 25, 50 and 75 kg N ha-^{1}) in sub-sub-plots and replicated thrice.

November I fortnight sowing recorded significantly higher grain yield (32.92 q ha-) followed by October II fortnight (29.79 q ha-^{1}) and November II fortnight (26.94 q ha-^{1}). November I fort-night sowing recorded 9.23 and 17.91 per cent higher grain yield than October II fortnight and November II fortnight sowing respectively. The dry matter, growth parameters and growth indices (CGR, RGR, NAR and LAD) and yield attributes (ear weight and effective tillers) followed the similar trend as that of grain yield.