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

DOCTOR OF PHILOSOPHY

AGRONOMY

Integrated Farming Systems for Coastal Region of Goa

B.L. MANJUNATH 2002 MAJOR ADVISOR : Dr. C.J. ITNAL

Field experiments were conducted for two years at ICAR Research Complex for Goa, Old Goa, to identify profitable farming system options for an average holding size prevailing in Goa. Recycling of paddy straw in rice with mushroom spent substrate in 2:1 ratio was found profitable both for rice and rice based cropping systems. Rice- brinjal system recorded the highest productivity (11122 kg/ha) under protective irrigation while rice-cowpea under residual moisture conditions (7662 kg/ha). These systems recorded better net returns (Rs.46440/ha and Rs. 42570/ha, respectively) with higher per day return (Rs. 1 63 and Rs. 195/day, respectively). Further, integration of cropping systems with poultry and mushroom added productivity to the tune of 6060 and 3660 kg/ha, respectively with additional net returns and employment on the farm.

Among the perennial forage grasses and legumes intercropped in coconut, PBN-16 + *Centrosema* and DHN-3 + Centrosema combination (1:1) recorded 26.9 and 15.9 per cent higher forage yield over NB-21 combination with consistency during both the years of experimentation. Further, intercropping in coconut and integration with dairy showed substantial improvement in the net returns from the system(Rs.48530 /ha) over mono cropping (Rs.6225/ha). In addition, dairy integration generated employment to an extent of 356 man days/ha.

The system provided scope for recycling of nutrients through coconut composting using cow dung from the integrated dairy with improvement in soil fertility. The system also enhanced the yield of coconut over pre-experimental period.

On the basis of data generated over a period of two years, integration of mushroom and poultry enterprises with rice-brinjal and rice-cowpea systems provide sustainability in terms of recycling of farm waste, employment generation and economic returns for the family round the year. Further, to make coconut production a viable proposition, intercropping with high yielding perennial forage grasses like PBN-16 and DHN-3 with perennial forage legume Centrosema in 1:1 ratio be recommended. Maintenance of two mulch cows in the system would bring stability to the system with enhanced net returns, additional employment opportunities and improvement in soil fertility.

GENETICS AND PLANT BREEDING

Studies on Induced Mutagenesis in Soybean (*Glycine max* (L) Merrill)

G.T. BASAVARAJA 2002 MAJOR ADVISOR: Dr. P.M. SALIMATH

An investigation was carried out to elucidate information on induced mutations in three soybean genotypes viz., Ankur, JS-335 and Local black soybean. Two mutagens viz., gamma irradiation (10, 20 and 30 kR) and EMS (0.4, 0.6 and 0.8%) were used. M_1, M_2 and M_3 generations were evaluated during 1997 to 1999 at MRS farm, University of Agricultural Sciences, Dharwad.

Mutagenic sensitivity in M_1 generation on the basis of reduced germination, survival and pollen fertility revealed a dose dependent reaction and differential response of the varieties. LD_{50} was found to be around 20-30 kR in case of gamma irradiation and 0.4-0.6% in EMS irrespective of the genotype. Studies in M_2 generation revealed differential response of the varieties with respect to chlorophyll and viable mutations. EMS was more effective and efficient compared to gamma rays.

Induced polygenic variability was assessed in M_2 and M_3 generations. In general, wide range of variability was created for most of the traits in all the treated populations compared to control. The range in general increased towards positive side in all the varieties with both the mutagens. EMS treatments were effective in increasing the yield potentiality compared to gamma rays in both generations.

Correlation between characters in both M_2 and M_3 generations, got strengthened or weakened or altered compared to control offering better scope for yield improvement through selection. Pods per plant exerted maximum direct as well as indirect effects on seed yield in most of the populations. Intergeneration correlation indicated no advantage of early generation selection for yield.

Ten mutants of Ankur confirmed their resistance to rust in field as well as glass house conditions. From the present investigation, 25 mutants were identified as

promising for yield and yield components (pods per plant, 100 seed weight) and rust resistance. Ankur was more promising in yielding useful mutants compared to JS-335) and Local black soybean.

Genetic and Breeding Investigation for Improving Heat Tolerance and Productivity in Dicoccum Wheat (*Triticum dicoccum* Schrank Suhulb)

MAHANTASHIVAYOGAYYA K. 2002 MAJOR ADVISOR : Dr. R.R. HANCHINAL

The present investigation was carried out to understand inheritance of heat tolerance in dicoccum wheat. Six heat tolerant genotypes (NP-200, DDK-1001, DDK-1009,DDK-1013 MACS-2920 and MACS-2931) and six susceptible genotypes (DDK-1017, HW-2000, MACS-2912, MACS 2925,MCS 2928, and LKXDK-247) were used to generate a set of diallel crosses. Parents and their 66 crosses were evaluated during rabi 2000-2001 under timely and late sown situations. Grain yield and other stress related morpho-physiological and chemical parameters were recorded. Besider an attempt has been made to create the variability by hybridization mutation and combination of hybridization followed by mutation by using Gamma rays and EMS in four parents DDK-1001,DDK-1009, DDK-1013 and MACS-2928 and their two crosses DDK-1009x DDK-1013 and DDK-1001 x MACS-2928.

The high heterosis was observed under both normal and heat stress conditions for spike length, spikelet per spike, productive tillers per plant, total dry matter per plant, seed yield per plant, 1000 grain weight, harvest index, stomatal conductance, rate of transpiration and epicuticular wax load. The biophysical parameters including rate of transpiration showed preponderancy of additive variation while rate of photosynthesis exhibited no-additive variance.

DDK-1001, DDK-1009, DDK-1013, DDK-1017, MACS-2920, MACS-2925 and MACS-2931 were good general combiners for heat stress related characters. All crosses showed better *per se* performance compared to check variety DDK-1009 particularly under late sown situation. Of these, DDK-1009 x MACS-2928, DDK-1017 x MACS-2928 and MACS-2925 x MACS-2928 were identified as promising crosses, since the nature of variation in them was mostly of additive type as indicated by low sea values. Simple selection was therefore, suggested for isolating high yielding genotypes tolerant to heat stress. The F_2M_2 population of the cross DDK-1009 x DDK-1013 irradiated with gamma rays showed high GCV, heritability and genetic advance for spike length and productive tillers per plant. Significant association of yield component characters with grain yield per plant was mere in F_2M_2 populations as compared to their F_2 populations.

More number of transgressive segregants was recorded in F2M2's compared to their corresponding F2's. It was observed that effectiveness of physical mutagen in creating transgressive segregants was more than the chemical mutagen.

AGRICULTURAL EXTENSION EDUCATION

A Study on Knowledge of Improved Cultivation Practices of Sugarcane and Their Extent of Adoption by Farmers in Bhadra Command Area in Davangere District, Karnataka

M. V. NAGARAJA 2002 MAJOR ADVISOR: Dr. B. SUNDARA SWAMY

The study was conducted during 2001 involving 240 sugarcane growers in Bhadra command area of Karnataka to measure the knowledge level and pattern of improved sugarcane cultivation and other related factors of sugarcane growers.

Majority (68.32%) of the sugarcane growers were having medium knowledge, while cent per cent had correct knowledge about weedicide and number of eye buds in each set to be used as seed material. Negligible per cent had correct knowledge about use of NPK nutrients and *Trichogramma* parasites.

Majority (61.24%) of the farmers were in the medium category of adoption, while cent per cent adopted weedicides, seed rate and planted at correct time. Cent per cent of the respondents did not use micro-nutrients, control measures for stem borer, shoot borer and use of bio-fertilizers.

The correlation exhibited non-significant relationship between NPK fertilizer applied and yield obtained.

Variables area under sugarcane crop, income and level of adoption significantly contributed towards 56.00 per cent variation in the knowledge level. Significant contribution of 42.00 per cent variation in adoption was found to be from education, income and knowledge.

More than three-fourth of the respondents expressed high cost of fertilizer, lack of credit facilities and policies of sugarcane factories as major constraints.

The sugarcane growers preferred training on ratoon crop cultivation (68.73%), management of NPK fertilizers (66.23%) and package of growing recent varieties (56.24%). The benefit cost ratio worked out for main crop was 1 : 2.58 and for ratoon crop it was 1 : 2.85.

MASTER OF SCIENCES

AGRONOMY

Effect of Tillage and Herbicides on Rainfed Lowland Rice-Greengram Sequence

MANISH KUMAR AHUJA 2002 MAJOR ADVISOR: Dr. V.C. PATIL

Field experiment was conducted during the kharif and rabi summer seasons of 2000-2001 at a farmers' field near the ARS, Mugad (UAS, Dharwad). Split-split plot and split plot designs were used for rice and greengram, respectively. Investigation comprised of three tillage levels (CT = Conventional tillage, MT = Minimum tillage, ZT = Zero tillage) and three pre-plant herbicide treatments (H_1 Paraquat @ 0.6 kg a.i./ha, H_2 = Glyphosate @ 2.0 kg a.i./ha, Ho Control) for both rice and greengram. However, pre-emergence herbicide treatments (B_1 = Butachlor @ 1.0 kg a.i./ha, Bo = Control) were imposed only to rice.

MT recorded 11.2 per cent higher grain yield (36.82 q ha^{-1}) than that of CT (33.12 q ha^{-1}). CT had no advantage over ZT (30.58 q ha^{-1}). Highest grain yield of rice with MT was attributed to higher chlorophyll content (1.33 and 0.61 mg/g of fresh leaf at 120 DAS and at harvest) and resulted higher panicle dry matter accumulation at harvest (11.85 g/panicle). However, tillage treatments did not have significant effect on grain yield of greengram.

Significantly higher grain yield of rice was recorded with glyphosate (39.26) than paraquat (37.07) and control (24.19 q/ha). While, with respect to the grain yield of greengram glyphosate and paraquat application were on par (8.14 and 8.09 q/ha) and were significantly superior to control. This was mainly due to efficient control of weeds and previous stubbles. Among the pre-emergence herbicide treatments butachlor application resulted significantly higher grain yield of rice (36.82q/ha) than control.

Interaction effect of MT + glyphosate combination resulted in 33.3 per cent higher grain yield of rice (44.15 q) than CT + control (farmers practice), but was found on par with MT + paraquat (41.98 q/ha) combination..

Maximum yield potential of rice-greengram sequence in terms of rice equivalent yield was recorded with MT + glyphosate/rice - MT + glyphosate/greengram sequence (63.12 q ha^{-1}) which was on par with MT + paraquat/rice - MT + paraquat/greengram sequence (60.94 q ha^{-1}). However, MT + paraquat/rice - MT + paraquat/ greengram sequence recorded highest net returns of Rs.29072.8 ha^{-1} with maximum net benefit cost ratio of 2.61.

CROP PHYSIOLOGY

Physiological Aspects of Allelopathic Potential of Weed Species on Cereals, Pulses and Oilseeds

BALAPPA R. JALAGERI 2002 MAJOR ADVISOR: Dr. B.B. CHANNAPPAGOUDAR

An investigation was carried out to find out the allelopathic effect of different weed species viz., Commelina benghalensis, Cyperus *rotundus*, *Parthenium hysterophorus* and *Prosospis juliflora* on different crops viz., sorghum, wheat, greengram, soybean, sunflower and groundnut with respect to per cent germination, rate of germination, root length, shoot length, seedling length, vigour index and dry matter content. Two separate experiments were conducted at Department of Crop Physiology, College of Agriculture, UAS, Dharwad, during 1999-2000.

The first experiment was aimed to find out the allelopathic potential of aqueous weed extracts (5 and 10 %) in laboratory and second experiment was conducted to study the effect of weeds residue incorporation (5, 10 and 20 g per kg of soil) to the soil on growth, development and biochemical parameters of sorghum, soybean and groundnut. The treatment were replicated thrice.

The per cent germination, rate of germination, root length, shoot length, seedling length, vigour index and dry matter content were reduced significantly in soybean and sunflower as compared to sorghum, greengram, wheat and groundnut with 10 per cent Commelina and Cyperus extract, while the same concentration of *Parthenium* and Prosopis weed leaf extract showed lower effect on the above said crops.

The plant height in soybean, sorghum and groundnut was significantly decreased due to different weed leaf residue incorporation at 15 and 30 DAS. The

inhibitory effect of *Commelina* and *Cyperus* residues (at 20 g per kg of soil) was higher as compared to *Parthenium* and *Prosopis*. The *Commelina* and *Cyperus* residues incorporation (at 20 g per kg of soil) resulted in greater inhibition of leaf area, stem and leaf dry matter accumulation in soybean followed by sorghum and groundnut.

The biochemical parameters like, chlorophyll content, nitrate reductase activity and sugar content showed a greater reduction in soybean than sorghum and groundnut due to weeds residue incorporation (20 g per kg of soil). The extent of decrease was more with *Commelina* followed by *Cyperus* residue incorporation than *Parthenium* and *Prosopis*.

Physiological Studies on Weed Control Efficiency of Different Herbicides in Potato (*Solanum tuberosum* L.)

PRABHU A. MALAWAD 2002 MAJOR ADVISOR: Dr. B.B. CHANNAPPAGOUDAR

A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad during kharif 1999 to study the influence of herbicides and crop weed competition on weed control efficiency in potato (Khufri Chandramuki). The experiment consisted of five herbicides each at two concentrations along with weed free and weedy check. The experiment was laid out in randomized block design with three replications.

Results revealed that the application of pendimethalin was phytotoxic while, metribuzin @ 0.75 and 1.0 kg a.i. ha^{-1} was not phytotoxic. The data on monocot, dicot and total number of weeds and total dry weight of weeds were found to be maximum in unweeded check and the herbicide treatments metribuzin @ 0.75 and 1.0 kg a.i. ha^{-1} decreased these parameters. The weed control efficiency was maximum with metribuzin @ 0.75 kg a.i. ha^{-1}.

The morpho-physiological traits viz., leaf dry weight, tuber dry weight and total dry weight were lowest in unweeded check and the application of metribuzin @ 0.75 and 1.0 kg a.i. ha^{-1} increased these parameters. The growth parameters viz., leaf area, AGR, CGR, NAR, SLW, LAD and BMD were significantly lower in unweeded check while the application of metribuzin @ 0.75 and 1.00 kg a.i. ha^{-1} was very effective and increased the above said all growth parameters.

The tuber yield decreased significantly due to weed competition. Among the herbicides, tuber yield was significantly higher in metribuzin @ 0.75 and 1.0 kg a.i. ha^{-1} followed by diuron @ 1.0 kg a.i. ha^{-1} and these treatments recorded significantly lower values for weed index. The total chlorophyll content was significantly lower in unweeded check while the application of metribuzin @ 0.75 and 1.00 kg a.i. ha^{-1} significantly increased the chlorophyll content. The benefit cost ratio was highest in metribuzin @ 0.75 kg a.i.ha^{-1} followed by metribuzin @ 1.00 kg a.i. ha^{-1}.

GENETICS AND PLANT BREEDING

Isozyme Characterization of Napier Grass Germplasm

ANITA P. BHANDARI 2002 MAJOR ADVISOR: Dr. D.H. SUKANYA

Napier grass (*Pennisetum purpureum Schum*) is an important forage crop of warm regions throughout the world. Existence of variability/ diversity in Napier cultivars give tremendous scope for characterization of Napier germplasm for its proper management documentation and assessment of variability which can be utilized in future crop improvement programme. Sixty-four Napier accessions collected from different sources were characterized for phenotypic traits, isozymes and total proteins polymorphism for its use in fingerprinting these accessions.

All the eleven morphological characters showed significant variation and available variation indicated the usefulness of traits viz., leaf to flowering for identification of germplasm. Nine divergent clusters obtained through D_2 statistics revealed no parallelism between geographical and genetic diversity. PCA and cluster analysis grouped accessions into four major groups and sufficient variation within clusters suggested need for supplementing tool for complete differentiation.

Napier accessions exhibited sufficient isozymic polymorphism for three isozymes (MDH,GOT and POX) and total proteins. Peroxide and total proteins exhibited comparatively higher polymorphism. Efficiency of three enzyme system was evident, as they have identified more than 90 per cent of the Napier accessions. Further the

combination of total proteins along with three enzyme systems allowed the development of cultivars specific profile/ fingerprinting for all the 64 accessions.

A preliminary effort on genetic interpretation of isozyme based on information available on related/ other species and quaternary structure of enzymes identified 12 polymorphic loci with 28 alleles in 64 Napier accessions. Higher frequency of null alleles and heterozygosity were common in vegetatively propagated /open pollinated / allotetraploid crops like Napier grass.

Cluster and PCA of electrophoretic data of alleles also grouped 64 accessions into 4 major groups indicating grouping was based on allelic distribution and not on geographical distribution or partially on morphological characters. Presence of substantial genetic diversity evident from phenogram and PCA was further confirmed through winboot analysis which revealed that the strength of differentiation was strong enough within clusters than between clusters for identifying the individual germplasm through isozyme technique.

Genetic Evaluation and Stability of New Expermimental Hybrids in Rabi Sorghum (*Sorghum bicolor* L) Moench)

C.S. ESHA 2002 MAJOR ADVISOR: Dr. M.S. PATIL

The material for the present study comprised of 19 parents, 21 hybrids and six checks of rabi sorghum. All these were evaluated during, different locations viz., Main Research Station, Dharwad rabi 2000 at four different locations viz., main Research Station, Dharwad (E_1), Agricultural Research Station, Annigeri (E_2), Regional Research Station, Bijapur (E_3) and Agricultural Research Station, Bheemarayanagudi (E_4). First three locations were rainfed environments, E_4 was irrigated condition. The same genotypes,were tested for reaction to shootfly and charcoal rot in two separate trails at Regional Research Station, Bijapur in the same season.

Analysis of variance revealed that the parents, hybrids, checks hybrids Vs parents and checks Vs hybrids were highly significant in all four locations for all the characters studied. The pooled analysis of variance revealed that genotypic differences pooled over environments were significant for all characters. The genotype x environment (GxE) interaction were significant for all traits which indicates that the genotypic performance of the lines and their respective hybrids varied with the change in environment. Based on heterosis, the hybrids 104A x BRJ204, 104A x R647, 116A x SVD9647 and 117A x BRJ356 were found to be the best combinations for grain yield and other component characters. But among these hybrids 104A x R647 was late maturing as compare to hybrid and local check, whereas 104A x BRJ204, 116A x SVD9647, 117B x BRJ356 were early maturing with higher grain yield as compared to checks. Incidentally 104A x BRJ204 was also showed considerable resistance levels for both shootfly and charcoal rot as compare to both checks with higher 1000 grain weight.

The estimates of stability parameters revealed that, 104A x SPV570, 104A x M148-136 and 117A x BRJ356 was stable for most of characters under study. The crosses 117A x BRJ356 was stable specifically for grain yield and M31-2A x SPV1501 stable only for fodder yield. However, 104A x R647 showed specific adaptation for favourable environmental conditions with respect to grain yield, while 104A x BRJ358 for unfavourable conditions. For fodder yield 104A x BRJ204 showed specific adaptation for favourable environmental conditions, while 116A x IUS181 for unfavourable conditions.

The results regarding identification of genotypic reaction to pest and disease reveal that the genotypes 104A x BRJ204, 116B, 117B and BRJ358 displayed considerable resistance levels for both shootfly and charcoal rot.

Identification of PCR- Based DNA Markers Linked with Resistance to Rust in Groundnut (*Arachis hypogaea* L.)

T. SHIVANAND VARMA 2002 MAJOR ADVISOR : Dr. CHANNABYRE GOUDA

Rust (*Puccinia arachidis* Speg.) is one of the important foliar diseases of groundnut that cause substantial yield loss as well reduces the fodder and seed quality. Few foliar diseases resistant cultivars have been released in India, however, they are not popular among farmers mainly because of late maturity, low shelling outturn, and inferior pod/seed characteristics compared to locally adapted cultivars. The resistant sources possess many undesirable pod/seed characteristics that were difficult to eliminate because of linkage drag by conventional breeding techniques.

The DNA markers have revolutionized the genetic analysis and opened up new vistas in crop improvement. The present experiment was initiated to identify SSR markers linked with resistance to rust in two crosses in groundnut. The parents, F_1, F_2, $BC_1P_1F_1$, and BC_1P_2 F_1 populations were evaluated for resistance to rust under greenhouse conditions. Of the 25 SSR primers screened for polymorphism, 7 primer detected variation between ICGV 99003 and TMV 2 and 5 between ICGV 99005 and TMV 2. None of the primers showed intra-accession variability among mapping parents. Highly resistant and susceptible F_2 plants were bulked and analyzed using bulk segregant analysis to identify markers linked with resistance to rust. The bulk segregant analysis did not provide useful results as in many cases both the parental bands were present in the resistant and susceptible F_2 bulks. Later on the individual resistant and susceptible F_2 plants were analyzed for marker-trait relationships. Resistance to rust in cross ICGV 99003 x TMV 2 is associated with SSR markers $3A01_{275}$ and $3A01_{387}$ while susceptibility with $3A01_{293}$ and $3A01_{412}$. Resistance to rust in cross ICGV 99005 x TMV 2 is associated with markers $5D05_{270}$ (and $5D05_{335}$and susceptibility with markers $5D05_{260}$ and $5D05_{312}$. Further studies are necessary to confirm these observations in later generations.

AGRI. BIO TECHNOLOGY

Evaluation and Molecular Characterization of Native Bacillus thuringiensis Isolates

N.G. PRASHANTH KUMAR 2002 MAJOR ADVISOR: Dr. M.S. KURUVINASHETTI

The present study was conducted to obtain new isolates of *B. Thuringiensis* from *phylloplane* and characterize them. In all, 40 isolate were obtained from phylloplanes of *Morus* alba (PK-1 to PK-8), *Parthenium hysterophorus* (PP-1 to PP-16), *Ocimum sanctum* (T-1 to T-8), leaves and flower petals of *Rosa indica* (R-1 to R-8). These isolates, along with others were tested against three lepidopteran insects, a nematode and a fungus. Molecular characterization was done based on protein profile, plasmid profile and by RAPD-PCR using specific primers.

Spore-crystal suspension of isolates - PK-4, PK-8, T-2, R-5, R-7 and M7 gave 80% mortality in second instar larvae of *Mythimana separate*. Similarly, PK-3, PK-4, PP-5, PP-10, PP-14 and T-2 gave 80% mortality at 96h for Chilo partellus. Crude protein extract of PP-10, T-2, R-5, P1 and Bt-42 resulted in 100 % mortality of 5 -day-old larvea of *Helicoverpa armigera*. But, culture suspension had varied response -P1 (90%) D1(87.5%) and PP-10(78.5%) at 96h. Probit analysis for top seven isolates against *Helicoverpa armigera* showed that insecticidal activity of PK-8>PP-10>Bt-42 and P1>PP-10= T-2> Bt-42> R-5>D1> PK-8 respectively, at 48h and 72 hours.

Coutrary to many reports in literature, it has been proved that *B.thuringiensis* Isolates were nematostatic rather than nematicidal against *Meloidgyne incognita*.

Isolates from parthenium phylloplane showed higher mycelial growth inhibition of Sclerotium rolfsii in co-culture tests. PP-1PP-2 and PP-4 were 100% inhibitory.

PP-10 and T-2 were significantly superior against all the lepidopteron species.T-2 is also effective against S. *rolfsii*. PK -4 was effective against all other test organisms, except *H.armigera*.

Analysis of protein profile by SDS-PAGE revealed variation among isolates. Standard isolate, HD-1 is closely related to PP-10 (0.88). Remaining isolates formed different clusters, indicating differences among them. All isolates had a common 15 kb plasmid, except R-2, which showed 5 distinct bands, and HD-1 had 7. Of the specific primers used (cry1 cry 5, cry7 and cry1), only cry 1 showed amplification in PK-8, HD1a and T-2. As most isolates had insecticidal activity, they are likely to produce one or the other toxic protein. Further characterization of the isolates is necessary.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Studies on Sulphur Status and Response of Rainfed Rice to Sulphur in Kalghatgi Taluk of Dharwad District.

SHAILENDRA KUMAR 2002 MAJOR ADVISOR: Dr. S.K. GALI

An investigation was carried out to study the sulphur status and response of rainfed rice to sulphur application in Kalghatgi taluk of Dharwad district. The available sulphur status revealed that, out of 174 samples analyzed, 39 per cent were deficient, 20 per cent were medium and 41 per cent were adequate in available sulphur. The available sulphur was positively correlated with EC and organic carbon content and negatively correlated with soil pH. The field experiment conducted in low S status soil in farmer field, revealed that all growth and yield

parameters and yield of rice increased due to S application, grain and straw yield of rice increased with increasing levels of S application (15 kg to 40 kg ha^{-1}). Although response of rice to sulphur application was significant upto 30 kg ha^{-1}, application of 15 kg S ha^{-1} gave highest Apparent-Recovery (11.97%), Agronomic Efficiency (21.30 kg kg^{-1}) and Value Cost Ratio (19.06). The N:S and P:S ratio decreased with increasing levels of sulphur application due to more uptake of sulphur. While, the decrease in these ratios was significant at 15 kg S ha^{-1}, the values at 30 kg S ha^{-1} and 40 kg S ha^{-1} application were on par with 15 kg S ha^{-1}. Sulphur application significantly increased the S fractions in the soil and these fractions decreased at harvest.

Sulphur Status in Dharwad and Halyal Taluks and Rice Response to Sulphur Application Under Rainfed Situation

MAHESH. B.G. 2002 MAJOR ADVISOR: Dr. H. M. MANJUNATHAIAH

Investigation was carried out in order to assess the available sulphur status of rice soils in selected villages of Dharwad and Halyal taluks of northern transition and hilly zones of Karnataka and field experiment was conducted to evaluate direct effect of different levels of sulphur on rice and the residual effect on greengram crop. The data on pH, EC, OC and available sulphur content of soils revealed that pH of the soils are acidic whereas EC of soils have normal salt content . The OC content of soils in Dharwad taluk is low i.e. 22.5 per cent whereas soils in Halyal taluk is low in 47.6 per cent. The data on available sulphur content of soils in Dharwad taluk indicated that less number of soil samples fall under low i.e. 28.5 per cent, whereas in Halyal taluk a majority of soil samples fall under low i.e. 41.0 per cent.

Under field experiment in rice growing soils with four levels of sulphur (0,15,30 & 37.5 kg S ha^{-1} as SSP), the growth and yield parameters and yield (grain + straw) of rice significantly increased with applied S level. The N, P and S content and uptake also followed the similar trend. The N/S and P/S ratio were significantly narrowed by increased levels of applied sulphur. Results obtained from the study on residual effect of sulphur on greengram revealed that seed and haulm yield increased due to sulphur levels.

The value cost ratio for rice greengram cropping system was higher in 15 kg S ha^{-1} treatment. Additional returns of Rs.2899.00 accrued by investing Rs.85.50 per hectare on sulphur.

AGRICULTURAL ENTOMOLOGY

Standization Production of Egg parasitoid *Trichogramma Achaeae* (Nagaraja and Nagarkatti) and its Laboratory host *Corcyra cephalonica* (Stainton)

SHIVALEELA 2002 MAJOR ADVISOR: Dr. B.V. PATIL

Standardization and production of egg parasitoid *Trichogramma achaeae* (Nagaraja and Nagarkatti) and its loboratory host *Corcyra cephlonica* (Station) was undertaken at Biocontrol laboratory, College of Agriculture, Raichur during 2000-01 to know the refrigeration of *Trichogramma achaeae* parasitoid, optimum temperature and humidity requirement of maximum egg production, evaluation of different food materials for rearing *Corcyra cephlonica*, *refrigeration* of *Corcyra cephlonica* eggs before prarasitization and natural enemy complex of *Corcyra* cephlonica.

The refrigeration of *Trichogramma achaeae* parasitoid was carried out at different day intervals recorded maximum emergence of 97. 0 per cent at two days of storage. Overall the per cent emergence of the parasitoid was maximum upto 30 days of storage.Overall the per cent emergence of the parrasitoid was maximum upto 30 days of storage.

Maximum incubation period of *Corcyra cephlonica* eggs was 6.12 days at 22 °C and 4.99 days at 60 per cent relative humidity. However, the interjection revealed that minimum incubation period of 2.83 days at 28 °C with 80 per cent relative humidity.

The hatching was maximum (97.2%) at 25 °C and 96.2 per cent at 90 per cent relative humidity. The interactions showed that maximum hatiching (100%) was recorded at 25 °C with 90 per cent relative humidity.

Fecundity of *Corcyra cephlonica* was maximum with 281.5 eggs at 25 °C where the egg laying of 341 eggs as maximum at 90 per cent relative humidity. The interaction revealed that a 25 °C with 90 per cent relative humidity fecundity was maximum.

Hybrid sorghum CSH-14 was recorded as cheap and preferred laboratory host. Maximum egg production of 25 CC was recorded on hybrid sorghum with a C:B ratio of 1: 28.5.

Storing of the *Corcyra cephlonica* eggs in the refrigerator for a period of two days resulted in maximum (96.0%) hatching.Overall the percentage of hatching was recorded to be higher upto 15 days of storage. Maximum parasitism of 96.0 per cent was noticed on two days stored *Corcyra* eggs.

Three natural enemies viz., mite, *Pyemotes ventricosus*, Bracon hebetor and Xylocoris flavipes were noticed in the *Corcyra* basins. *Tribolium* castaneum competed with *Corcyra* larvae for food.

Effect of Earthworm Density and Water Quality on Vermiculture and Vermicomposting

K. DAYANANDA 2002 MAJOR ADVISOR: Dr. R.S. GIRADDI

Investigations on the effect of earthworm density and water quality on vermiculture and vermicomposting were undertaken at University of Agricultural Sciences, Dharwad during 2000-01

Two crop residues, soybean harvest waste and cereal straw having varied C:N ratios were used as substrates. With the increase in earthworm density from 100 to 250 worms per bed of 1.0 x 1.0 x 0.5 m, the fecundity, non-clitellate and clitellate worms in numbers increased progressively. Similar increase was observed with vermicompost production which ranged from 11.17 kg at 100 worms density to 15.17 kg at 250 worms density. When observed on per worm basis , the rate of increase in earthworm development was higher at 100 worms density (7.25 and 5.61 fold) followed with 150 worms (5.48 and 4.30 fold), 200 worms (4.44 and 3.51 fold) compared to 250 worms (3.69 and 2.97 fold) which was the lowest in both soybean waste and cereal straw.The productivity of vermicompost was also higher at 100 worms (0.13 and 0.1kg) Inoculation density in both substrates and it decreased (lowest of 0.7 and 0.05 kg at 250 worms) with the increase in earth worm density. Between the two residues, soybean residues was a good substrate for cocoon production, development of worms and vermicompost production compared to cereal straw where the population growth and quantum of biodegradation were relatively less. Considering various parameters, 100 worms per bed appears to be the optimum incoculation density in both the substrates.

Higher number of cocoon, population growth and vermicopost was observed in potable water and sewage water-Potable water mix (1:5 proportion). The treatments to follow this were water with RSC of >2.5 meL^{-1}, water with EC of 2 dSm^{-1} and sewage water potable water mix (1:2 proportion). However, other treatments such as water with RSC of 5 meL^{-1}, water with EC 4 dSm-1 were moderate in their effect. Direct application of sewage water exerted adverse effect on the development of worms. No developments of worms was seen in treatments, water with EC of 8 dSm^{-1} and RSC of 10 meL^{-1} due to initial mortality of the worms immmediately after release indicating that they are unsuited for vermiculture and vermicomposting for all three species.

The toxicity of salt water on the survival of worms was in the order of Eudrilus eugeniae>Eisenia fetide>*Perionyx excavatus* whereas for sewage water it was E.*fetida*>E.*eugeniae* >P.*excavatus*.

AGRICULTURE MICROBIOLOGY

Studies on Growth Promoting Rhizobacteria Associated with Soybean (*Glycine max* .L)

NAGARAJA M. NAIK 2002 MAJOR ADVISOR: Dr. A.B. PATIL

An attempt was made to know the effect of growth promoting rhizobacteria, isolated from different locations on the growth and yield of soybean under pot culture conditions.

Plant growth promoting rhizobacteria (PGPR) such as *Rhizobium*(30 strains), *Azospirillum* (5 strains), phosphate solubilizers (18 strains) and general rhizobacteria (8.strains) isolated from different regions and they are characterized based on morphological

biochemical and physiological characteristics.Then they are screened for their beneficial traits such as N2- fixation, phosphate sulubilization, production of plant growth promoting substances such as IAA, GA and biocontrol test. By considering all these beneficial traits one efficient strain was selected from each group to know the combined effect of these growth promoting rhizobacteria on the growth and yield of soybean.

All the inoculation treatments showed better plant growth, yield and nutrient uptake compared to uninoculated control. Among the inoculation treatments, single inoculations performed better than uninoculated control whereas, dual inoculations performed better over single inoculation treatments. Combined inoculation of three beneficial organisms (*Rhizobium* + *Azospirillum*+PSB) was superior over dual, single inoculants and control. However, this was on par with the combined inoculation of four beneficial organisms(*Rhizobium* +*Azospirillum* +Phosphate solubilizers+ general rhizobacteria) with respect to plant growth, yield and nutrient uptake. The results of our studies indicate that the combined inoculations involving three or more beneficial organisms exerts more favourable effect on growth and productivity of soybean than dual or single inoculations.Results can be extrapolated to field conditions.The results of combination of four organisms were on par with combination of three organisms and hence the desired combination of *Rhizobium* + *Azospirillum* +PSB was producing maximum favourable influence on growth and yield of soybean and could be recommended for field applications in soybean.

Studies on Mineral Phosphate Solubilizing Micro-organisms of Salt Affected Soils

R. SRINIVASAN 2002 MAJOR ADVISOR: Dr. A.R. ALAGAWADI

Attempts were made to isolate phosphate sulubilizing micro organisms from salt-affected soils of Karnataka and Madhya Pradesh states. A total of 23 bacterial and 35 fungal strains were isolated a characterised. *In vitro* P-solubilization by bacteria ranged from 6.06 - 15.17 % from TCP and 0.20 - 4.29 % from MRP. Whereas that by fungal isolates ranged from 10.42 - 21.36 % from TCP and 0.4 - 14.55 from MRP. The bacterial isolates produced IAA and GA in the range 0.735-9.53 and 2.08 - 12.55 μg respectively whereas the fungal isolates produced 2.33 - 8.69μg of IAA and 3.44 - 14.80 μg GA / 25 ml broth.

Out of 12 isolates each of PSB and PSF, all except one bacteria showed production of atleast one organic acid. A maximum of three organic acids were produced by two PSB and eight PSF isolates. The *in vitro* influence of NaCl on growth and P-solubilization was also studied wherein PSBCRG$_1$-1 showed maximum growth at 0.4 M and P-solubilization at 0.8 M over control as compared to other bacterial isolates. Among fungal isolates, PSFCRG$_2$-1 recorded maximum growth at 0.2M and PSFNRH-2 recorded the maximum solubilization at 1.0M NaCl. Six each of bacterial and fungal isolates were further tested for their influence on plant growth in a salt affected and a normal soil separately. PSBCRG$_1$-1 among bacteria and PSFNRH-2 among fungi increased the growth, dry matter content and P$_1$ uptake of sorghum plants and available P content in salt affected soil over the respective reference strains. However in normal soil, PSBCRG$_2$-1 and PSBNRM-1 performed comparably to reference strain *Pseudomonas striata*. PSFNRM-1 among fungal isolates was significantly superior over the reference strain *Aspergillus awamori*. Analysis for P- solubilization in sterile soils with graded EC levels also showed better solubilization by PSBCRG$_1$-1 at EC level of 6.5 and PSFNRH-2 at 13 EC level.

AGRI. BUSINESS MANAGEMENT

A Study on Quality, Grading and Prices of Cocoon and Raw Silk Marketing in Karnataka

M. HARINATH 2002 MAJOR ADVISOR : Dr. L. K. WADER

The present study was undertaken in cocoon markets and silk exchanges of Ramanagaram and Sidlaghatta. The specific objectives of the study were the development of grade standards for cocoon and raw silk, to study the influence of quality and non-quality factors on price and to study the problems faced by farmers and reelers in production and marketing of cocoon and raw silk. Composite indexing technique was employed to develop grade standards. For the purpose of identifying the importance of each parameter appropriate weights were assigned to quality factors of cocoon and raw silk. Stepwise multiple regression technique was employed to

study the influence of quality and non-quality factors on prices of cocoon and raw silk. A large number of variables were found to be insignificant in determining the price of cocoon and raw silk by visual inspection. Buyers in Sidlaghatta cocoon market failed to estimate correctly reelability percentage as they discounted the lots which are having high reelability percentage. In Ramanagaram silk exchange buyers have failed to assess correctly the winding breaks and they have paid high price to the lots with higher winding breaks. This makes clear that there is a need to evaluate quality characters of cocoon and raw silk to determine the price paid to the producers in accordance with quality. Major problems expressed by farmers and reelers are inadequate finance for investment, shortage of skilled workers, lack of technical guidance, fluctuation in prices, unremunerative prices and absence of quality based pricing which can be over come by strengthening extension system and providing adequate credit facility, restricting import of raw silk and introducing scientific grading.

Management Appraisal of District Central Co-Operative Bank-A case of KDCC Bank LTD., Uttara Kannada District, Karnataka

P.G. VISWANATH 2002 MAJOR ADVISOR : Dr. S. B. MAHAJANASHETTI

Farm credit is a strategic input and demand for it steadily increased with the advent of modern technology. Among the various financial institutions, the cooperatives have emerged as a major source of agricultural credit. A three-tier system of cooperative credit structure came into existence to meet short term and medium term credit requirements of the farmers. An enqtiiry into the working of KDCC bank could reveal interesting facts about the bank's performance according to geographical variations. Three KDCC bank branches were selected for the study, which represents three different geographical regions. The study was based on both primary and secondary data.

The growth in number of branches, employees and membership was positive and significant. Except borrowings (8.17%) all the other financial variables showed positive and significant growth. The liquidity and solvency position of the bank was found to be sound. However, the net profit to net worth ratio was found to be negative from 1994-95 onwards. In Principal Component analysis, the first component indicates the overall measure of both physical and financial performance, where as, second component indicates performance in terms of number of loan accounts, number of deposit accounts and the extent of borrowings. The recovery percentage for the selected KDCC bank branches was found to be more than 90 per cent. The regression analysis revealed that the bank's overall performance mainly depended on the experience of Chairman and number of trainings undergone by the Managing Director led to efficient functioning of the cooperatives.

FORESTRY

Infestation Dynamics and Clonal Resistance of Teak to Trunk Borer *Alcterogystia cadambae* Moore. (Lepidoptera: Cossidae)

K. SANTOSH 2002 MAJOR ADVISOR: Dr. PRASAD KUMAR

Studies on the trunk borer infestation in teak plantations of Gunjavathi (Mundgod taluk) and Tatwala (Yellapur taluk) revealed that Tatwala had lesser infestation (32.54%) than Gunjavathi (35.76%). There was a definite pattern of trunk borer infestation with distinct patchy nature of infested trees as large as 6 m radius in heavily infested plantations. Plantations acquired new infestation during the months of July to September. The annual rate of progression was highest in moderate to heavily infested plantations both in Gunjavathi(7.69%) and Tatwala (8.49). Infestation was heavy in plantations close to human habitation, agricultural fields, roads and those affected by fire incidence and cattle grazing. The percent reduction in volume of borer infested trees ranged from 4.88 per cent to 56.88 per cent. Butea monosperma was found to be a new alternate host to trunk borer in and around infested plantations.Three species of woodpeckers viz., Golden backed woodpeacker, Great black wood peacker and Heart-spotted. Woodpecker were found to be actively pecking into infested trees and feeding on larvae of trunk borer thereby reducing the buildup of borer plantation.

Infestation percentage in Clonal Seed Orchard (CSO), Manchikeri ranged from 0 to 11.12 per cent while in

CSO, Karka it ranged from 0 to 52 per cent. Eleven out of 24 clones in CSO, Manchikeri were found healthy while almost all the clones in CSO, Karka were found to be infested by trunk borer. Clones from Southern provencance were thicker barked, healthy and resistant to trunk borer compared to Northern and Central provenances in both the CSOs. Clones MyHa D_4,MyHaV1, MyHuT2 and MyHuT3 in CSO, Karka had higher polyphenols and lower amounts of total sugars when compared to infested clones signifying the resistance of healthy clones to greater amounts of poly-phenols and lower concentration, of sugars in bark tissues.

AGRICULTURAL ENGINEERING

Simulation of Runoff and Erosion From Field Size Areas in Vertisols of Northern Dry zone of Karnataka

PREMANAND DASHAVANT 2002 MAJOR ADVISOR: Dr. SATISH KUMAR

The hydrological responses measured in terms of runoff volume and its peak discharge and sediment yield helps in evaluation of soil productivity that depleted on account of spatially and temporally ill distributed rainfall. The replicated field size terrace plots (<1 ha) prepared with a single outlet were established to measure runoff and sediment yield in Madabhavi micro watershed under agroclimatic conditions of northern dry zone of Karnataka. The modified soil conservation service (SCS) runoff model coupled' with soil moisture accounting procedure. (Pathak *et al.*, 1989) used for simulation of runoff volume on daily basis, whereas Williams, (1975) model was used to predict the sediment yield.

In the course of investigation it was found that out of total annual rainfall amount of 553.66 mm received, 90.209 mm and 83.02 mm were total quantities of runoff from bare plot and the plot with greengram crop during Kharif season respectively. The SCS runoff model predicted the measured value of runoff for each of five events with R^2 value of 0.985 in case of bare plot (Plot 1) and 0.9934 in case of greengram plot (Plot-II) respectively The measured sediment yield was found to be 12.24 t/ha in case of bare plot and 8.87 t/ha in case of greengram plot. The modified USLE sediment yield model (Williams 1975) predicted the soil loss with R^2 value of 0.6997 incase . Of bare plot and 0.97in case of greengram plot.

Haloperidol Pentazocine Premedication with Ketamine or Propofol Anaesthesia for Caesarian Operation in Goats

POMASINGH LAMANI 2002 MAJOR ADVISOR: Dr. B.V. SHIVAPRAKASH

The study was conducted to assess the efficacy and feasibility of combination of ketamine or propotal anaesthesia with haloperidol and pentazocine premedication for apparently healthy and also pregnant goats presented for caesarion operation. The study was conducted on 16 goats decided in 4 groups consisting of 4 animals each. All the goats were pre medicated with haloperidol (0.8mg/kg I.V) and pentazocine (1mg/kg I.V) 5 mins before anaesthesia.The Ketamine @ 6.5 mg/kg I.V. before anaeshesis. The Ketamine @ 6.5 mg/kg for non pregnant (GpI) and @ 6 mg/kg. I.V. For pregnant (GPII) and propofol @ 5.5 mg/kg I.V. for non pregnant (GPIII) and @ 5mg/kg I.V. for pregnant goats (Gp IV) was given.

Anasthetic combination was evaluated based on clinical, physiological, haematological and biochemical observations.

Clinical observations revealed that early induction of anaesthesia was observed with propofol combination (GpIII) and IV) as compared to ketamine combination. The duration of anaesthesia was significantly lower (11.50 to 12.80 mins) and recovery period was also shorter (12.50 to 13.50 mins) in propofol combination anaesthesia (Gp III and Gp IV) as compared to animals anaeshetised with ketamine combination.

Pedal reflex was absent in all the groups of goats during third stage of anaesthesisa. Swallowing Reflex was not abolished in group I and II. Ocular reflexes were not abolished even during surgical plane of anaeshesia in propofol combination (Gp III and IV)

Cutaneous analgesia was excellent but visceral analgesia was less satisfactory in group (I and IV where

caesarian operation was performed. Abdominal muscle relaxation was moderately satisfactory in caesarian groups. Survivability of dam and fetuses were satisfactory in both combinations.

Physiological observations revealed significant respiratory depression in propofol combination (Gp III and IV) as compared to ketamine combination. Non significant alterations were observed in rectal temperature, heart rate, mean arterial pressure and central venous pressure in all the groups. However the values fluctuated within physiological range.

No ECG abnormalities were recording all the groups at different intervals of anaesthesia.

Haematological observations revealed significant reduction in packed cell volume and haemoglobin values in all the groups and total erythrocyte count was normal in all the groups.

Biochemical observations revealed significant increase in blood glucose level in all the groups and non significant alterations were observed in serum glutamic pyruvate transaminase and serum electrolytes (Na^+ K^+ and Cl^-) in all the groups.

Hence ketamine or propofol anaesthesia is recommended for caesarian operation in goats.

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