4.4 per cent higher yield compared to control (1720 kg ha^{-1}).

Irrigation scheduled at 1.0 IW/CPE ratio along with 120 kg N ha^{-1} recorded higher seed yield (2125 kg ha^{-1}). Combined application of 120 kg N ha^{-1} and 60 kg S ha^{-1} recorded higher seed yield (1981 kg ha^{-1}). The highest net returns and B:C ratio were obtained with 1.0 IW/CPE ratio + 120 kg N ha^{-1} + 60 kg S ha^{-1}.

Integrated Nutrient Management in Scented Rice (*Oryza sativa* L.) Under Trans Planted Condition

M. K. MURALI 1998 MAJOR ADVISOR : Dr. R. A. SETTY

A field experiment was conducted at Agriculture Research Station, Siruguppa during kharif 1997 to study the effect of levels of NPK, vermicompost and triacontanol on growth, yield and quality of scented rice (Pusa Basmati-1). There were eighteen treatments with three replications laid out in three - factorail randomised block design.

Better vegetative growth interms of increased plant height, highest number of tillers, leaf area and dry matter production was recorded with NPK level of 150-75-75 kg ha^{-1} when compared to application of 125-62.5-62.5 and 100-50-50 NPK kg ha^{-1}. Yield components viz., number of panicles per hill (12.00), number of grains per panicle (196.36), grain weight (22.83 g) and highest grain yield 5261 (kg ha^{-1}) were recorded at this level of NPK when compared to other two lower levels. Net return (69446 Rs. ha^{-1}), quality parameters and uptake of Nitrogen were higher with the NPK level of 150-75-75 kg ha^{-1}.

Applications of Vermicompost @ 5 t ha^{-1} recorded significantly higher grain yield (4889 kg ha^{-1}), straw yield (7141 kg ha^{-1}), total 'N' uptake (168.47 kg ha^{-1}) and exhibited favourable quality traits like Hulling percentage (68.34%), kernal length (7.71 mm) and Amylose content (29.00%) when compared to no Vermicompost application.
Scented rice responded significantly to the spraying of triacontanol @ 500 ml ha^{-1} with higher yield attributes, grain yield (4861 kg ha^{-1}), straw yield (7070 kg ha^{-1}) and net return (63035 Rs. ha^{-1}).

The itnerction effect of NPK and Vermicompost revealed that the combined application of 125-62.5-62.5 NPK kg ha^{-1} with vermicompost @ 5 t ha^{-1} recorded on par grain yield with the treatment receiving 150-75-75 NPK kg ha^{-1} alone indicating the possibility of saving 25 per cent of chemical fertilizer with the use of Vermicompost without significant reduction in the grain yield.

Response of Sesame (*Sesamum Indicum* L.) Cultivars to Differetnt Dates of Sowing During Rabi/Summer Under Irrigated Conditions

V. S. KANABU 1998 MAJOR ADVISOR : Dr. V. B. NADAGOUDA

A field experiment was conducted at Agricultural College Farm, Raichur during Rabi/summer 1997-98 to study the effect of sowing dates on growth and yield of sesame varieties.

Sowing dates exerted significant effect on growth, maturity period, seed yield and quality aspects. Better vegetative growth interms of increased plant height, maximum leaf area and highest number of leaves were recorded when the crop was sown during second fortnight of February. While, yield components were found to be better when sown during second FN of November. Highest seed yield (747 kg ha^{-1}) was recorded when sown during second FN of November. Oil yield and oil content were higher with early sowing as compared to delayed sowings. The sasame sown during second FN of November, first and second FN of December matured early when compared to crop sown during first and second FN of January and February. Among the different varieties, E-8 and DS-1 produced better vegetative growth as compared to RT-281. The maximum number of capsules per plant and higher seed yield were obtained in E-8 and DS-1 varieties as compared to RT-281 variety. While, the per day productivity and oil content was higher in variety RT-281 due to its earlyness.

Interaction effects of sowing dates and varieties were significant with respect to maturity period, yield components, yield and quality parameters. The variety E-8 when sowing during second FN of February took moredays (108) to maturity. Highest yield (771 kg ha^{-1}) was recorded when variety E-8 was sown during second FN of November which also recorded highest number of capsules per plant.

Effect of Green Manuring Cover Crops, Their Row Proportions and Cutting Intervals on Chilli (*Capsicum annuum* L.)

K. H. BASAVANAGOUDA 1998 MAJOR ADVISOR : Dr. S. I. HALIKATTI

Field experiment was conducted to study the effect of cover crops, row proportions and cutting interval under rainfed conditions at Main Research Station, Dharwad during kharif 1997. The experiment was laid out in Randomised Block Design with three replications. There were 17 treatment combinations involving four cover crops (*Stylosanthes hamata*, Lucerne, Centrosema and Calapogonium), two crops proportions (1:1 and 1:2) and two cutting intervals (30 and 45 days) with sole chilli as control.

The highest fresh biomass production was recorded in the cover crop lucern (24:50 t/ha) and the lowest in centrosema (4.90 t/ha). Among row proportions, 1:2 rows produced higher biomass (14:20 t/ha) than 1:1 (10.40 t/ha) row proportion. Similar trend was observed with dry biomass production and nitrogen addition by cover crops.

The chilli yield with *S. hamata* cover crop was significantly higher (9.84 q/ha) compared to other cover crops and the lowest with lucerne cover crop (6.02 q/ha). Among row proportions, 1:1 produced higher yield (8.26 q/ha) than 1:2 (7.45 q/ha) row proportion. Similar trend was observed with reference to yield per plant and number of fruits per plant at harvest of chilli. Sole chilli without cover crop produced higher yield (9.35 q/ha) than all treatment combinations except with *S. hamata* and centrosema in 1:1 row proportion with 30 days cutting interval.

The highest net income (Rs.22,290/ha) with cropping system was obtained by growing *S. hamata* as cover crop in chilli in 1:1 row proportion with 30 days cutting interval followed by growing *S. hamata* in 1:1 row proportion with 45 days cutting interval (Rs.21,860/ha). But the lowest net income (Rs.4,670/ha) was recorded with lucerne in 1:1 row proportion at 45 days cutting interval. Similar trend was also followed with per cent net gain over control and B:C ratio.

Response of Pigeonpea [*Cajanus cajan* (L.) Millsp] Varieties to Dates of Sowing and Crop Geometry During Rabi Under Irrigation

SHIVANAGOUDA B. PATIL 1998 MAJOR ADVISOR : Dr. B. T. PUJARI

A field experiment was conducted at Agricultural College Farm, Raichur during rabi 1997-98 to study the response of pigeonpea (*Cajanus cajan* L. Millsp.) varieties to dates of sowing and crop geometry under irrigation. There were 18 treatment combinations comprising of three dates of sowing, two varieties and three spacings. The experiment was laid out in split-split plot design with three replications.

The pigeonpea sown on different dates influenced the growth and yield of pigeonpea. Pigeonpea sown on 25th September recorded significantly higher seed yield (18.73 q ha^{-1}) than sown on 10th September (17.90 q ha^{-1}) and 10th October (17.34 q ha^{-1}). The higher seed yield of pigeonpea sown on 25th September was attributed to significantly higher yield components viz., number of pods ($plant^{-1}$), seed weight ($plant^{-1}$), number of seeds ($plant^{-1}$) pod weight ($plant^{-1}$) and 100 seed weight as compared to other dates of sowing.

Variety ICPL-87119 recorded significantly higher plant height, number of branches, number of leaves and dry matter production than Maruti. The seed yield (18.28 q ha^{-1}) produced by variety ICPL-87119 was due to significantly higher yield components than Maruti.

Close spacing of 30 x 10 cm (3,33,333 plants ha^{-1}) produced significantly higher seed yield (19.98 q ha^{-1}) and stalk yield (35.60 q ha^{-1}) when compared to other spacings. Significant difference in the seed yield of pigeonpea with close spacing at 30 x 10 cm was mainly attributed to higher plant population per unit area inspite of significantly lower yield components when compared to wide spacings.

The pigeonpea sown on 25th September recorded significantly higher gross returns (Rs.38282 ha^{-1}), net returns (Rs.28619 ha^{-1}) and benefit cost ratio when compared to rest of the sowing dates. Variety ICPL-87119 recorded significantly higher gross returns (Rs.37376 ha^{-1}), net returns (Rs.27949 ha^{-1}) and benefit cost ratio (2.96) than Maruti.

Response of Sunflower (*Helianthus annuus* L.) to Irrigation Regimes, Sources and Levels of Sulphur

G. S. METI 1998 MAJOR ADVISOR : Dr. S. S. METI

An investigation to study the "Response of Sunflower (*Helianthus annuus* L.) to Irrigation Regimes, Sources and Levels of Sulphur" was conducted during rabi/ summer 1996-97 at Main Research Station, Dharwad under irrigated condition. The treatments were laid out in a split-split design replicated three times. The treatment consisted of two irrigation at 0.8 and 1.0 IW/CPE ratio as main plots, three sulphur sources viz., SSP, GYP and ELS as sub plots and four levels of sulphur (0, 20, 40, 60 kg/ha) as sub plots.

The data on yield and yield parameters indicated that scheduling of irrigation at 1.0 IW/CPE ratio (18.48 q/ ha) was found most promising followed by scheduling of irrigation at 0.8 IW/CPE ratio (16.99 q/ha). The higher seed yield with irrigation scheduling at 1.0 IW/CPE ratio was mainly attributed to various parameters which showed higher values compared to crop irrigated at 0.8 IW/CPE ratio.

Application of gypsum as sulphur source recorded significantly higher seed yield (18.27 q/ha) than SSP (17.67q/ha) and elemental S (17.27 q/ha). The higher yield with gypsum was the consequence of larger head size, higher number of filled seed/head, percentage of filled seeds, 1000 seed weight, number of seeds/head and seed weight/head. Significantly response of the applied sulphur across scheduling irrigation and sulphur source was observed upto 60 kg S/ha and was found on par with application of 40 kg S/ha. The higher oil content was found at scheduling the irrigation at 1.0 IW/CPE ratio (39.99%) than 0.8 IW/CPE ratio (39.43%). There was no significant variation in oil content by application of sulphur sources, but the maximum oil content was observed by application of 60 kg S/ha followed by 40 kg S/ha.

The highest seed yield (20.57 q/ha) of sunflower was recorded with scheduling the irrigation at 1.0 IW/CPE ratio along with application of gypsum as a source of sulphur @ 60 kg/ha and was closely followed by irrigating the crop at 1.0 IW/CPE ratio with the appliation of gypsum as a source of sulphur @ 40 kg S/ha. The higher yield with above treatment was mainly due to higher yield components and S uptake.

Higher gross income (Rs.19,545/ha), net returns (Rs.9,829/ha) and benefit: cost ratio (2.01) was recorded by scheduling the irrigation at 1.0 IW/CPE ratio along with application of gypsum as a source of sulphur @ 60 kg S/ ha.

Response of Kharif Sorghum (*Sorghum bicolor* (L.) Moench) to Methods and Levels of Iron and Zinc Application

F. M. DURGANNAVAR 1998 MAJOR ADVISOR : Dr. M. D. KACHAPUR

A field experiment was conducted in vertisols under rainfed conditions at Main Research Station, Dharwad duirng 1996-97 to study the response of kharif sorghum to method and levels of iron and zinc application. There were 12 treatments consisting of two methods of application and six levels of micronutrients. The experiment was conducted under RBD with three replications. The resutls of the trial indicated that application of 12.5 kg $FeSO_4$ per ha recorded higher number of green leaves per plant (5.7, 7.1, 6.1 and 5.1 at 30, 60, 90 DAS and at harvest, respectively), followed by application of 25 kg Zn SO_4 per ha. At 60 DAS maximum leaf area per plant (27.03 dm^2/plant) and LAI (6.1) were recorded due to soil + foliar application.

At 60, 90 DAS and at harvest total dry matter (TDM) production was higher (59.6, 139.6 and152.5 t/plant, respectively) due to soil + foliar application of micronutrients. The application of 12.5 kg $FeSO_4$ per ha recorded higherst TDM production at 60, 90 DAS and at harvest (61.6, 145.1 and 158.5 g/plant respectively), followed by application of 25 kg $ZnSO_4$ per ha. Maximum DM accmulation in stem was noticed (46.7 g/plat) at 90 DAS with soil + foliar application of micronutrients. At harvest DM accumulation in stem was highest (47.9 g/plant) with application of 12.5 kg $FeSO_4$ per ha followed by 25 kg $ZnSO_4$ per ha. Soil + foliar application of micronutrients recorded highest DM accumulation (96.7 g) in a ear at harvest. While application of 12.5 kg $FeSO_4$ per ha yielded highest DM accumulation in ear (100.9 g) at harvest. Grain yield was higher with soil + foliar application of micronutrients (67.92 q/ha), which recorded 10 per cent more grain yield than soil application alone (61.58 q/ha). Individual application of 12.5 kg $FeSO_4$ per ha recorded maximum grain yield (72.25 q/ha), closely followed by application of 25 kg $ZnSO_4$ per ha. Combined application of $FeSo_4$ and $ZnSo_4$ each at the rate of 12.5 kg per ha produced significantly lower grain yield (58.97 q/ ha). At harvest higher uptake of N, P and K (235.5, 32.8 and 191.4 kg/ha) and Fe and Zn (5616.02 and 718.81 g/ ha) was observed due to soil + foliar application at micronutrients as compared to soil application alone. Application of 12.5 kg $FeSo_4$ per ha resulted in maximum uptake of N, P and K (249.5, 304.7 and 202.1 kg/ha). Highest uptake of Zn (795.29 g/ha) was noticed with kg $ZnSo_4$ per ha. Cost of cultivation was marginally higher in treatments involving soil + foliar appliation of micronutrients. Highest net returns and benefit cost ratio were obtained with soil + foliar application of micronutrients. Similarly the highest net returns and benefit cost ratio were also recorded due to application of 12.5 kg $FeSO_4$ per ha.

Integrated Weed Management in Chilli (*Capsicum annuum* L.) Under Northern Transitional Tract of Karnataka

SHARANAKUMAR A. BIRADAR 1999 MAJOR ADVISOR : Dr. C. A. AGASIMANI

A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad during kharif season of 1996 to study the new post-emergent herbicide glufosinate ammonium in comparison with pre-emergent herbicide alachlor and integrated weed control methods in chilli, under rainfed conditions.

Weed population and weed dry weight were significantly reduced at all the growth stages by weed control treatments. At harvest, among the weed control treatments glufosinate ammonium @ 1.20 and 0.90 kg a.i.ha^{-1}, both in combination with IC at 40 and 60 DAT + HW at 45 and 75 DAT recorded lower seed weed dry weight (2.98 and 3.67 q ha^{-1} respectively) and higher weed control efficiency (95.08 and 94.04%, resepctively). Whereas, unweeded check was recorded significantly higher weed dry weight (61.19 q ha^{-1}) and lower WCE. Significantly higher dry chilli fruit yield was noticed in free check (10.52 q ha^{-1}) which was on par with glufosinate ammonium @ 0.90 kg a.i.ha^{-1}, alachlor @ 2.00 kg a.i. ha^{-1} and glufosinate ammonium @ 0.60 kg a.i. ha^{-1}, all the above treatments in combination with IC at 40 and 60 DAT + HW at 45 and 75 DAT (9.84, 9.12 and 8.68 q ha^{-1}, respectively). While, unweeded check recorded the lowest dry chilli fruit yield (1.96 q ha^{-1}).

All the weed dcontrol treatments recorded significantly higher nutrient uptake by the crop and lower nutrient uptake by weeds, while unweeded check recorded the highest nutrient uptake by weeds and the lowest by crop. Highest net income was recorded in weed free check followed by glufosinate ammonium @ 0.90 kg a.i. ha^{-1} and alachlor @ 2.00 kg a.i. ha^{-1}, both in combination with IC at 40 and 60 DAT + HW at 45 and 75 DAT. From the investigation, it could be inferred that post-emergence application of glufosinate ammonium @ 0.90 kg a.i./ha^{-1} + IC at 40 and 60 DAT + HW at 45 and 75 DAT is best to control the weeds in chilli on black soil.

Response of Fodder Sweet Sorghum (*Sorghum bicolor* L.) Genotypes to N and P Levels and Their Influence on Ratoon

MALLIKARJUN V. SILLI 1999 MAJOR ADVISOR: Dr. C. S. HUNSHAL

A field experiment was conducted to find out optimum level of 'N' and 'P' to maximise the biomass yield and quality parameters of different sweet sorghum genotypes and their influence on ratoon in randomised block design, replicated thrice at College of Agriculture Farm, Dharwad during kharif and rabi seasons of 1995-96.

Sweet sorghum genotypes significantly produced higher green fodder yield (48.29 t/ha) than the check DFJ-1 (34.04 t/ha). Among the sweet sorghum genotypes SSV-84 (49.26 t/ha) recorded significantly higher green fodder yield than SSV-12611 (47.32 t/ha). The brix value of juice was significantly higher in sweet sorghum genotypes (av. 9.32°) than DFJ-1 (5.17°). DFJ-1 had lower crude protein (4.95%) and higher crude fibre (35.96%) than sweet sorghum genotypes (5.84 and 33.7%, respectively).

Application of 125 kg N per ha produced significantly higher green fodder yield (54.60 t/ha) than at 100 and 75 kg N per ha (48.81 and 41.46 t/ha, respectively). SSV-84 responded better (55.66 t/ha) to higher level of nitrogen than SSV-12611 (53.33 t/ha). Application of 125 kg N per ha recorded significantly higher Brix (9.90°) whereas 125 kg N per ha recorded higher crude protein (6.56%) in sweet sorghum genotypes. With increase in nitrogen levels from 75 to 125 kg/ha the crude fibre content decreased from 34.14 to 33.16 per cent. Application of phosphorus did not showed any significant influence on yield and quality parameters.

Good ratooning ability of DFJ-1 resulted in production of significantly higher green fodder yield (14.8 t/ha) than sweet sorghum varieties (11.83 t/ha). Thus, SSV-84 responded better to application of 125 and 50 kg N and P_2O_5 per ha for obtaining good quality and higher fodder yield.

Allelopathic Effect of Row Planted Eucalyptus on Greengram in Red Soil

N. R. YEKKELI 1999 MAJOR ADVISOR: Dr. C. S. HUNSHAL

An investigation was carried out study the allelopathic effect of row planted eucalyptus hybrid (7 years old coppiced plants) on greengram in red soil at Agriculture College Farm, Dharwad during kharif 1998. The experiment consisted of 12 treatments comprising 6 distances (3, 6, 9, 12, 15 and 18 m) from treeline and 2 treatments partitioning the competition effects by use of cement rings (0.6 m diameter and 0.9 m height) were replicated thrice in

randomised block design. The ring contained non allelopathic soil.

The growth and yield of greengram increased in significantly with increase in the distance from tree line with maximum reduction nearer to the tree but there was non significant influence at 15 and 18 m distance. Within the cement ring the growth and yield was not affected at various distances but comparing within and outside the cement ring, the growth and yield was almost same at 15 and 18 m distance. Although the nutrient availability was greater nearer to the tree but the uptake was low and it increased with increase in the distance from the tree. Within the ring the available nutrient was lower than the outside ring but uptake was higher and among the rings there was no significant difference. There was no much difference in the availability of moisture with distance from the tree both outside and within the ring.

To study the allelopathic effect of soil on growth of greengram (till 20 days) in pots the soil from the experimental field before the planting of greengram was collected as per the treatments both from inside and outside the cement rings to conduct pot culture studies with greengram till 20 days of its growth. The plants grown in soil collected from rings had almost similar germination, plant height and dry matter, irrespective of distance from tree whereas outside the ring growth increased significantly as we moved away from the tree row and was maximum at 15 and 18 m distance. The growth parameters between the ring and outside the ring at 15 and 18 m distance were similar whereas at all other distances they differed significantly.

Effect of Intercrops in Different Row Proportions on Growth and Yield of Sorghum

SIDRAMREDDY 1999 MAJOR ADVISOR: Dr. M. D. KACHAPUR

A field experiment was conducted to study the effect of intercrops in different row proportions on growth and yield of sorghum at Main Research Station, Dharwad during kharif 1998. The experiment was laid out in Randomised Block Design with three replications.

Grain yield of sorghum was significantly higher in sorghum + groundnut in 2:1 row proportion (69.13 q/ha) but was on par with sorghum + soybean in 3:6 row proportion (65.42 q/ha). An increased grain yield of 17 and 10 per cent was observed by former treatments over sole sorghum. However, sole sorghum recorded maximum stover yield (101.46 q/ha). The competition functions namely land equivalent ratio (LER), Area time equivalent ratio (ATER) and sorghum equivalent yield were significantly higher with sorghum + soybean 3:6 row proportion (1.73, 1.57 and 126.14 q/ha, respectively). Among the soghum + groudnut intercropping systems, 2:4 row proportion recorded higher LER, ATER and sorghum equivalent yield (1.34, 1.28 and 105.56 q/ha, respectively).

Sorghum + soybean in 3:6 row proportion recorded significantly higher net returns (Rs.25,573/ha) and B:C ratio (3:11) as compared to other intercropping systems. There was an improvement in the soil available nitrogen in intercropping treatments as compared to that of sole sorghum. Sorghum + soybean 3:6 row proportion recorded significantly higher available soil nitrogen (182.27 kg/ha) after the harvest of crops over other treatments.

Response of Groundnut (*Arachis hypogaea* L.) Genotypes to Levels of NPK and Growth Regulators

C. B. KABADAGI 1999 MAJOR ADVISOR: R. A. SETTY

A field experiment was conducted at Agricultural College Farm, Raichur during rabi/summer season of 1997-98, to study the response of groundnut (*Arachis hypogaea* L.) genotypes to levels of NPK and growth regulators. There were 18 treatment combinations comprising of two groundnut genotypes, three levels of NPK and two growth regulators spray with one water spray as check. The experiment was laid out in split-plot design with three replications. Groundnut genotypes differed significantly, Genotype R-9251 recorded significantly higher pod yield 1867 kg/ha as compared to K-134 (150-6 kg/ha). The higher pod yield of genotype R-9251 is attributed to significant increase in yield components *viz*., number of pods per plant, hundred pod weight, shelling percentage and hundred kernel weight as compared to the genotype K-134.

No significant differences were observed with increasing the levels of NPK from 25-75-25 to 37.5 - 112.5 - 37.5 NPK kg/ha. However, higher dose of NPK resulted in numerically higher pod yield. Growth and yield attributing characters also did not differ significantly due to levels of NPK. There was a significant difference in pod yield due to spraying of growth regulators over water spray. Higher pod yield of 1803 kg/ha was recorded with triacontanol spray which was on par with brassinolide (1749 kg/ha) and these were found significantly superior over water spray (1508 kg/ha).

The variety R-9251 recorded significantly higher net return of Rs.14,123 per ha and benefit cost ratio of 1.22 as compared to net return (Rs.10,208/ha) and benefit cost ratio (0.97) with K-134. Among the fertilizer levels, low levels of NPK gave higher net return compared to higher levels. Between the growth regulators, triacontanol spray gave higher net return of Rs.13,827 per ha which is on par with net return of brassinolide (12,837/ha) and both these were found significantly superior over water spray (Rs.9,832/ha).

Response of Pigeonpea (*Cajanus cajan* (L.) Millsp.) Varieties to Dates of Sowing and Spacing During *Rabi* Under Irrigation

SOMASHEKHAR 1999 MAJOR ADVISOR: Dr. B. T. PUJARI

A field experiment was conducted at Agriculture College Farm, Raichur to study the response of pigeonpea varieties at dates of sowing and spacing during rabi season of 1998-99 under irrigation. There were 16 treatments comprising combinations of four dates of sowing (18th October, 25th October, 10th November and 25th November), two varieties (Maruti and ICPL-87119) and two spacings (30 x 10 cm and 45 x 10 cm). The experiment was laid out in a split-split plot design with three replications.

The seed yield of pigeonpea sown on 18th October (17.15 q ha^{-1}) and 25th October (16.75 q ha^{-1}) were significantly higher than 10th November (14.75 q ha^{-1}) and 25th November (13.33 q ha^{-1}) sowings. The higher seed yield on 18th and 25th October sown pigeonpea was mainly attributed to significantly higher yield components *viz.*, number of pods, number of seeds, seed weight $plant^{-1}$ and 100 seed weight than yield components recorded under later sown pigeonpea.

The variety ICPL-87119 recorded significantly higher seed yield (16.13 q ha^{-1}) than Maruti (14.87 q ha^{-1}). The higher seed yield of ICPL-87119 was attributed to significantly higher yield attributes than Maruti. The seed yield of pigeonpea recorded at 30 x 10 cm (16.40 q ha^{-1}) was significantly higher than at 45 x 10 cm spacing (14.59 q ha^{-1}). Significantly higher seed yield at 30 x 10 cm spacing was mainly attributed to higher plant population per unit area inspite of significantly lower yield components when compared to the pigeonpea sown at 45 x 10 cm spacing.

The pigeonpea sown on 18th and 25th October recorded significantly higher net return and benefit cost ratio than sown on 10th and 25th November. The variety ICPL-87119 recorded significantly higher net return (Rs.22774.75 ha^{-1}) and benefit cost ratio (2.24) than Maruti. The pigeonpea sown at 30 x 10 cm spacing recorded significantly higher net return (Rs.23104.50 ha^{-1}) and benefit cost ratio (2.21) than at 45 x 10 cm spacing.

Evaluation of Herbicides for Weed Control in Direct Seeded Onion + Chilli Intercropping System Under Rainfed Condition

V. M. NARASALAGI 1999 MAJOR ADVISOR: S. M. HIREMATH

A field experiment was conducted at the Main Research Station, University of Agricultural Sciences, Dharwad during kharif season of 1998, to evaluate two pre-plant herbicides (trifluralin 1.0 kg/ha and fluchloralin 1.0 kg/ha) and six pre-emergent herbicides (alachlor 1.50 kg/ha, metolachlor 1.0 kg/ha, butachlor 1.0 kg/ha, pendimethalin 1.50 kg/ha, oxadiazon 0.50 kg/ha and oxyfluorfen 0.15 kg/ha) were compared with farmers practice, weed free and weedy check. All herbicidal treatments were super imposed with one hand weeding (HW) at 45 DAS.

Weed population and dry weight of weeds were significantly reduced by different weed management practices. The lowest weed dry weight and highest weed control efficiency were noticed in weed free check followed by butachlor 1.0 kg/ha coupled with HW at 45 DAS and farmers practice.

Onion bulb and green chilli fruit yields were significantly highest in weed free check (92.93 q/ha and 9.26 q/ha, respectively). Butachlor 1.0 kg/ha + HW at 45 DAS and farmers practice recorded next highest yields. Yield was positively correlated with growth, yield components and nitrogen uptake by crops and negatively correlated with weed weight and weed index at harest.

Higher net returns were recorded with weed free check and butachlor 1.0 kg/ha + HW at 45 DAS, but the latter tretament recorded the highest B:C ratio. Thus, it could be inferred that pre-emergence application of butachlor 1.0 kg/ha coupled with HW at 45 DAS was not only effective in controlling weeds but also found economical.

SOIL SCIENCE AGRICULTURAL CHEMISTRY

Chemistry of Sulphur and Response of Maize (*Zea mays* L.) to Sulphur Application in an Alfisol of North Karnataka

B. C. DHANANJAYA 1998 MAJOR ADVISOR : Dr. B. BASAVARAJ

The importance of sulphur in the nutrition of crop is well known. The sulphur fractions in soil have been found to be well correlated with yield and quality parameters. But more information on the dynamics of applied sulphur in soil is lacking. Considering the above facts a field and a laboratory investigation were carreid out to study the crop response and transformation of applied sulphur under field and laboratory conditions.

Under field experiment in an alfisol, with four levels of sulphur (0, 15, 30 and 45 kg S ha^{-1} as SSP), the growth and yield parameters and yields (Grain + Straw) of maize significantly increased with applied S levels and were maximum in 45 kg S ha^{-1} level and minimum in no S levels. The N, P and S content and uptake followed the similar trend. The N/S and P/S ratio were significantly narrowed by increased levels of applied S. The S fractions in soil were selected significantly with crop growth and were less than the initial values after crop harvest. The S fractions at 60 DAS and harvest showed positive and significant correlations among themselves. The dry matter yield, S content and uptake at 60 DAS and harvest and grain and stover yields at harvest showed positive and significant releations with S fractions.

Study was made to know the transformation of applied S levels (0, 7.5, 15.0, 22.5, 30.0, 37.5 and 45.0 kg S ha^{-1} as SSP) under laboratory conditions. The soil samples were drawn twice at 30th and 60th of incubation. The values of all the S fractions were increased with increasing S levels and time of incubation. Maximum values of these S fractions were observed in 45 kg S ha^{-1} treatment. Positive and significant correlations were observed among the S fractions at both the stages of incubation.

Evaluation of Flyash as an Amendment for Reclamation of Sodic Soil

RAMAPPA JAKANUR 1998 MAJOR ADVISOR : Dr. N. A. YELEDHALLI

Flyash, a finely divided residue obtained by burning coal in thermal power plants, contains considerable amount of nutrient elements viz., Ca, S, Mg, Fe and Mn. A potculture experiments on evaluation of flyash as an alternate amendment to conventional gypsum to reclaim sodic soils was conducted at Agriculture College, Raichur, Karnataka, India during Rabi 1997-98. The experiment was laid out in completely randomized design with three replications. The treatments consisted of gypsum at five levels of per cent GR and flyash at five levels equivalent of per cent GR viz., 25, 50, 75, 100 and 150 per cent GR.

Application of flyash to sodic soil equivalent to 100 per cent GR significantly increased the seed yield of wheat. The increase in grain yield over control was 47.6 per cent and yield was on par with gypsum appplication. However, the highest grain yield of wheat (16.43 g/plot) was recorded due to application of @ 100 per cent GR.

Different levels of flyash application to sodic soil equivalent to GR reduced the soil BD, pH and ESP. Significant reduction in pH (9.05 to 7.90) and ESP (20.4 to 10.7) were noticed due to application of flyash equivalent to 100 per cent GR. The above resutls were on par with gypsum application. The increase in yield of wheat was attributed to improvement in soil physical condition mainly reduction in bulk density and increased water retension capacity and nutrient availability. The results clearly indicated that flyash, which is an inexpensive and largely available waste could be successfully used as an amendment to reclaim sodic soil, and also helps to overcome environmental problem arising out of dumping of flyash in ash pods.

Effect of Flyash on Growth and Yield of Rice, Soil Properties and N-Mineralization Under Flooded Condition

SAYEED ALMAS R. MULLA 1998 MAJOR ADVISOR : S. S. PRAKASH

Flyash, an amorphous, ferroalumino silicate, is a finely divided coal ash residue proudced by thermal power plant. Some efforts have been made to utilize flyash as an amendment to improve soil fertility and crop production. An augmented soil productivity following flyash application has generally been attributed to the increased, nutrient availability and water retension capacity. Field and laboratory experiments were carried out at Regional Research Station Farm, Raichur, Karnataka during kharif 1997, to study the effect of flyash on growth and yield of rice and nitrogen mineralization under flooded conditon respectively. The field experiment was laid out in split plot

design with three replications. The main treatment consisted to no FYM and FYM @ 10 t ha^{-1} The subolot treatments were flyash levels (0, 10, 20, 30 and 40 t ha^{-1} . The laboratory experiment was laid out in Completely Randomised Design with three replications to assess the nitrogen mineralization at different period of incubation under flooded condition Growth and yield of rice increased significantly with application of flyash and FYM to soil The yield increase was from 41.3 q ha^{-1} in control to 50.94 q ha^{-1} due to application of flyash @ 40 t ha^{-1}. The growth and yield of rice increased further from 40.16 q ha^{-1} in absolute control to maximum of 58.46 q ha^{-1} due to combined application of flyash 40 t ha^{-1} and FYM. The uptake of both macro and micronutrients by rice and the nutrient status in soil increased significantly due to application of flyash and FYM. Addition of flyash and urea increased th NH^{+}_{4}-N content progressively upto 30 days, while the NO_3-N content increased from 20 days after incubation and maximum was recorded at 60 days after incubation. The application of flyash increased the available phosphorus and potassium both at 30 and 60 days after incubation.

Solid Waste Management in Black Soil

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Flyash, the principal residue of thermal power station, resulting from combustion of pulverized coal. It is an amorphous ferro alluminosilicate with large proportion of silt sized particles. Similarly, sewage sludge is the solid waste product of domestic and industrial waste water-treatment plants, contains considerable amount of nutrient elements. Field experiments on the effect of solid wastes (Flyash and sewage sludge levels) with or without RDF on soybean and succeeding sunflower crops indicated that application of flyash and sewage sludge in 50:50 ratio with RDF, increased the seed yield of soybean and sunflower by 104.72 and 172.82 per cent, respectively over absolute control. The increase in seed yield of crops was attributed to enhanced uptake of nutrients by the crops. Application of flyash and sewage sludge in different proportion with or without RDF, significantly increased the organic carbon content, water holding capacity and nutrient availability and decreased the bulk density of soil and did not influence the pH significantly. However electrical conductivity of soils increased significantly but values are within the safe limits for most crops. The results suggested that flyash and sewage sludge which are inexpensive and largely available wastes could successfully be used as a source of nutrients and/or amendments to increase crop yields and soil productivity.

Effect of Fly Ash and Sewage Sludge on Crop Yield and Soil Properties

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Fly ash, a finely divided residue obtained by burning coal in thermal power plants and sewage sludge is settled sewage solids combined with varying amounts of water and dissolved materials removed from sewage by screening, sedimentation, chemical or bacterial digestion contains considerable amount of nutrient elements. Field experiments on the effect of flyash and sewage sludge levels of on soybean an succeeding sunflowersalong with or without recommended dose of fertilizers (RDF) indicated that the application of fly ash and sewage sludge in 50:50 ratio with RDF increased the seed yield of soybean and sunflower by 111 and 170 per cent respectively, over absolute control. The seed yield of crops in treatment receiving only RDF and only sewage sludge @ 52 t/ha were at par. There was marginal decrease in pH, EC and BD values due to application of fly ash and sewage sludge either individually or in combination. Thus increased the availability of major and micronutrients significantly and further uptake by the crops. However, there was no consistent relationship between nutrient uptake and crop yields. The increase in yield of crops was attributed to reduction in bulk density, increased water retention capacity and increased nutrient availability.

The results suggests that fly ash and sewage sludge which are inexpensive and largely available could successfully used as a source nutrients and amendments to increase crop yields and soil productivity.

AGRICULTURAL ENTOMOLOGY

Studies on the Effect of Neem Extracts on Some Lepidopterous Insect Pests

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The present study was undertaken on the effect of neem extracts on some lepidopterous insect pests and was carried out in the Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka during 1997-1998.

All the neem parts extract recorded lower leaf damage against castor semilooper, *Achaea janata* Linn. larvae. Among the different neem plant parts, the Kernel extract and whole seed extract were found to be very effective. Similarly the per cent antifeedant property and mortality was also high in both the cases.

Studies on the effect of different concentrations of neem seed kernel extract (NSKE) against five lepidopterous pests revealed that leaf damage, antifeedant property and larval weight gain varied with various concentrations. Higher the NSKE conccentration, higher was the activity against all the insect pests, but eight and above concentration caused phytotoxic effects on the treated leaves. Therefore five per cent concentration of NSKE was considered optimum, effective and safe to use against the lepidopterous pests.

Studies on the mode of actions of NSKE at five per cent concentration against *Helicoverpa armigera* (Hb.) indicated that neem seed kernel extract has got different mode of actions. Deformed *H. armigera* larvae, pupae, adults and larval-pupal intermediates were observed with respect to sterility and ovicidal action. NSKE five per cent recorded lower number of eggs and lower per cent hatching.

Maximum parasitization of *H. armigera* eggs by *T. achae* and emergence of adult larval parasitoid, *B. brevicornis* from *H. armigera* larvae were though recorded more in untreated control but NSKE five per cent treatment too recorded good number of emergence of *T. achaea* and *B. vrevicornis* adults which indicated the safetyness of NSKE to natural enemies.

Comparative Biology of *Helicoverpa armigera* (Hubner) and Management of Insect Pests on Rainfed Cotton

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Studies undertaken at College of Agriculture and Regional Research Station, Raichur. During 1997-98 on comparative biology of *Helicoverpa armigera* (Hubner) on *Gossypium hirsutum* (JK 276-4), *G. herbaceum* (DB 3-12) and *G. arboreum* (AK 235) and management of insect pests on rainfed cotton genotypes, indicated that freshly laid eggs were spherical in shape with flattaned base, cream coloured and turned to dark brown prior to a day of hatching. The minimum mean incubation, larval and pupal periods lastes for 3.40 ± 0.52, 16.70 ± 1.28 and 12.70 ± 0.37 days respectively when larvae were reared on JK 276-4 genotype. The insect possessed six larval instars on all three genotypes. The mean longevity of adult female and male with and without food was maximum on JK 276-4 and minimum on DB 3-12 genotype. The mean total life cycle was minimum on JK 276-4 and maximum on DB 3-12 genotype. Among the two genotypes, minimum sucking pests and bollworm incidence was noticed on DB 3-12 with maximum number of good opened bolls, minimum locule damage and highest seed cotton yield.

Imidacloprid 70 WS as a seed tretament recorded minimum population of sucking pests upto 40 days after sowing on both JK 276-4 and DB 3-12 genotypes. Supervisory control with sprays (xydemeton methyl-endosulfan-carbaryl-fenvalerate-quinalphos) recorded minimum sucking pests and bollworm incidence and maximum seed cotton yield followed by recommended plant protection schedule (RPP) with sprays and integration of seed treatment with imidacloprid 70 WS - two releases of *Trichogramma* sp. - edosulfan - HaNPV. Analysis of cost effectiveness of different treatments of DB 3-12 and JK 276 genotypes revealed higher benefit from RPP with sprays followed by supervisory control with sprays and supervisory control with dust in case of DB 3-12 genotype. On JK-276-4 genotype also, RPP with sprays registered highest benefit followed by supervisory control with dust and supervisory control with spray sand seed treatment with imidacloprid 70 WS followed by two releases of *Trichogramma* sp.-endosulfan-HaNPV.

Toxic Effects of Insecticides on Growth and Development of Earthworm, *Eudrillus eugeniae* (Kinberg)

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Investigations on toxic effects of insecticides on growth and development of earthworm, *Eudrillus eugeniae* (Kinberg) were undertaken at University of Agricultural Sciences, Dharwad during the period from 1997 to 1998.

The LC_{50} values of the four insecticides tested against adult and juveniles of *E. eugeniae* indicated chlorpyrifos to be the safest insecticides and endosulfan to be highly toxic. The pattern of lethality was endosulfan > monocrotophos > quinalphos > chloropyrifos at 48 hr exposure with LC_{50} values of 13.38 and 2.7, 27.77 and 6.9, 64.44 and 8.33 and 83.33 and 11.33 µl/ cm^2 for adult and juveniles, respectively. For the unidentified local earthworm species, the pattern of lethality based on LC_{50} values at 48 hr exposure was endosulfan > monocrotophos > chloropyrifos > quinalphos with LC_{50} values of 4.16, 8.33, 12.5 and 20.83 µl/cm^2, respectively.

Chronic toxicity of organochlorine, organophosphate and carbamate groups at three doses (sub-normal, normal and high dose) for the per cent survival of *E. eugeniae* by artificial soil method showed significant difference among the insecticides and doses tested. Highest survival was observed in control (96.69%) followed by chlorpyrifos, monocrotophos, quinalphos, endosulfan, phorate, carbaryl and lowest survival was observed in carbofuran (76.67%).

Test on the per cent reduction of weight and length of earthworm over control revealed significant difference among the insecticides and doses tested, chlorpyriphos (3.63 and 3.56%) was found to be safest while carbofuran (10.79 and 9.10%) recorded highest reduction of weight and length, respectively.

Highest fecundity and hatchability was observed in control i.e. 101.67 and 2.8 juvenile/cocoon, respectively. Among the insecticidal treatments chlorpyrifos recorded highest number of cocoons and hatchability (91.00 and 2.18) followed by quinalphos, monocrotophos, endosulfan, phorate, carbaryl and carbofuran (63.66 and 1.6) which recorded lowest number of cocoons and juveniles/cocoon.

Among the different parameters tested in chronic toxicity, chlorpyrifos was found to be safest followed by quinalphos, monocrotophos, endosulfan phorate, carbaryl and carbofuran.

Integrated Management of Early Shoot Borer, *Chilo infuscatellus* (Snellan) in Sugarcane

RACHAPPA 1999 MAJOR ADVISOR : Dr. L. KRISHNA NAIK

Investigations to know the post release movement of *Trichogramma chilonis* Ishii in sugarcane ecosystem, impact of intercrops and *T. chilonis* on the incidence of early shoot borer of sugarcane, *C. infuscatellus* and to assess the efficacy of different IPM modules against ESB in sugarcane were undertaken at Karnataka Institute of Applied Agricultural Research, Sameerwadi, Bagalkot, during 1997-98.

Studies on the movement of *T. chilonis* based on recovery at varied distances (1-10m) revealed that the per cent parasitization of *Corcyra* eggs kept at one to five metre distance did not differ significantly. Beyond five metres, the per cent recovery decreased at increasing rate. Forty to fifty per cent more recovery was found at down wind sectors than at upwind sectors at 45,60 and 75 days after planting (DAP). At 90 DAP, the recovery made at different directions were non significant.

The results on the impact of various intercrops (coriander, soybean, frenchbean and bhendi) and *T. chilonis* on *C. infuscatellus* indicated that marked control of *C. infuscatellus* and highest activity of *T. chilonis* was found in the combination of sugarcane+ coriander. On the contrary sugarcane+bhendi recorded significantly higher per cent infestation of *C. infuscatellus* and also lower activity of *T. chilonis*. The highest number of millable canes (1,13,130/ ha), cane yield (92.18t ha^{-1}), cane equivalent yield (100.54 t ha^{-1}) and maximum net return (Rs.63,498) was obtained from sugarcane+coriander combination followed by sole crop.

Chilo infuscatellus incidence was significantly less (2.6 to 7.15%) in Module I (sevidol, endosulfan and *Trichogramma*) followed by Module II (G.V. and *Trichogramma*). Significantly highest per cent incidence was seen in Module III (9.7 to 11.72%) (endosulfan spray). The yield data revealed that the Module I recorded significantly higher number of millable canes (1,17,100/ha) and cane yield of 95.27t ha^{-1} followed by Module II which recorded 1.09,830 millable canes per ha and cane yield of 90.38 t ha^{-1}. The highest cost benefit ratio of 1:2.76 was recorded by Module I followed by Module-II (1:2.65) and Module III (1:2.21).