

mental interactions were significant for all characters studied. The Rhizobium treated population had higher magnitude of variability parameters compared to the untreated population indicating clearly the impact of seed inoculation. Association and path analysis both environmentwise and pooled over environments brought out the importance of plant spread, pods/plant and harvest index for improving yield. Further, in Rhizobium treated population selection becomes more effective if properly defined characters like nodule number and their dry weight are also included. The genotypic x Rhizobium interactions were significant. It is suggested that selection of highly responsive varieties can bring about significant improvement in yield. The D² - study indicated that the clustering pattern did not confirm either to the geographical origin or to the

cultivar groups. Some entries like 11522, 1265, 2452 and 606 were found to have average stability and above average means for yield 100-seed weight and pod number. It is suggested that entries superior in performance and stability with respect to one or more characters should be used in breeding programmes for further improvement. Predominant additive gene action was evident for plant height, days to flowering, 100-seed weight and harvest index and the same could be utilized for the improvement of yield especially in cross combinations of parents with high g.c.a. like A-1, ICC-33 and BG 261. Further, it is suggested that the crosses Bombay Chana x ICC-33, A-1 x BG 209, A-1 x BG 261 and ICC-33 x BG 261 could be advantageously used to isolate high yielding true breeding lines.

Genetic Studies In Mungbean (*Vigna radiata* (L.) Wilczek)

VENKATRAMAN S. HEGDE

1988

Major Advisor : R. PARAMESHWARAPPA

A genetic study was undertaken to understand the nature of gene action and inheritance pattern of yield components and its related characters in three inter-varietal crosses of mungbean viz., ML-329 x Chinamung (Cross 1), Blackmung x Chinamung (Cross 2) and KDM-1 x Chinamung (Cross 3) using generation mean analysis. Heterosis over mid-parent was significantly positive for plant height and branches/plant in all the crosses, clusters/plant, seeds/pod and yield/plant in Cross 2 and Cross 3, pods/plant and pods/cluster in cross 2, and significantly negative for days to maturity in cross 1 and cross 2 and for days to flowering only in cross 2. Highly significant positive heterosis over better parent was observed for plant height in cross 1 and cross 2, clusters/plant in cross 2 and cross 3, seeds/pod in cross 2 and grain yield only in cross 3. The estimation of gene effects revealed the importance of dominance and dominance based interactions in the expression of all the characters studied in

cross 1, and for all the characters except clusters/plant, pods/plant, yield and powdery mildew resistance in Cross 2 for which none of the interaction effects were significant. Highly significant positive phenotypic association of yield with clusters/plant, pods/plant, pods/cluster, pod length and seeds/pod in all the F₂ populations indicated their primary importance in improving yield. The simultaneous practice of pedigree breeding as well as recurrent selection has been suggested for improvement of characters in which dominance and dominance based epistasis were predominant. Improvement in the characters for which additive gene action was predominant could be brought about by selection in the advanced generations until not only the improvement is achieved but also it is fixed. The shattering resistance was governed by a single dominant gene which can be transferred by backcross method of breeding to any of the agronomically desirable but shattering susceptible varieties.

Genetic Studies In Cowpea (*Vigna unguiculata* (L.) Walp.)

JAGADISH C. KARKANNAVAR

1988

Major Advisor : J.V.GOULD

Investigation on *Vigna unguiculata* (L.) Walp was taken up with an objective to study the mode of inheritance of certain qualitative characters and their

linkage relationships. A cross involving two varieties viz., Selection-2 and K₁₁ was effected in 1982. Their F₁, F₂ and F₃ progenies were raised at UAS, Dharwad

during subsequent years. F₂ population consisting of 580 plants and 80 F₃ families each consisting of 85-120 plants were studied. The mode of inheritance of nine qualitative characters and their linkage relations were established. The qualitative characters studied include plant habit, pigmentation on stem, stipule colour, position of pod, surface of pod, pod size (length), young pod colour, seed size and seed colour. Of the above characters stipule colour was studied for the first time in cowpea. A trigenic ratio of 39:25 was observed in F₂ for plant habit, indicating that one basic, one inhibitory and one anti-inhibitory genes interact to control tendrillar growth. Two complimentary genes were found to control pigmentation on stem and position of pod. Both the genes compliment each other to give a ratio of 9:7. A simple Mendelian monogenic ratio was observed for stipule colour, seed size and seed colour. The surface

of the pod and young pod colour gave a F₂ ratio of 21:43, thereby indicating one basic and two complimentary inhibitory genes. A digenic ratio of 3:13 is observed for pod size, thereby confirming that the pod size (length) is controlled by one basic and one inhibitory genes. Joint phenotypic segregation of all the character pairs showed that position of pod, surface of pod, pod size, young pod colour and seed colour assort independently. The basic gene (out of three genes) controlling habit showed linkage with the single gene governing the seed size with a cross over value of 46 per cent. One of the two complimentary genes conditioning pigmentation on stem was found to be linked with gene controlling stipule colour with crossover value of 17.4 per cent. This type of linkage in cowpea is reported for the first time.

Genetic Study of Some Rare Quantitative Characters in Maize (*Zea mays* L.)

M.S.RAMESHA

1988

Major Advisor : S.J.PATIL

The study was undertaken to highlight the importance of some rare quantitative characters in maize breeding programmes. A complete diallel set of crosses involving ten elite inbred lines was evaluated during kharif, 1987 at UAS, Dharwad. The observations taken on twelve quantitative characters viz., (a) maturity traits : days to anthesis, days to silking and interval between anthesis and silking; (b) tassel traits : number of primary branches, number of secondary branches and tassel length; (c) ear traits : Husk number and shank length; (d) grain traits: hundred grain weight, hundred grain volume and grain density and (e) grain yield per plant, were analysed following Griffing (1956b) Method-1 and Model-I. the heterosis in respect of various traits and correlations among them were worked out. Highly significant treatment differences were observed for all the characters. The mean squares due to gca, sca and reciprocal effects were also highly significant. The components of variance indicated the greater role of non-

additive genetic variances in the inheritance in most of the characters except days to anthesis and days to silking. The parents CM 106 and KUI 1411 were found to be good general combiners for most of the characters. Majority of the crosses showed, negative sca effects and negative heterosis over mid parent in respect of maturity, tassel and ear traits, whereas, they were positive for grain traits and grain yield per plant. The characters viz., maturity, tassel and ear traits showed strong negative correlation with grain yield and grain traits, but positive association among themselves. The traits hundred grain weight and volume showed strong positive correlation among themselves and also with grain yield. Grain density showed no association with grain yield, but positive and negative associations with grain weight and volume, respectively. The study brought out the importance of a plant ideotype and suitable plant breeding methods were suggested to achieve it.

Genetic Studies on Qualitative and Quantitative Characters in Cowpea (*Vigna unguiculata* (L.) Walp.)

B.D.BIRADAR

1988

Major Advisor : J.V.GOUD

Three cowpea crosses (C152 x GL35, C152 x Russian giant, GL35 x Russian giant) were subjected to generation mean analysis to determine gene action for different quantitative characters. In addition to this, the inheritance of four qualitative characters, the estimation of heterosis, heritability, correlation and path analysis of different quantitative characters was also done. Majority of the characters exhibited predominance of dominant effects (h) and dominance x dominance (1) epistatic effect. The dominant ratio revealed that the genes concerned exhibited over dominance. Majority of the yield traits revealed the heterosis in F₁ and inbreeding depression in F₂. Narrow sense heritability estimates were low for most of the characters except for pods per cluster. Genetic advance over F₂ mean was highest for pods per cluster, while moderate estimates were recorded for the remaining

characters. The characters pod weight, pod number, number of pod clusters per plant, seeds per pod and pod length showed positive association with yield. Their direct as well as indirect contributions to yield were positive emphasizing their importance in multiple trait selection. The four qualitative characters were governed by interaction of three to four genes giving F₂ ratios of 162:94, 45:19 and 183:73 for pigmentation at the tip of pod, in calyx and flower colour, respectively. For seed coat colour, ratio involving twelve phenotypic classes was noticed. study on pleiotropy revealed that pigmentation at the tip of pod shared on common gene with that of calyx, two with flower colour and two with seed coat pattern. The gene P₁ was common for pigmentation of calyx, flower and seed coat colour. Pigmentation of seed coat colour and flower shared two more common genes (P₁ and P₂).

Variability, Heritability and Genetic Advance in F₂ and F₃ Generations for Yield and Other Characters in *Gossypium Barbadense* L.

VENKATRAMAN HEGDE

1989

Major Advisor : S.N.KADAPA

Six F₂ bulks, corresponding six F₃ bulks and 53 individual plant F₃ - progenies developed by crossing six varieties, viz., PL-D6, BCS-12-25, TCS-9-5, TCS-3-5, PL-D2 and Giza-7, taking SI Andrews as base parent, were studied. In addition, four composite crossed bulks and their 40 individual plant progenies involving the same parental genotypes were grown in RBD at the Agricultural Research Station, Dharwad, during 1985-1986 under protective irrigation. Totally, 5976 plants were observed for yield and other economic traits. Variability, heritability and genetic advance from selection for the 11 traits were worked out. The study indicated that the cross SIA x TCS-3-5 had additive gene action for yield, boll number, boll weight and ginning out-turn. The cross also showed the highest variability and genetic advance for yield and bolls per plant in F₂

and F₃ generations than any other cross. Broad sense heritability was very high for yield, bolls per plant, boll weight and ginning out-turn in this cross. Among composite crosses, CC₂S₂ showed the highest variability and genetic advance for yield and boll weight indicating release of more variability in two cycles of composite crossing followed by two selfed generations of breeding. CC₁S₂ progenies were more reliable for selection of plants based on yield as indicated by highest narrow sense heritability. In all the generations, yield was highly and positively correlated with bolls per plant, boll weight and ginning out-turn. Selection of individual plants showed possibility of increasing yield, bolls per plant, boll weight and ginning out-turn along with superior fibre quality.

Stability and Combining Ability Analyses across Seasons in Sorghum (*Sorghum bicolor* (L.) Moench)

H.D.PATIL

1989

Major Advisor : R. PARAMESHWARAPPA

A line x tester (7 x 11) sorghum experiment involving some newly developed male sterile and restorer genotypes was planned to elicit information on 12 quantitative characters on genetic architecture, *per se* performance and stability of parents and hybrids across *kharif*, *rabi* and summer seasons at UAS, Dharwad and part of material in *rabi* at Agriculture Research station, Annigeri. The analysis of variance showed significant genotypic differences for all the characters across seasons. High genotypic coefficients of variation, heritability and genetic advance were observed for most of these characters. The phenotypic and genotypic correlation studies revealed high positive correlation of grain yield with peduncle length, panicle yield, and harvest index across and also pooled over seasons. Path analysis revealed that the panicle yield, grains per panicle, threshing per cent, 100 grain weight and panicle length influence the grain yield either directly or indirectly. Diversity studies indicated high diversity forming seven, six and ten clusters in *kharif*, *rabi* and summer, respectively. The genotypes 2077A, SPL 100B, M-148-138 and SPV 86 showed the divergence

across seasons. Thirty six, 37 and 48 hybrids produced 33.8, 23.3 and 51.1 per cent higher heterosis for grain yield on an average over their mid parents in *kharif*, *rabi* and summer, respectively. Among the yield components, heterosis for grains per panicle (28.7%), panicle length (13.8%) and 100 grain weight (11.5%) contributed to heterosis of grain yield. Combining ability analysis revealed significant variances for lines, testers and hybrids for most of the characters across and also pooled over seasons. The SCA variance was higher than GCA variance. The crosses having high sca involved all combinations of high, medium and low combining parents. Among females, 296A and T x 623A and among males, SB 5501 were the best combiners over seasons for grain yield. Stability analysis across seasons revealed significant differences of genotypes, environments and genotype x environment interactions for all the characters studied. The most stable parents over seasons among females, IC5A 3, SPL 100 A, SPL 120 A, 296 A and T x 623 A and among males, MR 840, MR 841 and SPL 70R were observed for grain yield.

Genetic Evaluation of Derived B Lines and Induced Mutants of Sorghum (*Sorghum bicolor* (L.) Moench)

VISHNU V. PANDIT

1989

Major Advisor : S.S.PATIL

The present study was carried out under two field experiments to evaluate improved B lines and mutants of SB 5501 based on combining ability and heterosis of their crosses. In the first experiment, six derived B lines (2077DB₁, 296DB₁, 296DB₂, 2077DB₂, 3660DB and 2219DB) and the original versions of ruling male sterile lines (296A, 2219A and 2077A) were crossed in line x tester manner with six restorers. Resulting hybrids were evaluated along with the parents. The second experiment involved 50 randomly selected M₄ lines obtained by gamma irradiation (30 KR) of SB5501 to evaluate their ability to combine with 296A. The study revealed highly significant differences among the genotypes. The estimates of SCA variance were greater than GCA variance for all the characters studied. Among the six

derived B lines, three were superior over their corresponding original male sterile versions in their *per se* performance. The derived B line 296DB₂ was found to be good general combiner for yield, while 296DB₁ and 2219A were good general combiners for early maturity. The crosses of derived B lines differed from their counterparts involving original male sterile lines. Some crosses showed improvement in both *per se* performance as well as heterosis. Some revealed improvement in only one of them, while some were inferior with respect to both of them. On the basis of superior yielding ability, high gca effects of the parents and low sca effect of the cross 296DB₁ x MR836 is suggested for selection in segregating generations. Studies on induced mutants revealed an increase in variance among mutants as well

as derived F₁s over the respective controls. The change in direction of mean performance and mean combining ability due to induced mutation varied for different characters. Some of the derived F₁s showed desired plant

type like reduced plant height and earliness. Majority of the derived F₁s exhibited higher magnitude of heterosis for all the characters studied.

Phenotypic Stability of Wheat Genotypes for Quantitative and Biochemical Characters

C.H.MRUTHYUNJAYA

1989

Major Advisor : R.R.HANCHINAL

Stability analysis for quantitative and quality characters performed by 16 durum and 15 aestivum wheat cultivars planted at Dharwad, Ugarkhurd and Gangavati is reported. The GxE interactions were significant for traits Days to heading, days to maturity, number of spikes/sq.m., plant height, spike length, number of spikelets/spike, number of grains/spike, grain weight/spike, 1000 grain weight, grain yield/plot, bulk density, per cent protein, gluten and phenols content of grain. The characters viz., seed volume, per cent starch and total sugar content of grain showed non-significant interaction. For the traits spike length, number of grains/spike, grain weight/spike, percent gluten and starch content of grain, the linear component was significant indicating the GxE interaction for these characters was due to the linear association of the genotypes to the varying environment. However, for characters viz., seed volume, per cent starch and total sugar content of grain, both linear and non-linear components

were non-significant, while rest of the characters showed significant linear component. The regression analysis revealed that none of the genotypes was stable for all the evaluated characters. However, the genotypes D 3302 and D 3303 emerged as the most adaptable genotypes exhibiting stable performance for grain yield, spike length, spikelets/spike and grain weight/spike. D 2894-5, DWR-39, and HD 2189 also recorded unit regression and least mean square deviation conferring wider adaptability and stability. The genotypes D 424, D 318 and DWR 16 showed average yield potential, average stability and significant S^2_{di} indicating their adaption to moderate environment. With respect to stability of bio-chemical characters, the genotypes HD 2189 emerged as most stable for protein and gluten content of grain. In comparison of models, Eberhart and Russell and Perkins and Jinks models produced similar results in respect to both responsiveness (b_i) and stability (S^2_{di}).

Agronomy

Effect of Plant Population and Hydrophilic Polymer on the Performance of Short Duration Maize (*Zea mays* L.)

B.K.DESAI

1987

Major Advisor : A.S.PRABHAKAR

A field experiment to study the effect of plant population and hydrophilic polymer on the growth and yield of short duration maize was conducted at UAS, Dharwad during the *kharif* season of 1986 under rainfed conditions on black clay loam soils. The experiment consisted of 12 treatment combinations comprising three plant population levels (55,555, 74,050, 1,11,111 plants/ha) and four hydrophilic polymer

(control, adhesivegum 1%, hydrophilic polymer seed coating 2%, soil application 6 kg/ha). The factorial experiment was laid out in RBD with three replications. Maize grown with 1,11,111 plants pr ha (55.26 q/ha) gave 25.56 and 5.66 per cent increase in grain yield over low (44.01 q/ha) and medium (52.30 q/ha) plant populations, respectively. Stover yield increased significantly with increase in plant population. High plant

population recorded higher stover yield (65.19 q/ha) plant populations, when compared to other. However, grain yield obtained with high and medium population did not differ significantly. This suggests that maize (G-25) can be grown with medium population (74,050 plants/ha) which enables to obtain higher yields. The total yield in medium and high plant populations was significantly more even with the low performance of the

individual plants, due to higher plant stand. The higher grain yield obtained with increase in plant density was a consequence of increase in CGR with increase in plant population resulting in higher dry matter production per unit area and its distribution in cob. Application of hydrophilic polymer (Jalshakti) did not produce significant differences in grain yield. Interaction of plant population and hydrophilic polymer was not significant.

Studies on Row Proportion and Plant Population of Groundnut (*Arachis hypogaea* L.) and Pigeonpea (*Cajanus cajan* (L.) Millsp.) under Intercropping System in Transition Tract of Dharwad.

UMESH K. HULIHALLI

1987

Major Advisor : M.N.SHEELAVANTAR

A field experiment was conducted on black clay loam soil under rainfed conditions at UAS, Dharwad, during *kharif* and *rabi* seasons of 1986-87 to study the effect of three row proportions of groundnut and pigeonpea (3:1, 4:1 and 5:1) and four levels of pigeonpea population (25, 50, 75 and 100 per cent of sole crop) under intercropping system. Respective sole crops were raised as controls. After the harvest of sole groundnut, sole crop of chickpea was grown as a second crop. Sole crop of groundnut gave the highest pod yield (21.91 q/ha) and yield reduction in groundnut due to intercropping was 17 per cent. The reduction in the yield of groundnut under intercropping was traced back to reduced growth, yield and yield components. Sole crop of pigeonpea realised significantly higher seed yield (16.16 q/ha), yield reduction of intercropped pigeonpea to an extent of 25 per cent. Although individual plant performance of pigeonpea was better under intercropping with respect to seed yield/plant, number of pods/plant, intercropped pigeonpea failed to

give higher yield because of low plant population on unit area basis. Further, intercropping combination of groundnut (DH-8) and pigeonpea (C-11) in 5:1 row proportion spaced at 30 cm apart with 100:75 per cent respective crop populations resulted in the highest total seed yield of 25.95 q/ha and it was about 10 q/ha higher than the seed yields of either sole crop of groundnut (15.54 q/ha) or pigeonpea (16.16 q/ha). The above mentioned combination was found to produce about 6 q/ha higher seed yield than the double cropping of groundnut (15.54 q/ha) and chickpea (4.0 q/ha). Based on Area Time Equivalent Ratio (ATER), this system of intercropping was found to be 29 per cent more efficient in utilizing land area and time than either of the sole crops. This combination of intercropping treatment resulted in highest net returns of Rs. 10,011/ha. This inter-cropping system enabled to bring an additional income of Rs.2,288/ha over sole groundnut of Rs. 8,191/ha over sole pigeonpea or Rs. 1,649/- ha over double cropping of groundnut and chickpea.

Studies on the Yielding Abilities of Short Duration Pigeonpea (*Cajanus cajan* (L.) Mill sp.) under Periodical Planting and Plant Densities

ISHWAR R. NOOLVI

1989

Major Advisor : M.N.SHEELAVANTAR

A field experiment was conducted at UAS, Dharwad, during the *kharif* season of the year 1987-88, under rainfed conditions on medium black clay loam soil to study the influence of planting time (June II, June IV, July II and July IV week) and plant density (3.3, 4.4 and 6.6 lakhs/ha) on the yielding ability of short duration pigeonpea genotype (DT-7). Results of experiment revealed that early planting in June II week with high plant density of 6,66,666 plant/ha was found to give maximum yield of 12.31 q per ha. Delayed planting from June II to July IV week successively reduced the seed yield by 16, 19 and 22 per cent, respectively. Seed yield losses due to delayed planting could not compensated through increased plant population levels. Dry matter production per plant was significantly higher with June II week planting and it was 20, 22 and 43 per cent higher when compared to June IV week, July II week

and July IV week. Dry matter production per plant was not influenced by increase in plant population levels. The LAI, LAD and CGR were maximum with June II week planting and with high plant population levels. Pigeonpea yield of early planted crop in June II week was mainly due to consumption of higher heat units (1409.3°C) and maximum exposure to light duration (1256.13 hr). Protein content in seed was not affected by time of planting and by increased plant population levels. Evaluation of seed microflora of seeds of different planting dates revealed that early planted seeds possessed lower number and very few microflora indicating better quality seeds. Such seed may not deteriorate fast under stored conditions. Significant positive correlations were observed between seed yield and heat units (10.986) and light duration exposed (10.993).

Response of Short Duration Pigeonpea (*Cajanus Cajan* (L.) Millsp) to Nitrogen and Phosphorus Levels and The Residual Effect of These Nutrients on Succeeding Wheat (*Triticum aestivum* (L.)) Crop

PRAKASH S. MATIWADE

1987

Major Advisor : M.N.SHEELAVANTAR

A field experiment was conducted on black clayey soils under rainfed conditions at UAS, Dharwad during *kharif* and *rabi* seasons of 1986-87, to study the effect of three levels of nitrogen (0, 25 and 50 kg N/ha) and four levels of phosphorus (0, 50, 100 and 150 kg P₂O₅/ha) on growth and yield of short duration pigeonpea (95 - 100 days) DT-7 and the residual effect of these nutrients on succeeding wheat crop. The variety DT-7 responded to nitrogen up to 25 kg N per ha (13.61 kg/ha) by producing 18 per cent higher seed yield than under no nitrogen application. Further increase in nitrogen level to 50 kg N per ha did not increase the seed yield significantly. The increased seed yield was mainly attributed to increased number of pods per plant, number of seeds per pod, and 100-seed weight. The increased yield and yield components were reflected in higher dry matter production and accumulation in pods, LAI, LAD, CGR, uptake of nitrogen and phosphorus. However, the NAR and RGR were reduced with the application of

nitrogen. Protein yield also followed similar trend as that of seed yield. The variety also responded to phosphorus up to 100 kg P₂O₅ per ha (13.79 q/ha) and it produced 12 and 6 per cent higher seed yield, respectively, over with the application of no phosphorus and 50 kg P₂O₅ per ha. Interaction between nitrogen and phosphorus levels was absent in most of the characters. From response curves, the optimum levels of nitrogen and phosphorus were found to be 41 and 61 kg per ha, respectively. Profit per ha with the optimum levels of nitrogen and phosphorus was Rs.1305/- and Rs.280/-, respectively, over no nitrogen and no phosphorus application. The residual effect of nitrogen and phosphorus applied to DT-7 pigeonpea on succeeding wheat revealed that Pigeonpea-wheat double cropping system with the application of 50 kg N and 100 kg P₂O₅ per ha to pigeonpea and its residual effect on wheat crop resulted in the total net returns of rs. 11,945/- per ha with the cost benefit ratio of 3.17.

Effect of Varietal Mixture of Sorghum on Yield and Quality of Fodder

S.A.GADDANAKERI

1987

Major Advisor : S.K.GUMASTE

A field experiment was conducted at UAS, Dharwad on clay loam soil under rainfed condition in *kharif* season of 1986 to study the effect of varietal mixture of sorghum on yield and quality of fodder. The treatment having 66 per cent J-set-3 with 33 per cent SB-1079 recorded significantly higher green fodder yield (56.54 t/ha) over highest-yielding monoculture of J-set-3 (49.60 t/ha). The same treatment also recorded significantly higher crude protein yield (15.04 q/ha) over

sole J-set-3 (10.95 q/ha). The increase in the green fodder yield and crude protein yield with the treatment having 66 per cent J-set-3 and 33 per cent SB-1079 was to an extent of 12.27 per cent and 27.19 per cent, respectively over sole J-set-3. The treatment which recorded significant higher green fodder yield and crude protein yield also recorded less fibre content (1.74%) compared with the sole crop of J-set-3.

Influence of Water Hyacinth and Fertilizer Levels on Growth and Yield of Hybrid Sorghum (*Sorghum bicolor* (L. Moench))

SUDHIR KAMAT K.V.

1987

Major Advisor : S.A.HOSAMANI

A field experiment was carried out on black clay loam soil at UAS, Dharwad during the *kharif* season of 1986 to study the influence of water hyacinth and fertilizer levels on growth and yield of sorghum hybrid CSH-5 under rainfed conditions. The experiment consisted of 16 treatment combinations comprising four levels of water-hyacinth manure (0, 3, 6 and 9 t/ha) and four fertilizer levels (0, 25, 50 and 100 per cent of recommended dose of 100:75:37.5 kg N, P₂O₅ and K₂O/ha). Factorial experiment was laid out in RBD with three replications. Fertilizer substitution and economics of manuring were calculated. The hyacinth sample was put to chemical analysis. Analysis of water-hyacinth plant revealed composition of 92.5, 1.96, 0.87 and 3.10 per cent of moisture, N, P₂O₅ and K₂O, respectively, on dry weight basis. Water-hyacinth at nine tonnes per

hectare (36.96 q/ha) gave 6.4, 10.8 and 16.3 per cent higher grain yield and 8.2, 7.3 and 14.8 per cent higher stover yield than of water-hyacinth at six, three and zero tonnes per hectare. Higher grain (45.18 q/ha) and stover (78.91 q/ha) yield was recorded with the application of recommended fertilizer dose and lower grain (23.24 q/ha) and stover (39.69 q/ha) yield under the control. Interaction effect was only significant with respect to leaf area per plant at 90 days after sowing. Water-hyacinth at nine tonnes per hectare resulted in saving of 32.5 per cent of recommended fertilizer dose, valued at Rs. 331.89. Net profit was higher under nine tonnes water-hyacinth per hectare plus recommended fertilizer dose. Return per rupee spent was higher (Rs. 4.45) under nine tonnes water-hyacinth per hectare.

Effect of Crop Residues Incorporation and Fertilizer Application on Growth and Yield of Safflower (*Carthamus tinctorius* L.) in Semi-Arid Vertisols

SATYANARAYANA RAO

1987

Major Advisor : V.S.PATIL

A field experiment was carried out on deep black, clayey soil at the Agricultural Research Station, Bijapur, during *rabi* 1986-87 to study the effect of incorporation

of crop residues and fertilizer application on the growth and yield of safflower and major nutrients content in soil. Seven treatments were: application of recommended

and half the recommended dose of fertilizers (RDF), incorporation of sunnhemp (green), green subabul lop-pings, safflower stalks + RDF, sorghum stubbles + RDF and FYM at the rate of 5 t pr ha. The experiment was laid out in RBD with four replications. Observations on growth, yield and yield components, major nutrients uptake and their balance in soil at harvest were recorded. Studies revealed that incorporation of sun-hemp recorded the highest seed yield (9.22 q/ha) fol-lowed in decreasing order by safflower stalks + RDF, RDF, Subabul and half RDF and gave 47.3, 38.0, 34.9, 34.5 and 33.8 per cent higher seed yield than FYM application, respectively. The lowest seed yield was

noticed due to FYM application (6.26 q/ha), which was on par with that of sorghum stubbles + RDF. Incorpora-tion of sunnhemp recorded the highest total N, P and K uptake at harvest followed by safflower stalks + RDF, subabul and RDF and these treatments were on par and significantly superior over FYM which recorded the lowest values followed by sorghum stubbles + RDF. All the treatments increased the organic carbon content in soil at harvest. A positive nitrogen, phosphorus and potassium balance in soil at harvest was noticed with all treatments, except safflower stalks + RDF and half RDF in case of phosphorus and half RDF in case of potash.

Effect of Frequency and Intensity of Leaf Cutting on Agave Genotypes

SURESH S. HALLIKERI

1988

Major Advisor : G.D.RADDER

A field experiment was conducted on shallow clay loam soil at the Agricultural Research Station, Bijapur during 1986-87 to study the effect of leaf cutting fre-quency (6 months and 12 months interval) and intensity (retaining top 5, 10 and 15 leaves) on agave genotypes (local, hybrid and selection GDR). These treatment combinations were reiplicated two times in a split-plot design. Among the genotypes, local performed better in plant height, leaf length and number of grade-I leaves cut per ha, and thus gave significantly more fibre yield per ha compared to hybrid and selection GDR. Agave hybrid produced more leaf width, single leaf weight, fibre extraction percentage and more coarser fibre. Selection GDR although recorded significantly more number of leaves cut per plant, but due to smaller leaf size and leaf weight, the fibre yield per ha was less than

local. Significant positive correlations were obtained with leaf weight cut per plant and fibre weight per plant, leaf length versus leaf weight per ha and fibre yield per ha. Frequency of leaf cutting once or twice in a year did not cause significant difference on fibre yield per ha. However, an improvement was noticed with leaf weight per ha and fibre yield per ha when cutting was delayed until one year. Intensity of leaf cutting to retain 10 leaves produced significantly more fibre yield per ha as com-pared to retaining top 5 or 15 leaves per plant. Perform-ance of local was superior in fibre yield when intensity of cutting was made to retain 10 leaves per plant as compared to other two genotypes with any of the inten-sities of leaf cutting followed. The highest fibre yield was recorded in local when cutting was made at 6 months interval retaining top 10 leaves.

Studles on Row Proportion and Plant Density In Groundnut (*Arachis hypogaea* L.) and Sunflower (*Helianthus annuus* L.) Intercropping System During Summer Under Irrigated Condition

B.G.KOPPALKAR

1988

Major Advisor : M.N.SHEELAVANTAR

A field experiment was conducted at UAS, Dhar-wad on medium black soil under irrigated conditions during the summer (Jan.-May) 1987 to study the effect of row proportions, groundnut plant populations and

sunflower genotypes in groundnut and sunflower inter-cropping system on the growth and yield of component crops, total yield and economics of intercropping sys-tem in relation to sole cropping. There were eleven

treatments comprising combinations of two sunflower genotypes (BSH-1 and Morden), two row proportions (3:1 and 4:1), two levels of groundnut populations (75 and 100%) along with three sole crop treatments. The reduction in the pod/oil yield of groundnut under intercropping system (26.59/8.15 q/ha) over sole cropping system (39.6/11.76 q/ha) was to an extent of 32/31 per cent and that of the sunflower seed/oil yield under intercropping system (15.62/6.76 q/ha) over sole cropping system (21.58/9.26 q/ha) was to an extent of 28/27 per cent. Sunflower genotypes differed significantly in their effect on intercropped groundnut. Of the two sunflower genotypes tried, BSH-1 had lower suppressing ability on intercropped groundnut and resulted in higher pod yield of groundnut when compared to Morden intercropping. The highest seed yield (35.83 q/ha)

and oil yield (16.91 q/ha) were produced under 4:1 row proportion with 75:50 per cent respective population of groundnut and BSH-1 sunflower and it was 47 and 44 per cent higher than the seed and oil yield obtained from sole cropping of groundnut. This optimum intercropping combination also recorded the highest yield advantage of 61 per cent (LER 1.61). The highest net income (Rs.20,269.63/ha) and benefit cost ratio (1.97) was obtained under intercrop with 4:1 row proportion with 75 and 50% population levels of groundnut and BSH-1 sunflower and the additional income was to the extent of Rs. 4,599.24 and rs. 12,966.04 per ha when compared with the net income realised, respectively, under sole cropping of groundnut (Rs. 15,670.39/ha) and BSH-1 sunflower (Rs. 7,303.59/ha).

Effect of Saline Water Irrigation on Growth and Yield of *Setaria* (*Setaria Italica* Beauv.)

VIJAYANANDA S. KUBSAD

1988

Major Advisor : C.S.HUNSHAL

A field study was conducted during 1987 *kharif* season to study the effect of saline water irrigation (Synthetically prepared) on the growth and yield of setaria on pre-salinised black clay soils laid out in micro-plots of 2.5 m x 2.5 m size using RBD at UAS, Dharwad. The plant height, dry matter production and its distribution, AGR, CGR, RGR and STW did not differ significantly due to salinity levels in irrigation water at all growth stages. Whereas LAD and NAR during 30 and 60 days and LAI at 30 and 90 DAS differed significantly. The grain yield was significantly higher at 6 dS/m (31.51 q/ha) and was on par with all treatments except 12 dS/m (17.90 q/ha). The yield components like grain weight per hill, ear weight and effective number of tillers per meter row differed significantly, while others did not. The results on the uptake of nutrients indicated an

increasing trend in P, Ca and Mg uptake upto 4 dS/m and N and K uptake upto 6 dS/m after which it decreased. Sodium uptake showed an increasing trend upto 12 dS/m which was rather inconsistent. The total K/Na ratio differed significantly both at flowering and at harvest. The ratio increased with increasing salinity levels. From the soil analysis, it was evident that, soil EC gradually decreased after sowing till 61 DAS. It rose till 75 DAS but less than the EC at sowing and then decreased at harvest. The pH showed the reverse trend. The available N and P₂O₅ were more in surface layer after harvest. Among water soluble cations, the concentration of K⁺, Mg⁺⁺ and Na⁺ increased with increasing salinity levels and Ca⁺⁺ upto 6 dS/m at both soil depths after harvest.

Effect of Different Irrigation and Phosphorus Levels on Growth and Yield of Soybean (*Glycine Max.* (L.) Merrill)

BASTI PARSWANATH

1988

Major Advisor : A.S.PRABHAKAR

A field experiment was conducted during *kharif* 1987 at the Agricultural Research Station, Belavatagi to identify optimum irrigation schedule and phosphorus

level for soybean grown on clay soil of Malaprabha project area. The experiment included four levels of irrigation (0.8, 0.6, 0.4 IW/CPE and rainfed control) as

main plot treatments and four levels of phosphorus (0, 30, 60 and 90 kg P_2O_5 /ha) as sub plot treatments laid into split plot design. Growth parameters such as plant height, leaf area, dry matter production and rate of dry matter production were higher at 0.8 IW/CPE and at 90 kg P_2O_5 /ha than rest of the irrigation and phosphorus levels, respectively. Yield (21.66 q/ha) and yield parameters like number of pods/plant, number of grains/plant and grain yield/plant were maximum in treatment receiving irrigation at 0.8 IW/CPE followed by 0.6 and 0.4 IW/CPE ratios which were significantly superior to rainfed control but not among themselves. Hence, 0.4 IW/CPE ratio which yielded 19.20 q/ha and received only one irrigation may be recommended. Increasing the level of phosphorus increased the grain

yield significantly and thus the highest yield (23.34 q/ha) was recorded at 90 kg P_2O_5 /ha. The interaction effect was not significant. Both irrigation and phosphorus treatments at higher levels increased the oil and protein content of the seed. Phosphorus content of the above ground portions increased as the crop age advanced. Uptake of phosphorus was highest at 0.8 IW/CPE ratio of irrigation and 90 kg P_2O_5 /ha level (60.1 and 56.9 kg P_2O_5 /ha, respectively). Soil moisture depletion in the soil profile was highest from surface layers (0-30 cm) in treatments receiving frequent irrigations (0.8 and 0.6 IW/CPE) and it was highest from sub surface layers (30-60 cm) when irrigation was delayed (0.4 IW/CPE) or no irrigation was given.

Response of Groundnut (*Arachis hypogaea*. L.) Genotypes to Irrigation Levels at Different Growth Stages.

G. V. SUGUR

1988

Major Advisor : V.S.PATIL

A field experiment was conducted to study the response of three groundnut genotypes viz., Dh-3.30, TG-3 and TG-18 to irrigations scheduled at 150 mm, 100 mm and 75 mm CPE with application of 60 mm irrigation water each time, imposed at three different crop growth stages viz., 15 to 45 days, 45 days to 75 days and 75 days to harvest, during summer season of 1978 at University of Agricultural Sciences, Dharwad. The experiment was laid out in partially confounded design.

The data revealed that Dh-3.30 produced highest pod yield followed by TG-3 and TG-18. The highest pod yield of Dh-3.30 was attributed to its highest pod weight and number of two seeded pods. However, TG-18 recorded highest kernel weight due to bold kernels. Moisture stress during 45 to 75 days significantly

reduced the pod yield compared to moisture stress during 15 to 45 days and 75 days to harvest which were at par. Pod yield of all the three varieties increased significantly with every step increase in irrigation frequency and the response was highest in Dh-3.30. Irrigating crop at 75mm CPE throughout resulted in maximum yield. Economisation of irrigation water without appreciable reduction in pod yield was possible with irrigation at 150 mm CPE during 15 to 45days followed by irrigation at 75 mm CPE at other growth stages. The effect of variety x growth stage interaction on pod yield was not significant. The total moisture depletion and consumptive use of water increased with increase in irrigation frequency, but were not appreciably affected either due to varieties or due to growth stages.

Influence of Some Tree Species on Sunflower + Pigeonpea Cropping System

RAVI BHAT

1988

Major Advisor : V.C.PATIL

Investigations were carried out on the influence of some tree species on sunflower + pigeonpea cropping system in black soils of University of Agricultural

Sciences, Dharwad during 1987-88. The experiment was laid out in RBD with four replications. There were seven treatments including one control (without tree

species). The six tree species were bamboo (*Dendrocalamus strictus*), casuarina (*Casuarina equisetifolia*), eucalyptus (*Eucalyptus tereticornis*), sissoo (*Dalbergia sissoo*), subabul (*Leucaena leucocephala*) and teak (*Tectona grandis*). Trees were planted on 14.7.1979. Sunflower (BSH-1) and pigeonpea (ICP 8863) were sown in 2:1 row proportion with first row of sunflower at 2m distance from the tree line. The seed yield of sunflower (4.72 q/ha) and pigeonpea (4.74 q/ha) were higher in the absence of tree species. Yield reduction of sunflower was maximum (77.75%) under bamboo and least (55.08%) under subabul. The reduction in seed yield of pigeonpea was more (71.94%) under eucalyptus and sissoo and least (38.40%) under subabul. Reduction in yield was more nearer the tree species compared to away from the tree line. Yield reduction in sunflower was 86.25 per cent at 3 m

distance compared to 49.24 per cent at 9 m distance. Yield reduction in pigeonpea was 79.62 per cent at 3 m distance compared to 33.48 per cent at 9 m distance. Nitrogen and phosphorous content and uptake were maximum under control treatment in both sunflower and pigeonpea. Among the tree species, casuarina had the least effect on nitrogen uptake and content followed by subabul. Yield recorded on western side (1.75 q/ha) was more than that recorded on eastern side (1.02 /ha) in sunflower, whereas the yield recorded on eastern side (1.95 q/ha) was more than that recorded on western side (1.61 q/ha) in pigeonpea. Moisture depletion was more nearer the tree line compared to away from the tree line. Light transmission ratio was higher away from the tree line compared to nearer the tree line. The crops received full sunshine in forenoon on eastern side and in afternoon on western side.

Investigations on Measures to Improve Rain-Water Use In Rainfed Cotton

S.B.MODAK

1988

Major Advisor : V.R.KORADDI

A field experiment was conducted on medium black soil at Agricultural Research Station, Dharwad during 1987-88 on two cotton genotypes Laxmi (*Gossypium hirsutum* L.) and Jayadhar (*G. herbaceum* L.) under rainfed conditions for determining suitable measures to make the best use of scanty and undependable rains and thus increase rainfed cotton yields. The treatment besides control comprised (a) effective weed control (diuron 1 kg/ha preemergence spray + hand weeding) (b) Vitamin B complex spray (21/ha at 90, 105 and 120 days), (c) growth retardant CCC (60 ml ai/ha at 75, 105 and 120 days), (d) seed hardening with 2% CaCl₂ solution, (e) antitranspirant phenylmercuric acetate (10⁻⁴ M at 110, 130 and 150 days), (f) use of hydrophilic polymers 'Jalashakti' (6 kg/ha) and CTRL product-I (5kg/ha) for soil application at 60 days and (g) opening furrows between crop rows at 30 days. Phenylmercuric acetate (PMA) significantly increased the seed cotton yield of both Laxmi (702 kg/ha) and Jayadhar

(681 kg/ha) by about 20% over control by maintaining relative water content (RWC) and free-proline content in leaves at a significantly higher level during stress period. For Jayadhar, CCC proved to be the best treatment which, by protecting plants against shedding and *Alternaria* leaf spot, effected the highest seed cotton yield of 909 kg/ha (63 % increase over control). CCC also helped to maintain soil moisture content and leaf proline content at a higher level during stress by decreasing plant growth. Hydrophilic polymer CTRL product-I also increased the seed cotton yield of Laxmi (720 kg/ha) significantly. Rest of the treatments either had a little or no effect on yield of both the genotypes. Vitamin B complex however increased the dry matter production in both the genotypes and slightly increased the yield of Laxmi. Thus, the treatment CCC, PMA and the hydrophilic polymer CTRL product-I were found to be promising for efficient use of rain water in rainfed cotton.

Effect of Duration of Water Supply, formulations and Split Applications of Urea on Growth, Yield and Fibre Quality of Hybrid Cotton

S.N.KULKARNI

1988

Major Advisor :L.A.DIXIT

A field experiment was laid out at UAS, Dharwad during 1982-83 in split plot design with three durations of water supply (up to 100, 165 and 225 days after sowing) as main plot treatments and combinations of two formulations (prilled urea and urea super granules) and two split applications (three and four splits) of urea as sub-plot treatments. Plant height, number of nodes on main stem, monopodial and primary sympodial branches did not differ significantly due to various factors under study. Application of urea super granules produced 2317 kg seed cotton per ha which was higher by 16 per cent than that obtained by the application of prilled urea (1990 kg/ha). This increase was associated with the increase in dry matter accumulation in leaf lamina and reproductive parts as well as the increase in nitrogen uptake, crop growth rate, relative growth rate, net assimilation rate, leaf area index and leaf area

duration. However, number of bolls harvested per plant, mean boll weight, seed index, ginning percentage, and fibre quality character were not affected. Split application tried had no influence on growth, yield, fibre quality and nitrogen uptake. Maintaining water supply upto 165 days after sowing (DAS) had favourable effect on various growth parameters and the number of bolls harvested per plant. The yield of seed cotton per ha increased from 1589 kg per ha with the water supply up to 100 DAS to 2326 kg per ha when the water supply was maintained upto 165 DAS. This increase in the yield was 46 per cent. Continuing the water supply further up to 225 DAS did not further influence the growth components, yield parameters and the yield. Maturity coefficient and bundle strength of fibres improved by maintaining water supply upto 165 DAS and beyond but fibre length, and fibre fineness were unaffected.

Soil Science

Studies on the Genesis and Classification of Some Soils of Upper Krishna Project in Bijapur District

VIJAYAKUMAR S. REVANNAVAR

1987

Major Advisor :A.S.HADIMANI

Five pedons representing Devalapur, Rakkasagi, Amminbhavi, Mamadapur and Managoli series from Hunagund, Bijapur and Sindagi taluks were included in the study. Devapur red sandy loam and Rakkasagi red sandy clay loam soils were high in hydraulic conductivity, but low in dispersion coefficient, COLE and POLE values, whereas reverse trend was observed in Amminabhavi silty clay, Mamadapur clay and Managoli clay soils. Significant differences were noticed in the occurrence of CaCO_3 and salt layers, organic carbon, CEC, exchangeable Ca and Mg contents in red (Devalapur and Rakkasagi series) and black soils (Amminabhavi, Mamadapur and Managoli series). Exchangeable Ca and Mg was high in Amminabhavi silty clay throughout the solum and exchangeable Na was high in Mamadapur clay in lower depth among the three

black soils studied. While exchangeable Ca and Mg in meq/100 gm in red soils were of the order of 14.5 to 29.5, in black soils it was of the order of 45.7 to 65.7, thus providing environment for formation of montmorillonite clay minerals. Further, low K content and higher amount of Mg in clay support the presence of montmorillonitic type clay mineral in the black soils. The petrographic analysis of fine sand fractions of both the Red and Black soils exhibited almost similar type of heavy and light minerals with slight differences among all black soils studied. According to the Taxonomical classification, red soils of Devalapur and Rakkasagi were classified as Isohyperthermic Loamy Typic Haplustalf and Isohyperthermic Loamy Paralithic Ustochrepts, respectively. The black soils were classified as Isohyperthermic Montmorillonitic Typic

Chromusterts. Among all the soil forming factors, climate, parent material and topography seem to be mainly responsible.

Studies on the Evaluation of Chemical Extractants for Available Iron and Response to Ferrous Sulphate in Major Soil Series of Malaprabha Right Bank Command Area

P.P.KULKARNI

1987

Major Advisor : N. VASUKI

An investigation was carried out to study the iron status of Malaprabha right bank command area and its relationship with soil properties, evaluation of chemical extractants for available iron and effect of application FeSO_4 on nutrient content of sorghum. Available iron content of various locations under different series, viz., Hirekumbi, Hanchinal and Kiresur were found to be deficient. Clay and iron oxide contents were highly associated with total iron content of soil. The available iron extracted by different extractants were in the order of $0.1 \text{ N HCl} > \text{DTPA} + \text{CaCl}_2 + \text{TEA} (\text{pH } 7.3) > \text{EDTA} (\text{NH}_4)_2 \text{CO}_3 (\text{pH } 8.6) > \text{NH}_4\text{OAC} (\text{pH } 4.8) > \text{Morgan's reagent}$. Results indicated that CaCO_3 , clay and HCO_3 ions were the dominant factors associated with extrac-

tion of iron by various chemical extractants. In addition to these, DTPA extractable iron was also found to be influenced by pH and organic matter content of soil. $\text{DTPA} + \text{CaCl}_2 + \text{TEA} (\text{pH } 7.3)$ extractant was found to be suitable chemical extractant to predict the available iron status of calcareous soils as reflected by its high correlation coefficient value ($r = 0.935^{**}$) with iron content of sorghum seedlings. A significant increase in the dry matter content of plant was observed with the application of FeSO_4 . The concentration of iron, nitrogen, potassium, calcium and magnesium of sorghum crop significantly increased with the application of FeSO_4 in all the soils, whereas reverse trend was noticed with phosphorus content of plants.

Evaluation of Methods Used in determination of Cation Exchange Capacity in Black Soils

M.D.ERANNA

1987

Major Advisor : H.P.ACHAR

A laboratory investigation was conducted on evaluation of methods used for determination of cation exchange capacity in black soils, to provide a detailed information as to why different methods give different cation exchange capacity values for same soil sample and to find out a suitable method for estimation of cation exchange capacity in calcareous soils. Ammonium acetate and Alexides and Paxions methods gave lower cation exchange capacity values than those obtained from sodium acetate method. The cation exchange capacity obtained from Polemio and Rhoades and Gupta *et al* methods were found to give higher cation exchange capacity than that of sodium acetate method. Simple two factor correlation co-efficient between soil properties viz., pH, Calcium carbonate and sand with cation exchange capacity values were found to be non significant. The simple correlation between organic carbon/clay/silt on one hand and cation exchange

capacity on the other hand were significant. The multiple regression analysis revealed that sodium acetate and Polemio and Rhoades methods are quite efficient for estimation of cation exchange capacity in calcareous soils with less than 10 per cent calcium carbonate content, Gupta *et al* method for calcareous soils having calcium carbonate between 10.0 and 14.9 per cent and sodium acetate method for calcareous soils having calcium carbonate between 15.0 and 19.9 per cent. Sodium acetate and Gupta *et al* methods were found suitable for estimation of cation exchange capacity for calcareous soils with as high as 20 per cent or more calcium carbonate content. The multiple regression analysis for overall soils revealed that Polemio and Rhoades and Gupta *et al* methods were suitable for estimation of cation exchange capacity in calcareous soils.

Characterisation and Reclamation of Some Salt Affected Soils of Bijapur District, Karnataka State

S.S.BALLOLI

1987

Major Advisor : D.P.VISWANATH

An investigation was undertaken to characterise, classify and also to find out suitable amendments or combination of amendments to reclaim the salt affected soils of Bijapur district of Karnataka. The texture of soils studied was clay and they were calcareous in nature. The organic carbon content ranged from 0.1 to 0.5 per cent. The pH values ranged from 8.1 to 8.8. The EC_e values were higher in surface layers as compared to subsurface layers which indicated the movement of salts from the subsurface layers towards surface layers along with water front. Water soluble sodium was found to be the dominant cation. Among the anions, chlorides and sulphates were found to be the dominant ones. The higher concentration of hot water soluble boron in the surface layers indicated the accumulation of boron during the process of salinisation. The ESP of soils studied was more than 15. Dispersion coefficient values were in relation to ESP status. Based on pH, EC, SAR

and ESP values Mangoli, Nandihal and Sarwad soils were classified as saline-sodic, whereas Hunnur and Konnur were classified as saline soils. The USSL staff equation underestimated the ESP status in saline-sodic soils, whereas in saline soils, it overestimated. Regression equations were worked out for predicting the ESP status using the observed SAR values. Application of Gypsum (50% G.R.) + FYM @ 5 t/ha has resulted in significant dry matter yield of sorghum (60 days). Pyrites application to saline-sodic was also found to be beneficial. A combination of chemical amendments with FYM was found to be more effective as compared to their individual application. From the point of improvement in soil properties, Gypsum (100% G.R.) was found to be the promising treatment. Reclamation of saline-sodic soil through the amendments is relatively more effective in the presence of crops than otherwise.

Studies on Fixation and Influence of Liming on Availability of Potassium in Some Acid Soils of Karnataka

N. NINGAPPA

1987

Major Advisor : N.VASUKI

The present investigation was carried out to study the potassium fixing capacity in acid soils, to find out the relationship of soil properties with the available potassium extracted by different extractants and effect of liming on nutrients uptake by groundnut crop. Thirty one soil samples (0-20cm) from various locations of Uttarkannada and Belgaum districts of Karnataka were included in the study. The potassium fixing capacity of soils were low ranging from 21.42 per cent to 40.62 per cent. Significant positive correlations were observed between potassium fixing capacity with soil properties viz., soil pH, CEC, silt + clay, exchangeable calcium, magnesium and potassium and negative correlation with extractable acidity. 1N boiling HNO₃ was found to extract more potassium (0.08 to 1.09 cmol/kg) followed by 0.05N NaTPB (0.07 to 0.63 cmol/kg) 1N NH₄OAc (0.06 to 0.61 cmol/kg). Significant positive correlations were observed between potassium extracted by all the

extractant with soil properties studied except organic carbon which was found to influence only the potassium extracted by HNO₃ ($r=0.425^{**}$) and extractable acidity only with NH₄OAc extracted potassium ($r=-0.374^{*}$).

The application of potassium (K₁ level), dolomite ($\frac{1}{2}$ LR) and calcite (1 LR) was found to be superior with respect to yield and nutrient uptake (Nitrogen, Phosphorus, Potassium, Calcium and magnesium) by groundnut crop. Antagonistic effect of potassium on calcium, magnesium, nitrogen and phosphorus uptake was observed at higher level of potassium (K level). Antagonistic effect of magnesium on nitrogen, phosphorus and potassium uptake at higher level (1 LR) of dolomite was also evidenced. Liming both as calcite and dolomite increased the exchangeable calcium and magnesium content of the soil. Significant increase in soil pH and decrease in exchangeable acidity were observed in proportion to the quantity of lime added.

Investigations on Fractionation of Soil Phosphorus and Uptake by Maize (*Zea mays* L.) In Vertisols of Malaprabha Command Area

J. VISHWANATHA

Major Advisor : V.S.DODDAMANI

Four profile and twenty surface vertisols of Heb-sur, Hirekumbi, Kiresur and Nalvadi soil series of Malaprabha command area were studied for P fractions, transformations of applied P and P fractions contributing towards P uptake in absence and presence of sodium pyrophosphate (NaPP) in Hirekumbi series by maize. P fractionation study revealed that ca-P was the dominant mineral form of P contributing 18.3 per cent of the total P. The average percentages of different inorganic P fractions in surface soils followed the order : Ca-P > Red Sol P > Al-P > Occl.P > Fe.P > Saloid P. The saloid-P, Org-P and total P were generally found to decrease with depth, whereas distribution of Al-P, Fe-P, Red.Sol.P and Ca-P did not follow any definite pattern. Highly positive significant correlation between organic carbon and Org.P ($r=0.890^{**}$), CaCO_3 and Ca-P ($r=0.888^{**}$) and significantly negative correlation between pH and saloid-P ($r=-0.536^{**}$) and CaCO_3 and Fe-P ($r=-0.591^{**}$) was observed in case of surface

samples. Study on transformation of applied P indicated that saloid-P and Al-P forms changed to a greater extent 10 days after the application of superphosphate with NaPP. The increase in Red.Sol.P, Occl.P and Ca.P, 60 days after sowing of maize was more where phosphorus alone was applied. The content of Saloid.P, Al-P decreased 60 days after sowing of maize where phosphorus was applied with and without NaPP. An increase of 25.6, 32.5 and 6.7 per cent in drymatter, P uptake and P content was observed when phosphorus was applied with NaPP. The Per cent recovery of applied P decreased with increased levels of P in presence and absence of NaPP. However, mean per cent P recovery was more (23.12) where superphosphate supplemented with NaPP (10 kg/Ac). Stepwise regression analysis showed that ninety four per cent variation in P uptake by maize was due to Al-P fraction and inclusion of other P fractions did not increase the variation in P uptake.

Effect of Different Levels of Sulphur and Micronutrients on Uptake and Yield of Sunflower (*Helianthus annuus* L.)

G.A. GANGADHARA

1988

Major Advisor : H.M.MANJUNATHAIAH

A field experiment was conducted on typical chromustert of Main Research Station, Dharwad during *kharif* 1987 under rainfed situation to know the effect of different levels of sulphur and micronutrients (Zn, Fe, Mn, Cu and B) on yield, uptake and oil characteristics of sunflower (*Helianthus annuus* L.). The soil contained lower amounts of S, Zn, Fe and medium levels of M, Cu and B. Sulphur was supplemented as elemental sulphur and other micronutrients were given in the sulphate forms, except boron as borax. These nutrients were applied along with the recommended dose of NPK as band placement at the time of sowing. In all, there were fifteen treatment combinations laid out in completely Randomised Block Design with three replications. A sig-

nificant increase in the seed yield and yield parameters was observed with the application of 10 kg sulphur, 25 kg ZnSO_4 , 50 kg FeSO_4 and 20 kg CuSO_4 per ha and non-significant difference was recorded to MnSO_4 and borax treatments as compared to NPK alone. A significant increase in the oil content was recorded to 10 kg sulphur application and non-significant differences were observed with micronutrient treatments. Crude protein and oil characteristics were significantly increased with sulphur treatments. But non-significant increase was observed due to micronutrient treatments. The concentration of N, SO_4 , Mn, Cu and Zn in fourth leaf was increased with sulphur and micronutrients, except borax application. The concentration of N, K and

B in the leaf was increased to borax treatments. In whole plant at 60 DAS, the concentration and uptake of N, K, SO_4 and Mn was increased due to sulphur and micronutrients application, excluding borax, whereas, borax application increased the concentration of N and B. At harvest, in stalk and seeds, the concentration and uptake of N, SO_4 , Zn and Cu was increased due to

sulphur and micronutrient treatments. As compared to stalk, boron concentration appeared to be more in seeds due to borax treatments. Except boron, all other nutrients in the fourth leaf were positively correlated with yield. Similar positive relationship between nutrient uptake by the plant and seeds with yield was observed.

Studies on the Fractionation and Availability of Iron in Calcareous Vertisols of Malaprabha (Right Bank) Command Area

R.M.YERRI SWAMY

1988

Major Advisor : N.VASUKI

The investigation was carried out in the major soil series of Malaprabha (right bank) Command Area in order to study the distribution of total, available and other fractions of soil iron, to know the effect of ferrous sulphate and organic manures on the availability of iron to maize plants and to know the effect of ferrous sulphate and organic manures on the periodical changes in DTPA - extractable iron. Distribution of total iron was more in subsurface layers compared to surface layers and found to be associated with clay and free iron oxides. DTPA - extractable iron followed an irregular pattern of distribution and was associated with organic matter, calcium carbonate and soil pH. Fractionation studies revealed that the water soluble, Mn-oxide occluded and organically bound iron decreased, while exchangeable acid soluble, pb - displacement, amorphous, iron oxide occluded and residual iron increased with depth in all the soil bodies. Percentage contribu-

tion of different fractions to total iron was in the following order. Residual > amorphous Fe-oxide occluded > organically bound > Mn-oxide occluded > lead displacable > exchangeable acid soluble > water soluble iron. Application of ferrous sulphate and organic manures significantly increased the dry matter yield, concentration of nitrogen, iron and copper in maize plants. Concentration of phosphorus, potassium, manganese and zinc significantly decreased with the application of ferrous sulphate alone, while the same increased with organic manure application. Incubation study indicated that the DTPA-extractable iron in soil continuously increased up to 20 days of incubation period and thereafter decreased when ferrous sulphate alone was added and the same was increased even beyond 20 days of incubation period, when ferrous sulphate was applied in combination with organic manures.

Investigations on Influence of Rockphosphate on Groundnut (*Arachis hypogaea* L.) In Acid Soil

K.M.MANJIAH

1989

Major Advisor : H.T.CHANNAL

An investigation was carried out to study the efficacy of Mussoorie rockphosphate (MRP) with and without adjuncts i.e. organic amendments (farmyard manure - FYM, biogas spent slurry - BSS and green manure - GM). Phosphate solubilizing bacterium (PSB, *Pseudomonas striata*) and fungus (PSF, *Aspergillus awamori*) on yield and nutrient uptake of groundnut crop in acid sandy loam soil of Agricultural Research Station

(Paddy) at Sirsi. Soil and plant samples were collected at flower initiation stage (FIS, 30 days of crop growth), pod development stage (PDS, 60 days of crop growth) and crop maturity stage (CMS) and were analysed for N, P, K, Ca, Mg and S. The experiment consisted of 14 treatments (including control) viz. two P sources (MRP and SSP), MRP + organic amendments, MRP + P solubilizers and MRP + organic amendments + P

solubilizers. Phosphorus was applied at 50 kg P_2O_5 /ha through both the P forms and the organic amendments at 10 tonnes/ha. Application of P-significantly increased the growth and yield components, nutrient uptake and pod yield of groundnut. Mussoorie rockphosphate (MRP) was observed to be equally effective as SSP in increasing the above parameters. The MRP recorded 16.01 q/ha pod yield which was statistically on par with 16.70 q/ha by SSP. Inclusion of P solubilizers with MRP increased the pod yield from 16.01 q/ha to 16.79 q/ha. Further, the pod yield increased significantly with the combination of MRP + organic amendments + P

solubilizers (average of 18.50 q/ha) over SSP. In the initial stages of crop growth (Upto F150, SSP was observed to be more effective with respect to availability of nutrients in soil (N, P, K, Ca, Mg and S) and their uptake by plants. In the later stages, MRP excelled over SSP. The combination of organic amendments and P solubilizers with MRP found significantly superior at all the stages of crop growth over their separate addition with MRP and over both the P sources (SSP and MRP). The pod yield was significantly (positive) correlated with the available nutrients in the soil at different stages of crop growth.

Investigations on Status and Forms of Sulphur In Soils of North Karnataka

S.R.BALANAGOUDAR

1989

Major Advisor : T.SATYANARAYANA

Fifteen soil bodies from black (10), red (2) and lateritic soils (3) from North Karnataka were collected and important physico-chemical properties of soil including different forms of sulphur in soils were estimated. Water soluble, sulphate, non-sulphate, organic and total sulphur ranged from 1.4 to 230.6 ppm, 2.8 to 250.0 ppm, 404 to 3356 ppm, 8.4 to 138.6 ppm and 500 to 3500 ppm, respectively. The extractable sulphur was found only 2.47 per cent of the total sulphur having rest of the sulphur as unavailable or reserved sulphur. Total, non-sulphate, sulphate and water soluble sulphur increased with depth with few exceptions. Organic

sulphur invariably decreased with depth in profiles. If 10 ppm is taken as the critical level for available sulphur in soils, 51 per cent of the soils of Malaprabha Command Area fall under low category and most of the soils in lateritic type. Total sulphur was positively significant with non-sulphate sulphur, sulphate sulphur and water soluble sulphur. Organic sulphur was positively correlated with organic cation. Sulphate sulphur and water soluble sulphur were positively correlated with pH, EC, calcium carbonate and clay content. The mean C:N, C:S, N:S and C:N:S ratios in soil profile samples are 11.2:1, 62.4:1, 54:1 and 100:8.9:1.8, respectively.

Horticulture

"Studies on the Propagation of Cashew (*Anacardium occidentale*. L.) by Air-Layering and Epicotyl Grafting"

NARAYANA.K.HEGDE

1987

Major Advisor : G.S.SULIKERI

The studies on the vegetative propagation of cashew were conducted at the Plantation Crops Unit of University of Agricultural Sciences, Dharwad during June 1986 to August 1987 to find out the suitable season, effect of etiolation, optimum concentration of growth regulator for air-layering and the possibility of propagating cashew by epicotyl grafting under Dharwad conditions. Monsoon season (July, 1986) proved to be superior to summer (March, 1987) for air-layering in

respect of percentage of rooting and root characters namely, number of roots, length of roots and weight of roots. Establishments of rooted air-layers (Up to the end of 60 days) was also better in monsoon season layering. Etiolation of the layering shoot 30 days prior to layering produced better results in summer season but it was of little use in monsoon season. However, there was no significant difference in respect of percentage of layers rooted in both the seasons. Among the different levels

of growth regulators tried, the results with respect to percentage of rooting and root characters were better at 200 and 300 ppm of Indole-Butyric Acid (IBA) in monsoon season and at 300 and 400 ppm of IBA in summer season. In both the seasons, mixture of IBA and NAA in equal proportions were not advantageous when compared to IBA treatment alone. However, all

the growth regulator treatments were superior to control in both the seasons in respect of the percentage of rooting and root characters leading to better survival. The epicotyl grafting produced maximum success (39%) in the first fortnight of June. Higher percentage success was obtained in June-July as compared to August, September and October months.

Effect of Nitrogen and Spacing Levels on Growth, Yield and Quality of Two Cultivars of Carrot (*Daucus carota* L.)

V. PARAPPA

1987

Major Advisor : U.G. NALAWADI

A field experiment was carried out on red soil of New Orchard, College of Agriculture, Dharwad during rabi 1980-81 to study the effect of varying levels of nitrogen and spacing on growth, yield and quality of two cultivars of carrot. There were 18 treatment combinations consisting of three nitrogen levels, three spacings and two cultivars. The experiment was laid out in a factorial randomized block design with three replications. Growth parameters viz., plant height, number of leaves and length increased with increased nitrogen level and wider spacing. Pusa Kesar cultivar proved superior in these characters. Yield attributing characters viz., root length, root diameter, average root weight and yield per hectare increased with increased application of nitrogen and the yield per hectare was highest in spacing S₂ (30cm x 10cm). Among the cultivars, Pusa Kesar was superior in the above yield attributing chara-

acters. The nitrogen content (leaves and roots), total sugars (roots) and reducing sugars (roots) increased with increased application of nitrogen and at wider spacing. Nitrogen content (leaves and roots), total sugars (roots) and reducing sugars (roots) were highest in Pusa Kesar cultivar. Positive correlation was seen between the growth characters and yield attributing characters except in the case of plant height at 60 days after sowing and at harvest with root yield per hectare in local cultivar and number of leaves per plant at harvest with root yield per ha in Pusa Kesar cultivar (C₂). A net additional profit of Rs.2,626.17 and Rs.3,937.31 per ha were obtained by application of 75 and 100 kg/ha N, respectively, over 50 kg N. In this experiment 100 kg nitrogen has given highest yield per ha with a spacing of 30cm x 10cm and Pusa Kesar has proved superior over local cultivar.

Effect of Napthalene Acetic Acid (NAA) on Growth, Yield and Quality of Cabbage (*Grassica oleracea* Var. *Capitata*) Varieties

VISHWANTH S. PATIL

1987

Major Advisor : A.A. PATIL

The effects of spraying three cabbage varieties viz., Pride of India (V₁), Suttons Express (V₂) and September cabbage (V₃) with Napthalene acetic acid (NAA) at 0-100 ppm 15 days and one month after transplanting were assessed at UAS, Dharwad during rabi 1986-87. Growth, yield and quality were greatly enhanced by all the concentrations of NAA in all the varieties. The best results were obtained with a concentration of 50 ppm. The combination of September cabbage with 50 ppm NAA gave the highest yield

(88.78 t/ha) which was 23.93 per cent higher over control followed by the interaction of September cabbage variety with 75 ppm NAA (82.88 t/ha.). Moreover, harvesting was about 5 days early in all treatments sprayed with NAA than the unsprayed control. Ascorbic acid and protein contents were also increased by all the treatments. Highest ascorbic acid content was recorded by 75 ppm NAA, with September cabbage variety, whereas, highest protein content was recorded by Suttons Express variety at 1000 ppm NAA.

Nutritional Studies in *Barleria cristata* L.

RAVISHANKAR N.S.

1987

Major Advisor : U.G.NALAWADI

To know the nutrition requirement of *Barleria cristata* L. of a field experiment was carried out in floriculture unit, UAS, Dharwad. The experiment was conducted adopting a factorial RBD design with 2 levels each of NPK i.e., nitrogen at 120, 140 (N₁, N₂), Phosphorus at 60, 80 (P₁, P₂) and potassium at 60, 80 (K₁, K₂) kg/ha. These different treatments/levels were combined to form 8 treatment combinations and compared with the control. The treatment (T₈) receiving NPK at

140:60:80 kg/ha recorded moderate plant height (80.58 cm), maximum number of branches (27.67), maximum number of levels (37.42), maximum leaf area (191.86 m² per plant), early flower bud emergence (64.67 days), maximum total leaf chlorophyll content (2.32 mg/g fresh weight), more leaf N and K nutrient content (2.67 and 2.00%), maximum number of flowers per plant (2970.0) and maximum flower yield (21.18 q/ha).

Influence of Different Forest Tree Species on Growth and Production of Coorg Mandarin (*Citrus reticulata* B), on two Root Stocks under Agro Forestry System

T.B.ALLOLLI

1987

Major Advisor : U.G.NALAWADI

A field experiment was conducted at Agricultural Research Station, Prabhunagar during 1986 on eight year old established Coorg mandarin trees on two different root stocks. Coorg mandarin (*Citrus reticulata* B) trees were planted on trifoliate orange (*Poncirus trifoliate*) and Troyercitrange (*Poncirus trifoliate* x sweet orange) with different forest tree species such as eucalyptus, casurina and silveroak with definite row proportion to evaluate the performance of mandarin trees under agro-forestry system as influenced by said forest tree species. The mandarin trees planted with casurina were found superior with respect to vegetative parameters, nutrient status of leaves and yield attributes over those which were planted with eucalyptus and silveroak and also over indicating beneficial effects of casurina and detrimental effects of eucalyptus. There was no significant difference with respect to most of the above characters among the plants that were planted with casurina and control, silveroak and control and silveroak and casurina. The two rootstocks under the trial behaved differently with respect to all vegetative

parameters and yield attributing characters. Troyercitrange was found superior over Trifoliateorange with respect to above characters. Interaction effects of different forest tree species and rootstocks revealed that the mandarin trees planted with casurina on troyercitrange root stocks found superior over other interactions the mandarin trees planted with eucalyptus on trifoliateorange exhibited poor performance. The fruits harvested from mandarin trees planted alone were found excellent over the fruits of mandarin trees planted with different forest tree species as manifested by higher TSS (%) and sugar content (%) in the fruits. Fruits of mandarin trees on troyercitrange exhibited increased amount of sugar (%) and decreased amount of ascorbic acid when compared to the fruits harvested from trees planted on trifoliateorange. The mandarin plants planted alone on troyercitrange were found superior with respect to quality of fruits over other combinations and fruits harvested from the trees planted with eucalyptus on trifoliateorange were found inferior.

Effect of Time and Method of Grafting in Some Varieties of Mango under Dharwad Conditions

SHANKAR S.

1987

Major Advisor : U.G.NALAWADI

Studies on the effect of time and method of grafting in five varieties of mango were carried out at the Silver Jubilee Orchard, Dharwad, during 1986-87. Three methods of grafting namely, epicotyl, veneer and greenwood wedge grafting were employed. The epicotyl grafting was carried out during second fortnight of June and first and second fortnights of July, 1986. The veneer grafting was done during second fortnight of August and first and second fortnights of September, 1986. The greenwood wedge grafting was carried out during second fortnight of February and first and second fortnights of March, 1987. Epicotyl grafting done during the first fortnight of July registered maximum sprouting and graft take (76.6% and 42.2%) followed that done in the second fortnight of June (63.3% and 34.3%). Among the varieties, Totapuri recorded maximum sprouting and graft take followed by Neelam, Mallika, Alphonso and Pairi. In greenwood wedge grafting, maximum

sprouting and graft take was observed during second fortnight of March (68.6% and 44.6%) followed by first fortnight of March (54.6% and 40.0%). Among the varieties, Mallika registered maximum sprouting and graft take (75.5% and 51.1%) followed by Pairi, Neelam, Alphonso and Totapuri. In veneer grafting, maximum sprouting and graft take were recorded during second fortnight of September (55.9% and 24.0%) followed by first fortnight of September (51.9% and 24.0%) and second fortnight of August (47.9% and 23.9%). Among the varieties, Mallika recorded maximum graft take (38.88%) followed by Neelam, Alphonso, totapuri and Pairi. The optimum weather conditions like high humidity (70-80%) medium high temperature (27-29° C) and higher minimum temperature (19-20° C) at the time of grafting are responsible for higher sprouting and graft take.

Effect of Nitrogen, Phosphorus and Potassium on Growth and Yield of Garlic (*Allium sativum* L.)

B.SAMPATHKUMAR SETTY

1988

Major Advisor : G.S.SULIKERI

A field experiment was conducted on red sandy clay soils under rainfed condition at Agricultural College, Dharwad, during Kharif 1987 to study the effect of three levels each of nitrogen (0, 100 and 200 kg/ha), phosphorus (0, 50 and 100 kg/ha) and potassium (0, 50 and 100 kg/ha) in all combinations on growth and yield of garlic. The nitrogen application influenced the plant height significantly at all the stages of crop growth. Phosphorus, potassium and none of the interactions showed significant effect on plant height. Nitrogen at 200 kg/ha, phosphorus at 50 kg/ha and potassium at 50 kg/ha increased the number of leaves significantly as compared to their respective control. Neck thickness was significantly increased by nitrogen application. Nitrogen and phosphorus content of aerial part was influenced significantly by NP, PK and NPK combination. The highest nitrogen and phosphorus composition was observed in the combination of N₂₀₀ + P₁₀₀ + K₁₀₀ kg/ha (19.2 and 0.31%, respectively). Potassium content was influenced only by K and PK. Dry matter pro-

duction was significantly influenced by nitrogen, phosphorus and all interactions. Uptake of nitrogen, phosphorus and potassium were highest in the treatment combination of N₁₀₀+P₅₀+K₁₀₀ kg/ha, respectively. Nitrogen, phosphorus and potassium fertilization influenced the bulb length, diameter and number of cloves per bulb. Length of the bulb was significantly influenced only by N x P interaction. Diameter of the bulb was influenced by all the interactions and number of cloves was influenced only by N x P. Nitrogen at 100 and 200 kg/ha resulted in significantly higher yield compared to control. N₁₀₀+P₅₀+K₅₀ kg/ha recorded the highest yield of garlic bulb resulting in about 36 per cent increase over control (N₀+P₀+K₀). Highest crude protein content of bulb was observed in the combination of N₁₀₀+P₅₀+K₅₀ kg/ha. Loss of weight in garlic bulb was more wherever nitrogen was applied. Phosphorus and potassium fertilization reduced the loss in weight of bulb during storage.

Studies on Performance of Different Companion Crops of Vegetables under Rainfed Conditions of Dharwad Tract

VIRESH G. KADALLI

1988

Major Advisor : V.M.BANKAPUR

A field experiment comprising eight treatments replicated three times was conducted on black clay loam soils at Agricultural College farm, Dharwad, during 1986-87 to find out suitable companion cropping system in chilli and to work out the economics of growing companion crops in chilli. Also, onion as a companion crop with chilli was studied. The maximum chilli yield was obtained in the treatment chilli alone (46.76 q/ha) followed by onion (s) + chilli (46.53 q/ha). The maximum onion yield was obtained in onion (s) - french bean (16.559 q/ha) followed by onion (s) + chilli (15.999 q/ha) and the maximum yield in french bean was recorded in onion (s) - french bean (29.31 q/ha) followed by onion (t) french bean (24.77 q/ha). Companion cropping reduced the leaf area and dry matter production in chilli considerably. Least reduction in leaf area and total dry

matter production per plant after harvest in chilli was observed in onion (s) + chilli. The treatments onion (s) + chilli and onion (t) + chilli (45.32 q/ha) reduced the chilli yield to a minimum extent and proved superior to others. Cost of cultivation and labour requirement was maximum in the treatment onion (s) + chilli (t) - french bean, followed by onion (t) + chilli (t) - french bean. The maximum gross income (Rs. 21,188.34) and net profit (Rs. 10,310.12) were recorded in the treatment onion (s) + chilli (t) - french bean. The net profit obtained was more in this combination without plant protection measures compared to onion (t) - french bean (Rs. 3,760.04), onion (s) - french bean (Rs. 5,029.93) and onion (t) + chilli (t) (Rs. 6,279.52). Maximum additional income (Rs. 4,951.91) was recorded in onion (s) + chilli (t) - french bean over chilli alone.

Effect of Growth Regulator and Nutrients on Growth and Yield of Byadagi Chilli (*Capsicum annum* Linn. Var. *accuminatum*) under Rainfed conditions of Charwad Tract

K.H.HULAMANI

1988

Major Advisor : V.M.BANKAPUR

A field experiment was conducted on red sandy loam soil at New Orchard, Dharwad to study the effect of growth regulator and nutrients on growth and yield of Byadagi Chilli (*Capsicum annum* Linn. Var. *accuminatum*) under rainfed conditions of Dharwad tract during Kharif 1985. The plant height and the number of branches increased with the application of naphthalene acetic acid (NAA) 20 ppm in combination with urea (2%) at 40 and 60 days after transplanting. Irrigation also helped increase the plant height and number of branches per plant. Number of leaves and thickness of stem were also found to increase due to application of growth regulator (NAA 20 ppm) and nutrient (urea 2%) in combination. Spraying of NAA (20 ppm) + urea (2%) at 40 and 60 days after transplanting increased the per cent fruitset by 43.06 and 37.66 at 50 and 70 days after transplanting, respectively, as compared to control. This also increased the yield of chilli from 7.74 q per ha to 33.83 q per ha, an increase of 287 per cent. Irrigation

at 40 and 60 days after transplanting also resulted in 159 per cent increase in yield. Significant increase was noticed in length (8.21 to 11.22 cm) girth (0.751 to 1.045 cm) and volume (0.04 cc to 0.61 cc) of the fruit when it was sprayed with urea and NAA in combination. Higher weight of 100 ripe and dry fruits (771.25 g and 95.42 g respectively), more number of seeds per fruit (83.15) and higher 1000-seed weight (4.944 g) were also recorded in the same treatment. Average fruit number per plant increased from 111.57 to 247.22 due to irrigation at 40 and 60 days after transplanting. This irrigation treatment also helped to significantly increase dry matter content (g/plant) in stem, root and leaves (140g, 57g and 8.23 g respectively). Treatment with NAA (20 ppm) + urea (2%) at 40 and 60 days after transplanting also recorded higher number of fruits (245.82) per plant. Significant increase in total soluble solids (TSS) was observed in all the treatments as compared to control.

Propagation Studies in some Important Ornamental Climbers by Cuttings

MAHESH C. MATHAD

1988

Major Advisor : U.G.NALWADI

The studies were conducted at the new orchard, UAS, Dharwad, during 1986-87. Nine ornamental climbers were screened for their rooting ability and based on percentage of rooted cuttings, they were classified as easy to root and difficult to root climbers. Two growth regulators IBA and NAA were applied to the easy to root climber *Banisteria laevifolia* and difficult to root climbers *Thunbergia grandiflora* and *Arrabidaea magnifica* to know rooting ability. The cuttings of *A. magnifica* which received NAA 3000 ppm registered the highest percentage of rooting and the highest number of primary roots. The treatment IBA 2000 ppm was found to be the best in *T. grandiflora* which showed maximum number of primary roots and highest percentage of rooting. In *B.laevifolia*, IBA 4000 ppm and 3000 ppm were the best treatments with regard to promotion of rooting. There

was utilization of carbohydrates, amino acids and nitrogen till the end of rooting. However, there was no correlation between utilization of total free amino acids and total nitrogen with rooting in all the three climbers. The C/N ratio was low in the climber *T. grandiflora* in the treatment that showed best rooting characters, while it was high in the climbers *A.magnifica* and *B.laevifolia*. In the present investigation, the exogenous application of growth regulators enhanced the utilization of carbohydrates, phenols, nitrogen and amino acids and helped in better rooting in difficult to root climbers. It is also revealed that the requirement of growth regulators concentrations varies with the genera, species and type (hardwood, semihardwood and softwood) of plants.

Varietal Responses of Cucumber (*Cucumis sativus* L.) to Growth Regulators

BASAVARAJAPPA G. VADIGERI

1988

Major Advisor : B.B.MADALAGERI

A study on the effect of ethrel (200 ppm or 400 ppm) and gibberellic acid (5 ppm or 10 ppm) on vegetative growth, flowering, yield and quality of two cucumber varieties viz., Poinsettee and Belgaum Local was carried out during Kharif 1987 at UAS, Dharwad. Varieties differed significantly in all the growth, flowering, yield and quality parameters. Although poinsettee yielded maximum (20.16 t/ha), it had no market acceptance because of poor fruit quality. Belgaum Local had high ratio of male to female flowers inspite of having higher number of female flowers than the Poinsettee. Ethrel treatment (both 200 ppm and 400 ppm) reduced the length of main axis and inter nodal length and increased

the number of nodes on the main axis and primary branches compared to gibberellic acid. Ethrel at higher concentration produced the first female flower at the proximal node, delayed the male flower appearance and enhanced the early production of higher number of female flowers thus, resulting in least male to female ratio. On the contrary, gibberellic acid of higher concentration had reverse effect. The number of fruits per vine (11.10), yield per vine (2.27 kg) and yield per hectare (22.74 t) were higher in 400 ppm ethrel treatment compared to control and gibberellic acid. Further, ethrel spray (400 ppm) increased ascorbic acid, reducing sugar and total sugar contents in cucumber fruits.

Response of Sweet Potato (*Ipomoea batatas* (L.) Poir) to Varying Levels of Nitrogen, Potassium and Inter-Row Spacing

YOGIRAJ B. PATIL

1988

Major Advisor : A.A.PATIL

A field experiment was conducted during Kharif 1987 at the New Orchard, UAS, Dharwad with a view to find out optimum levels of nitrogen, potassium and inter-row spacing for increasing the production. The differences in tuber yield due to two spacings were significant. The maximum tuber yield of 22.83 t/ha was obtained with closer spacing of 45 x 30 cm which was mainly due to high plant population (74074) per unit area. Significantly higher tuber yield was recorded by the application of 75 kg N/ha in both closer and wider spacing. It was due to good growth and development of foliage and more number of tubers per plant. Tuber yield varied significantly with respect to potassium application. The highest yield of 21.18 t/ha was obtained by the application of 100 kg compared 50 kg and 75 kg K₂O

/ha. The higher nitrogen and potassium uptake was noticed at closer spacing compared to wider spacing with 75 Kg Nitrogen/ha and 100 kg potassium / ha. An increase in nitrogen and potassium application at wider spacing increased the crude protein, starch, reducing sugar and B-carotene contents of tubers. However, cooking qualities such as cooking time, firmness, appearance, taste and mouth feel were not influenced significantly by spacing, nitrogen and potassium levels. The various growth attributes showed positive and significant correlation with yield. Growing sweet potato at closer spacing with 75 kg nitrogen and higher dose of potassium (100 kg/ha) is advisable to get the maximum yield of tubers and high net returns.

Effect of Varying Levels of Nitrogen, Phosphorus and Potassium on Growth and Yield of Coriander (*Coriandrum sativum* L.)

VIVEK R. BHAT

1988

Major Advisor : G.S.SULIKERI

A field experiment was conducted on red sandy clayey soil under rainfed condition with protective irrigations at the New orchard of Agricultural College, Dharwad, during 1987, to study the effect of three levels of nitrogen, three levels of phosphorus and three levels of potassium on growth and yield attributing characters including seed yield and oil yield of coriander. Seed yield rose from 437.61 kg per ha in the control to 672.84 kg with N₄₀P₆₀K₃₀ combination, resulting in about 54 per cent increase over control. The aforesaid combination gave a realization of Rs. 3.81 per rupee spent on fertilizer. The same combination of fertilizer recorded the maximum oil yield (6.13 kg/ha). Influence of these nutrients can be understood through their effect on yield attributing characters. Umbel production was increased from 15.00 in the control to 31.50 per plant with

N₈₀P₃₀K₃₀ combination. Number of seeds was maximum with N₄₀P₆₀K₃₀ (14.07 g). Nitrogen at 40 kg per ha and phosphorus at 60 kg per ha resulted in highest number of branches. Thus, higher uptake of nitrogen and phosphorus at 40 kg N and 60 kg P per ha resulted in higher production of primary and secondary branches which in turn resulted in better seed yield. There was significant positive correlation between growth parameters viz., plant height, number of leaves, primary and secondary branches and yield attributing characters like number of umbels, seeds and seed yield. The order of these parameters based on their contribution towards seed yield was : primary branches > number of umbels > secondary branches > seed per umble > number of umbels.

Propagation Studies in some Important Ornamental Shrubs by Cuttings

SATISH S. HEGDE

1988

Major Advisor : U.G.NALWADI

A pot experiment on the propagation of important ornamental shrubs by cuttings was conducted at the College of Agriculture, Dharwad, during 1987-88, to find out effect of different concentrations of IBA, NAA and their combinations and the role of the biochemical constituents of cuttings such as starch, sugars, total carbohydrates and total free phenols on *Lantana camara* Linn. var. *Depressa*, an easy-to-root shrub and *Gardenia florida* Linn. and *Hamelia patens* Jacq., difficult to root shrubs. The highest rooting percentage and greater utilization of starch, phenols and carbohydrates were recorded with IBA both at 2000 and 3000 ppm concentrations in *Lantana*. IBA with NAA each at 4000 ppm

registered the maximum number of primary roots and area of rooting zone and at 3000 ppm recorded longest primary root in the same shrub. In case of *Gardenia*, the highest rooting percentage was with IBA in combination with NAA each at 3000 as well as 4000 ppm and the maximum number of primary roots were observed with IBA and NAA combinations each at 4000 ppm. NAA alone at 3000 ppm proved best in producing maximum rooting zone with the utilization of higher reserve food material. *Hamelia* rooted better with NAA at 4000 ppm concentration. However, water soaking for 24 hours and IBA at 4000 ppm resulted in maximum number of primary roots and rooting zone respectively.

Propagation Studies in Ornamental Climbers by Cuttings

M.S.GIDDAPLAVAR

1988

Major Advisor : U.G.NALWADI

Studies on the propagation of ornamental climbers by cutting were carried out at New orchard, Agricultural College, Dharwad, during 1987-88, to find out effect of different concentrations of IBA and NAA either alone or in combinations and role of biochemical constituents of cuttings such as sugars, starch, total carbohydrates, total nitrogen, C/N ratio, phenols, amino acids and rooting "co-factors" on an easy-to-root climber, *Poiveria grandiflorum* and on two difficult to-root climbers, *Clerodendron splendens* and *Lonicera japonica*. The easy-to-root climber, *P.grandiflorum*, recorded 100 per cent rooting in all the growth regulator treatments. Highest mean length of primary roots and longest primary roots were produced in the treatment, IBA 3000 ppm. Maximum utilization of all the biochemical constituents was found with IBA 4000 ppm. In the

case of *C.splendens*, the highest rooting percentage and maximum number of roots were found in the treatment NAA 3000 ppm, whereas highest mean length of primary roots and longest primary root were produced by IBA 4000 ppm and NAA 3000 ppm, respectively. Utilization of all the biochemical constituents was maximum in the treatment NAA 3000 ppm. *L. japonica* rooted better and produced maximum number of primary roots with IBA 2000 ppm. Mean length of primary roots and longest primary roots were recorded in IBA 3000 ppm and NAA 4000 ppm, respectively. The easy-to-root climber, *P.grandiflorum*, possessed all the four important rooting "co-factors" but they were absent in difficult-to-root climber, *C.splendens*. The other difficult-to-root climber, *L.japonica* also possessed all the rooting "co-factors" except rooting "co-factor 4."

Influence of Intra-row Spacing with Different Levels of Nitrogen and Phosphorus on Growth and Flower Yield in Crossandra (*C. undulaefolia* S.)

VENKATESH N.HUBBALLI

1988

Major Advisor : U.G.NALAWADI

A field experiment was conducted at floriculture unit of Agricultural College, Dharwad on sandy loam soil to study the influence of intra-row spacings and different levels of nitrogen and phosphorus on growth and flower yield in crossandra during 1987-88. The intra-row spacings differed significantly with respect to growth parameters like number of branches per plant, plant spread, dry matter production per plant and leaf area and yield parameters like 100 flower-weight, number of flowers per plant and flower yield per ha. The intra-row spacing of 30cm recorded the maximum flower yield (11.64 q/ha) compared to 45cm and 60cm (9.04 and 6.8 q/ha, respectively). The nitrogen levels also differed significantly with regard to all growth parameters and

yield parameters like 100 flower weight, number of flowers per plant and flower yield per ha. The nitrogen level of 150 kg per ha was found superior with respect to growth and yield parameters compared to 100kg N and 200kg N per ha. The nitrogen level of 150kg N recorded maximum flower yield (10.07 q/ha) compared to 100kg N and 200kg N (8.76 and 8.65 q/ha, respectively). The phosphorus levels differed significantly with respect to growth parameters like plant height, plant spread and leaf area and flower yield per ha. The phosphorus level of 100kg P per ha registered maximum flower yield (9.56 q/ha) compared to 60kg P per ha (8.76 q/ha).

Studies on the Effect of Varying Levels of Nitrogen and Intra-row Spacing on Growth, Yield and Quality of Cabbage (*Grassica Oleracea* var. *capitata*) cv. Pride of India

G.M.BOMMAIAH

1988

Major Advisor : A.A.PATIL

A field experiment on the response of 'Pride of India' variety of cabbage to varying levels of nitrogen and intra-row spacing was conducted during rabi season 1987 on red sandy loamy soil under irrigated conditions at the New Orchard, University of Agricultural Sciences, Dharwad. The intra-row spacings differed significantly with respect to growth parameters like plant height, plant spread, leaf area, leaf area duration, leaf area index, dry matter production, head initiation and maturity and yield parameters like number of inner leaves in head, diameter of head and head yield per plant. Closer intra-row spacing of 30cm recorded maximum yield (59.04 t/ha) compared to 45 and 60cm (50.14 and 40.05 t/ha respectively). Ascorbic acid con-

tent in heads and total nitrogen uptake were maximum under closer intra-row spacing (30cm). Protein content in heads was maximum under wider spacing. The effect of nitrogen levels also differed significantly with regard to all the growth and yield parameters. The nitrogen level 250 kg per ha was found to be superior than the lower levels. The highest dose of nitrogen recorded maximum yield (60.65 t/ha). Increased levels of nitrogen resulted in significantly higher protein content and uptake of nitrogen while the ascorbic acid content in head decreased as the nitrogen level increased. The combination of 250 kg N per ha with closer intra-row spacing of 30 cm gave the maximum yield of 70.58 t per ha.

Studies on the Effect of Varying Levels of Intra-row Spacing and Nitrogen on Seed Production of Onion (*Allium cepa* L.) cv. Bellary Red

AMIRODDIN B. PATEL

1988

Major Advisor : A.A.PATIL

A factorial experiment was laid out during rabi, 1987 at Agricultural College, Dharwad with randomised block design with three replications. There were four nitrogen levels including control and three intra-row spacings. The various treatments tried did not show any effect on the plant height. Significant increase in the number of leaves per plant was observed with wider spacing. Leaf area and total dry matter production increased in nitrogen and spacing level. There was no striking effect of various treatments on days for flower stalk emergence, 50 per cent flowering, diameter of umbel and 1000 seed weight. More number of flower stalks per plant and more number of flowers per umbel were recorded with plant fertilized with 90 kg N/ha which

were spaced widely. Seed yield per umbel and seed yield per plant increased with increase in nitrogen and spacing level. But, seed yield per hectare was more with plants fertilized with 90 kg N/ha with closer spacing (10 cm apart). Laboratory germination and subsequent vigour studies indicated no significant difference in the quality of seeds. The total nitrogen uptake (kg/ha) was maximum with higher dose of nitrogen and closer spacing. Positive significant correlation was observed between various growth components, yield components and final seed yield per plant. Maximum realisation per rupee spent on nitrogen was with 10 cm spacing and nitrogen at 90 kg N/ha where the level of net returns Rs.75,959.60/ha compared to all other treatments.

Studies on Time and Levels of Pruning on Yield and Quality in CV. Thompson Seedless Grapes. (*Vitis vinifera* L.) under Dharwad Conditions

M.V.KUMARA SWAMY

1989

Major Advisor : U.G.NALAWADI

A field experiment was carried out on red soil of New Orchard, University of Agricultural Sciences, Dharwad during 1985-86 with three year old vines trained on Tasgaon system at a spacing of 210cm x 120cm. There were 12 treatments with three pruning dates and four levels of pruning. The experiment was laid out in Split-plot design with three replications. Growth parameters viz., Number of secondaries per vine, stem girth, thickness of cane and number of canes per vine were higher

when pruning was done on 10th October. Pruning on 10th October at 10 bud cane length recorded higher number of bunches per vine (11.3) and weight of bunch (0.318 kg). Other characters like length and diameter of bunch, yield per vine, length and diameter of berries and even 25 berri weight were superior with this treatment. Quality parameters like total Soluble Solids (TSS) also showed better values.

Studies on the Propagation and Flowering Behaviour in Bougainvillea Cultivars under Dharwad Conditions

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1989

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Studies were conducted in the New Orchard of University of Agricultural Sciences, Dharwad, during 1982 and 1983 in two phases. In the first phase, 40

Bougainvillea cultivars were screened to asses their rooting ability as easy-to-root, moderate-to-root and difficult-to-root. In the second phase, two cultivars viz.,

'Partha' and 'Mary Palmer' (difficult-to-root) were further studied for rooting behaviour with growth regulator treatments, IBA and NAA, either alone or in combination. Among the 40 cultivars used to screen their rooting ability, 17 cultivars were found to be difficult-to-root cultivars. They were 'Charles Wilson', 'Cascade', 'Floribunda', 'Garnet Glory', 'Gloden Glow', 'Lady Hudson of Ceylon', 'Maharaja of Mysore', 'Mahatma Gandhi', 'Mary Palmer', 'Mrs Mc Clean', 'Purple Gem', 'Snow Queen', 'Sweet Heart', 'Sydney', 'Trinidad', 'Thimma' and 'Zulu Queen'. Ten moderate-to-root cultivars were 'Alba', 'Asia', 'Elizabeth', 'Lady Mary Baring', 'Lavender', 'Pink Supreme', 'R.R.Pal', 'Scarlet Glory', 'Scarlet Queen' and 'Vijaya Laxmi'. The easy-to-root

cultivars were 'Brilliant', 'Gillian Green Smith', 'Kalyani', 'Killie Campbell', 'Meera', 'Meriol Fritz Patrik', 'Mrs H.C.Buck', 'Padmi', 'Partha', 'Poultoni', 'Ruaraka', 'Srinivasa' and 'Versicolour'. The easy-to-root cv Partha recorded 100 per cent rooting in all the treatments of IBA (5000, 6000 and 7000 ppm), NAA (5000 and 6000 ppm) and IBA + NAA (5000 and 6000 ppm). The difficult-to-root cv Mary Palmer recorded highest rooting percentage with 5000 ppm of IBA + NAA. Cultivars like Gillian Green Smith and Meera flowered throughout the year with heavy flushes. The cultivars like Kalyani and Nigrette flowered for a very short period during early spring. However, most of the cultivars flowered during summer.

Effect of Plant Density and Levels of Nitrogen and Phosphorus on Growth and Flower Yield of *Gaillardia* (*Gaillardia pulchella* Foug.) cv. Kanabargi Local.

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The response of *Gaillardia* (*Gaillardia pulchella* Foug.) Cv. Kanabargi Local to plant density (S), levels of nitrogen (N) and phosphorus (P) was studied in the year 1987-1988 at the College of Agriculture, Dharwad. There were three levels of plant densities as main treatments viz., $S_1 = 83,333$ (30 cm x 40 cm), $S_2 = 1,07,142$ (30 cm x 30 cm) and $S_3 = 1,66,666$ (30 cm x 20 cm) plants/ha and nine sub-treatments of the combination of three levels of nitrogen viz., 150 (N_1), 200 (N_2) and 250 (N_3) Kg/ha and three levels of phosphorus viz., 80 (P_1), 120 (P_2) and 160 (P_3) Kg/ha arranged in split plot design with two replications. The flower yield increased with increase in the plant density. The maximum yield of 35.5 tonnes/ha was obtained when spaced at 30 cm x 20 cm. *Gaillardia* did not respond to higher

levels of N and P beyond 150 Kg N and 80 Kg P per hectare. An average yield of around 26 tonnes/ha was realised at these levels. The first order interactions (S X N, S X P and N X P) for flower yield were significant. The combinations - N_1P_1 , S_3N_1 and S_3P_1 yielded 28.61, 38.08 and 37.50 tonnes per hectare, respectively. The highest flower yield of 42.2 tonnes/ha was recorded from the treatment combination of closer spacing (30cm x 20cm) supplied with 150 Kg N, 80 Kg P and a common dose of 60 Kg K per hectare, with a net return of Rs.66,724.25 and a cost benefit ratio of 1:4.77. The uptake of nutrients by *Gaillardia* was not commensurate with increase in the levels of application although their content in the shoot generally increased with the increase in the levels of application.