

Application of N and P @ 150 Kg and 75 Kg/ha recorded higher grain yield. Increased grain protein and yield attributing characters were the result of added chemical fertilizers.

The higher net returns and B:C ratio were obtained with variety KRL 1-4 when applied with FYM @ 10 Mg/ha and 150 Kg N+ 75 Kg P/ha.

Response of Sunflower Hybrids to Planting Geometry and Levels of N and P After Kharif Paddy

S.R. NAGANUR

1997

MAJOR ADVISOR : V.P.NAGALIKAR

A field experiment was carried out at the Agricultural Research Station, Siruguppa on deep black soil during summer 1996-97 under irrigation, to study the response of sunflower hybrids to planting geometry and levels of N and P after Kharif paddy. Sunflower hybrids (H_1 =KBSH-1, H_2 =MSFH-17 and H_3 =VRF-3) were allotted in the main plot, planting geometry (S_1 =4.5 x 20 cm, S_2 =60 x 20 cm and S_3 =60 x 15 cm) in sub plot and fertilizer levels (F_1 =60 : 75 : 60 NPK kg/ha and F_2 =80 : 100 : 60 NPK kg/ha) were allotted in sub plots. There were eighteen treatment combinations and the trial was laid out in split-split plot design with three replications.

Among the sunflower hybrids, KBSH-1 produced significantly higher seed (1855 kg/ha) and stalk yield (2047

kg/ha) with higher oil content of 43.35 per cent when compared to MSFH-17 and VRF-3. Similar trend was noticed in respect of growth and yield components. Sunflower hybrids grow at a planting geometry of 60x20 cm was found to be optimum with a record seed yield (1717 kg/ha) and oil yield (676.17 kg/ha) which was significantly superior than 45x20 cm and 60x15 cm spacings. Response of sunflower hybrids indicated that application of 60 : 75 : 60 NPK kg/ha was optimum and recorded highest net returns (Rs. 10386/ha) with higher benefit cost ratio (1.63)

The study revealed that, sunflower hybrid KBSH-1 performed better at a planting geometry of 60x20 cm and with a fertilizer application of 60 : 75NPK kg/ha.

Integrated Nutrient Management in Hybrid Maize (*Zea mays* L.)

CHANNAPPA S.LAMANI

1998

MAJOR ADVISOR : Dr. Y.B.PALLED

A field experiment was conducted at the Main Research Station, Dharwad during 1996-97 to study the response of maize to integrated nutrient management. There were 27 treatments combinations consisting of three green manuring treatments (no green manuring, sunhemp, cowpea) three organic manure treatments (no organic manure, vermicompost, poultry manure) and three fertilizer levels (no fertilizer, 50% RDF, 100% RDF).

The experiment was laid out in randomized block design with three replication. Grain yield was significantly higher in treatment receiving sunhemp green manuring (40.27 q/ha) over cowpea and no green manuring. Among the organics, application of poultry manure (1 t/ha) gave significantly higher grain yield (39.55 q/ha) over vermicompost and no organics. Application of 100 per q/ha) over 50 percent RDF and no

fertilizer. The combination of sunhemp green manuring and poultry manure with 100 percent RDF recorded significantly higher grain yield (49.49 q/ha). The combination of sunhemp green manuring and poultry manure with 100 per cent RDF recorded maximum harvest index (40.99%). Maximum uptake of N, P and K by maize crop was recorded due to combined application of sunhemp green manuring and poultry manure with 100 percent RDF (298.75, 49.41 and 189.08 kg/ha respectively).

Significantly higher organic carbon content in soil was recorded with sunhemp green manuring (0.786%) over cowpea and no green manuring. Significantly higher net return was realised with combined application of sunhemp green manuring and poultry manure with 100 percent RDF (Rs. 13, 921/ha).

AGRICULTURAL CHEMISTRY AND SOIL SCIENCE

Studies on Sulphur in Vertisols Under Oilseed Based Cropping System of North Karnataka

M. S. VENKATESH

1997

MAJOR ADVISOR : Dr. T. SATYANARAYANA

An investigation was undertaken to study the forms and distribution of sulphur in Vertisols under oilseed based cropping system of North Karnataka; transformation of sulphur as influenced by sulphur application under incubation and

response of safflower to sulphur. The range in contents of different forms of sulphur were 900 to 2990 ppm of total sulphur, 771.50 to 2781.13 ppm of sulphate sulphur and 2.10 to 71.50 ppm of water soluble sulphur. Total sulphur was mostly

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composed of non-sulphate sulphur (average 91.0%). Considering 10 ppm as general critical limit, surface soils of 12 soil profiles could be rated as S deficient. Correlation studies revealed that total S was positively and significantly correlated with CaCO_3 content and non-sulphate S. Non-sulphate S was positively and significantly correlated with CaCO_3 and EC. Organic S was significantly correlated with organic carbon. Sulphate S and water soluble S showed significant and positive correlation with pH, EC, Silt + Clay, non-sulphate S and total S. The average C:N, C:S, N:S and C:N:S ratios of soils were 11.57:1, 33.56:1, 2.92:1 and 100:8.71:3.18, respectively. Results obtained from incubation studies revealed that release of S was more with ammonium sulphate treatment. Field

investigations on response of safflower to sulphur revealed that the dry matter production, grain yield, stover yield increased significantly with the application of sulphur through ammonium sulphate @ 30 kg ha⁻¹. An increase by 2.77 per cent in oil concentration was noticed when compared to control due to sulphur application @ 30 kg ha⁻¹. The content and uptake of S by safflower grain and stalk was significantly increased by S fertilization upto 30 kg ha⁻¹. Sulphur application resulted in significant decrease in N:S ratio of safflower. Maximum S depletion in soil was observed both in control and through ammonium sulphate. Ammonium sulphate @ 30 kg S ha⁻¹ was a better source in terms of B:C ratio.

Studies on Status and Distribution of Potassium in the Soils of North Karnataka

DAYASAGAR B. PATIL

1997

MAJOR ADVISOR : Dr. G. N. DANDAGI

The investigation was carried out to study the distribution of different forms of potassium and other related soil potassium parameters of nine soil bodies collected from Agri. Research Stations located at Bijapur (Three profiles deep, medium and shallow black) and Kalloli, Arabhavi and Annigeri (one each) coming under zone-3 and Kanabargi, Bailhongal and Kumbapur (one each) falling under zone-8 of North Karnataka.

The range of contents of various forms of potassium (C mo p⁺ kg⁻¹) in different soil bodies were 0.00 to 0.12 of water soluble, 0.12 to 0.72 of exchangeable, 0.12 to 0.81 at available, 0.43 to 2.67 of non-exchangeable, 1.8 to 15.34 of lattice K and 2.73 to 17.08 of total K.

In general, water soluble and exchangeable potassium content in surface soil were more than those in sub-surface

soils in most of the soil bodies, where as non exchangeable, lattice and total-K were more on the sub surface soils, which may be attributed to the process of illuviation as well as more exploitation of surface soils than sub-surface soils and due to dominance of K-bearing minerals in sub surface soils.

The potassium fixation capacity of surface soils of different bodies ranged between 0.65 and 1.85 C mol (p⁺) kg⁻¹ with the highest value recorded in Annigeri (1.85) and the lowest in Bijapur shallow black soil (0.65).

The amount of step K decreased with successive extractions and major portion of it was extracted within initial five successive extractions. The amount of step K in surface soils may be taken as an index of step K in subsequent depths of the soils bodies.

Studies on Phosphorus and Iron in Coffee Growing Soils of Balehonnur

A. N. MANJUNATH

1997

MAJOR ADVISOR : B. BASAVARAJ

A study was undertaken in along term fertilizer experiment of Central Coffee Research Institute at Balehonnur, to evaluate the effect of different fertilizer treatments on the soil phosphorus and iron and the interaction of phosphorus and iron in the soil on long term basis. The fertilizer treatments comprised of different levels of N, P₂O₅ and K₂O ranging from 0:0:0 to 495:374:495 kg per hectare with liming in alternate years. Rock phosphate was the source of phosphorus, also contributed iron to soil. Soil and leaf samples were collected at the time of harvest and were analysed.

The contribution of different inorganic - P_i fractions towards total inorganic - P are in the order of Fe-P > RS-P > Ca-P > Al-P > Occl-P > Sal-P. A decrease in total inorganic phosphorus over the years may be due to downward movement of phosphorus in the soil profile. Regular liming increased the

low pH value sat 4.0 at the experimental site in the year 1979 to 5.0 over the years. This resulted in the increase of available P in soil with increased level of fertilizer as reflected in high Sal-P fraction. Due to the addition of Fe₂O₃ through Rock phosphate a higher percentage of Fe_o fraction and available-Fe with increase in fertilizer was noticed. Fe_o the active fraction of iron oxide responsible for P-fixation in soils.

Concentration of available P and Fe were not reflected in leaf phosphorus, leaf iron and yield. There is a need for revision of fertilizer recommendation in respect of phosphorus. Comparison of experimental field with planters field indicated that Al-P and Fe_o were significantly superior in experimental field whereas leaf-Fe and yield were significantly superior in planters field.

Studies on Properties of Groundnut Growing Soils of U.K.P. (Phase-1) Command Area

R. P. SANGAYYA

1997

MAJOR ADVISOR : G. S. DASOG

A study was undertaken on groundnut growing red & black soils of UKP (Phase-1) command area in North-eastern dry zone of Karnataka to understand the morphological, physical and chemical properties and to evaluate their suitability for irrigation and for cultivation of groundnut.

Five pedons and fifteen surface soil samples derived black soil pedon was also included for comparison. The soils were deep to very deep, sandy loam to loamy sand in texture with colour hue of 2.5 YR and 5YR with weakly to moderately developed subangular blocky structure. Red soil contained high sand and low silt content. Clay movement was apparent in Narayanpur, Kodekal and Kakera pedons where as Huansigi pedon was clayey throughout the depth. The moisture retention at 33k Pa and 1500 K Pa followed the trend of clay in all the pedons.

The pH varied from slightly alkaline to moderately alkaline and increased with depth. The exchangeable calcium was the dominant cation followed by magnesium, sodium and potassium in all the soils. The available nitrogen content ranged from 123 to 296 kg/ha. The available phosphorus and potassium was medium. The uptake of N was more in red soils than black soils but no such difference was noticed for P and K.

A high positive correlation between available N, P, K and Calcium of soils and their uptake in kernal was observed. The pod and kernal yield was more in red soils than black soils. The soil suitability evaluation for groundnut was attempted based on climatic and soil requirements. The overall suitability was rated as suitable (S2) and slightly suitable (S3) soils for groundnut in respect of red and black soils, respectively.

Leaf Analysis as an Index of Sulphur Fertilization to Sunflower

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1997

MAJOR ADVISOR : Dr. N. A. YELEDHALLI

Tissue analysis is a diagnostic tool which can be used in identifying sulphur deficiencies and predicting sulphur fertilizer requirements of sunflower crop. A water extraction procedure for removal and measurement of inorganic sulphate in sunflower leaves was developed and assessed as a measure of sulphur availability in sunflower crop. Relationship between sulphate concentration in leaf and yield were obtained for sunflower crop grown on three different sulphur status soils (Alfsoils) with five rates of sulphur fertilizer supply, in a pot experiment conducted at College of Agriculture, Raichur, Karnataka during summer 1997.

Studies on standardization of extraction conditions for water soluble sulphate sulphur showed that the sunflower leaf sample size of 0.5 sq. cm diameter and shaking time of 1.0 hours was optimum. The sulphate concentration in the leaf

tissue was measured at the time of 3-4 pair leaf stage and at early bloom stage. The results showed significant relationship between the water extractable sulphate in the leaf and the yield of sunflower and the supply of available sulphur in the soils at both the crop growth stages. Inorganic sulphate sulphur concentration in leaves of sunflower crop at 3-4 pair leaf and early bloom stage were found to be satisfactory index of sulphur deficiency in sunflower.

The sunflower crop grown in low and medium sulphur status soil showed good response to the applied sulphur levels. Application of 20 mg S/kg of soil equivalent to 40 kgS/ha to low and medium sulphur status soil was found optimum. Further, increase in sulphur levels there was reduction in seed yield and oil content of sunflower and it was not economically beneficial. The sunflower crop showed poor or no response to applied sulphur levels in high sulphur status soil.

Long Term Effect of Cropping Systems and Organic Manure Application on Soil Properties in Vertisol

S. MADHUKAR

1998

MAJOR ADVISOR : Dr. H.M.MANJUNATHAIAH

Investigation was carried out to study the long term effect of cropping systems and FYM application on fertility status and physico-chemical properties of a vertisol.

This permanent cropping system manurial trial was initiated in the year 1948-49 and terminated in 1995-96 at ARS, Hebbali farm, Dharwad. After taking the 95-96 crop yield soil samples were collected on cropping system wise and analysed.

Results of the soil analysis indicated that the different cropping systems and application of FYM to the crops every year or alternative year did not influence much on textural component of the soil.

Among the different cropping systems studied, the groundnut-jowar manured cropping system found better enhance the fertility status of the soil.

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Soils are found neutral reaction. EC values were found to increasing with depth in all the cropping systems studied. OC content was found to decrease with depth which varied from 0.27 to 1.12 percent. The CaCO_3 content of soil considerably decreased in the FYM treated plots. Calcium and Magnesium content in manured plots were found in the range of 52.9 to 58.6 C mol(p⁺) kg⁻¹. Whereas, in unmanured plots it was in the range of 48.90 to 52.10 C mol (p⁺) kg⁻¹. CEC of the soil closely followed the clay content and OM content of the soil. FYM treated cropping system contained high available

N, P_2O_5 and K_2O as compared to unmanured cropping systems.

Available sulphur in soil was found increased towards depth ranging from 18.6 to 43.1 ppm in the treatments studied.

Organic manures added plots showed higher available micronutrient status in surface soils as compared to unmanured plots. This may be due to the addition of FYM @ 10 t ha⁻¹ to the surface soil and incorporation of crop residues every year to the soil.

AGRICULTURAL ENTOMOLOGY

Influence of Host Plants on the Multiplication and Persistence of *Spodoptera litura* Fab. NPV

GURURAJ G. KULKARNI

1997

MAJOR ADVISOR : Dr. P. S. HUGAR

The study on the preference of host plants on the mortality of *Spodoptera litura* Fab. indicated that castor and groundnut were most preferred and recorded highest larval mortality. The next best hosts were soybean and mulberry where as cotton was least preferred. Number of larvae required to get one LE NPV were lowest on castor and was highest in cotton. Among the different concentrations tested, the highest mortality was recorded at 6×10^8 POB per ml. The larval mortality was directly proportional to the concentrations. Lowest LT_{50} value was recorded when larvae reared on castor and it was inversely proportional to the concentration of NPV.

LC_{50} values were lowest on castor followed by

groundnut, soybean, mulberry, strawberry, potato, tomato, sunflower and cotton. In persistence studies the mortality was highest on soybean followed by groundnut, while the least on cotton. The larvae mortality recorded when NPV alone, and in combination with UV protectant applied at different timing of a day, in comparison with endosulfan indicated that endosulfan indicated that endosulfan recorded highest mortality followed by NPV + boric acid sprayed at evening hours. The least mortality was noticed when NPV along sprayed at morning hours. The same experiment when conducted in kharif and summer showed that persistence of NPV on groundnut was noticed upto seven and six days during kharif and summer seasons, respectively.

Performance of Palynology of European Honey Bee, *Apis mellifera* L. Under Dharwad Conditions

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1997

MAJOR ADVISOR : SHASHIDHAR VIRAKTAMATH

Studies on the performance of *Apis mellifera* L. was made on the main campus of the University of Agricultural Sciences, Dharwad from June 1996 to May, 1997. Significantly highest colony strength of 9.2 frames was recorded during the first fortnight of October. However, significantly lowest colony strength of 2.5 frames was recorded during the second fortnight of January and first fortnight of February.

Similarly, significantly highest brood frames (7.5 frames) and brood area (5116.56 cm²) were recorded during first fortnight of October and lowest brood frames (0.6 frames) and brood area (18.78 cm²) during second fortnight of January. Pollen and honey stores varied during the year with a major peak during first fortnight of October (402.56 and 915.22 cm², respectively) and minor peak during the second fortnight of April (309 and 477.89 cm², respectively). In Dharwad, October and April were the major and minor honey flow seasons,

respectively, while June - August and December - February were the dearth periods.

The foraging behaviour was more or less similar in monsoon and winter seasons with peak activity of outgoing foragers, pollen foragers and nectar foragers during 1200-1300 hr. But in summer, there were two distinct peaks of outgoing foragers and pollen foragers during 0900-1000 hr and 1700-1800 hr and three peaks of nectar foragers during 0700-0800 hr, 1000-1100 hr and 1600-1700 hr. Among 49 plants recorded as pollen sources, 11 species were major, 14 species medium and 24 minor pollen yielders.

Pollen analytical studies from honey samples revealed that *Sapindus detergens* Roxb., *Eucalyptus* Sp., *Prunus* sp., *Allium cepa* L. and *Azadirachta indica* Juss. were the predominant pollen types during September - April.

Evaluation of Botanicals to Safflower Aphid, *Uroleucon compositae* (Theobald) and its Natural Enemies

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1997

MAJOR ADVISOR : Dr. K. BASAVANA GOUD

Studies on the evaluation of botanicals to safflower aphid, *Uroleucon compositae* (Theobald) under laboratory condition indicated that two and five per cent aqueous and cooked extracts of *Vinca rosea* and *Vitex negundo* were found to be very effective by causing 100 per cent mortality of aphid after 72 hours of application. Cold alcoholic extract of *Parthenium hysterophorus* and *Azadirachta indica* (Seed) excelled all other botanicals used in the study by recording cent per cent mortality of aphid both at 1.5 and 2 per cent concentration at 72 hours of duration. Among the dust formulations of botanicals, *Pongamia pinnata* and *Bougainvillea spectabilis* at twenty five per cent concentration caused maximum (more than 89%) mortality. In case of seed extracts, neem oil at 2 per cent concentration was highly effective by causing maximum (87.33%) mortality.

Based on the laboratory findings, nine promising botanicals were selected and tested safflower aphid under field condition. Aqueous extract of *V. rosea* at 2 per cent concentration proved to its superiority by recording minimum

population of aphids (0.69) per top 5 cm twig seven days after application and also recorded highest (6.03 g) 100 seed weight and grain yield (14.88 q/ha).

The dust formulation of *B. spectabilis* at 25 per cent concentration were found to be safer to the eggs (85% hatchability) and all the three instars (less than 16.66% mortality) of *Chrysoperla carnea* at 48 hours of application. The dust formulations of *B. spectabilis* at 25 per cent concentrations, 2 per cent aqueous and cooked extract of *V. negundo* and 2 per cent cooked extract of *V. rosea* were found to be safer to pupae of *C. carnea* with a maximum (more than 86%) adult emergence. Aqueous extract of *V. negundo* at 2 per cent concentration was safer to adults of *C. carnea* with minimum mortality of 26.66 per cent. The dust formulation of *B. spectabilis* and cooked extract of *V. negundo* proved highly safer to the grubs of *Coccinella septempunctata*, whereas for adults, the dust formulation of *B. spectabilis*, cooked extract of *V. negundo* and *V. rosea* were found safer with less than 6.67 per cent mortality.

Evaluation of Different Sprayers, Nozzles and Spray Volumes Against Cotton Insect Pests

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1997

MAJOR ADVISOR : Dr. B. V. PATIL

Evaluation of different 1. Sprayers viz., Knapsack sprayer, Low volume aspee bolo power sprayer, Gator sprayer, Ultra low volume sprayer, High volume battery operated sprayer, Guntur sprayer 2. Different nozzles viz., Hollow cone nozzle, Deflector nozzle, Floodjet nozzle, Duromist nozzle and 3. Spray volumes viz., 750, 1000, 1250, 1500 litres per ha (using High volume knapsack sprayer), 125, 187.5, 250, 375, 500 litres per ha (using low volume aspee bolo power sprayer) against cotton insect pests was undertaken at the College of Agriculture, Raichur during 1996-97 season.

During early stage of crop growth Knapsack sprayer registered lowest leafhopper, *Amrasca biguttula biguttula* (0.16 on top three leaves) and highest seed cotton yield (628.11 kg/ha). At reproductive stage of crop growth it again recorded lowest bollworm incidence (67.87%), bad opened bolls (8.5 per plant) and locule damage (19.30%), highest good opened

bolls (22.51 per plant) and seed cotton yield (589.48 kg/ha). Similarly, Hollow cone nozzle recorded lowest leafhopper (0.04 on top three leaves), highest seed cotton yield (502.29 kg/ha) in the early stage of crop growth. It also recorded lowest bollworm incidence (8.09%), bad opened bolls (9.79 per plant), locule damage (11.9%), highest good opened bolls (26.98 per plant), seed cotton yield 579.23 kg/ha) in later stage of crop growth. Spray volume of 1000 litres per ha with high volume sprayer registered lowest bollworm incidence (8.19%) and bad opened bolls (5.66 per plant), locule damage (13.30%) and highest good opened bolls (20.60 per plant) and seed cotton yield (606.40 kg/ha). Similarly spray volume of 375 litres per ha with low volume sprayer registered lowest bollworm incidence (10.5%) and bad opened bolls (7.5 per plant) locule damage (18.11%) and highest good opened bolls (15.62 per plant) and seed cotton yield (522.10 kg/ha).

Abstract of Theses

Bioecology and Management of Groundnut Pod Bug *Elasmolomus sordidus* (F.) (Hemiptera : Lygaeidae)

R. G. NAGANNAVAR

1997

MAJOR ADVISOR : Dr. V. P. DESHPANDE

Investigations on bioecology and management of groundnut pod bug, *Elasmolomus sordidus* (F.) were undertaken at Lakshmeshwar, during 1996-97. The population was nil during first week of September in Lakshmeshwar, Shirhatti and Dharwad threshing yards. Later the population first appeared on sesamum in both Lakshmeshwar and Shirhatti threshing yards. While in Dharwad it appeared on groundnut. Whereas in godown the population which appeared bit late compared to to threshing yard. Peak, population of bug was observed during December and January month. Dharwad recorded lower population compared to other two locations. The population decreased gradually from second week of January onwards in all the three locations.

The development of egg, nymph, adult was completed in 7.50, 25.40 and 13-17 days, respectively. The nymph moulted four times to complete five instars. Fecundity of bug was 161.3. The total life cycle occupied 53.77 days. *Carioxenus* sp. is an adult parasitoid recorded for the first time during the study. *Gryllus domesticus* was observed to

prey on all instars of *E. sordidus*.

Loss caused by pod bug was to the tune of 11.78, 11.46 and 10.87 per cent in groundnut, sesamum and sunflower respectively when exposed to ten bugs over a period of 30 days. Similarly per cent oil loss was 6.15, 8.61 and 3.26 in groundnut, sesamum and sunflower, respectively. The per cent weight loss and oil loss was 47.49 and 33.95 in spreading groundnut were, respectively. The corresponding values for bunch groundnuts were 46.73 and 31.53.

Among different stages after groundnut harvest, freshly harvested pods recorded minimum per cent weight loss 46.29 and oil loss 32.69 followed by normal dried (15 days) and stored groundnut (one month). Among seven insecticides evaluated for the control of the pod bug, Chloropyrifos (@ 0.05 per cent) malathion @ 5 per cent dust and monocrotophos @ 0.05 per cent emerged as superior in reducing the pod bug infestation to the extent of 96.86, 92.41 and 90.70 per cent, respectively.

Management of Ber Fruit Borer, *Meridarchis scyroides* Meyrick (Lepidoptera : Carposinidae) and Fruit Fly, *Carpomyia vesuviana* Costa (Diptera : Tephritidae)

I. M. HOSAGOUDRA

1997

MAJOR ADVISOR : Dr. B. S. NANDIHALLI

Studies carried out at the Regional Research Station, Bijapur in 1996-97 indicate the incidence of fruit borer (*Meridarchis scyroides* Meyr.) and fruit fly (*Carpomyia vesuviana* Costa) from first week of November, 96 till the end of third week of January, 97 with a peak incidence during third week of December. An unidentified species belonging to Eucolidae : Hymenoptera on fruit borer and unidentified species belonging to Pteromalidae : Hymenoptera and *Monodontomerus* sp. (Torymalidae : Hymenoptera) on fruit fly were noticed as larval parasitoids. Among eight ber cultivars, Sanaur-2, Umran, Kadaka and Sanaur-6 recorded highest infestation of the pests, while Ilaichi and Chhuhara recorded lowest infestation. The intensity of fruit borer and fruit fly larvae per infested fruit was maximum in Sanaur-2 and Umran

varieties but Ilaichi recorded only one larva per infested fruit. The bioefficacy of insecticides against ber fruit borer and fruit fly indicated that monocrotophos 36 SL (0.036% concentration) was found effective followed by deltamethrin 2.8 EC (0.04% concentration), fenvalerate 20 EC (0.01% concentration). Among different insecticide dusts, fenvalerate 4 per cent and chloropyrifos 1.5 per cent both at seven and fifteen days after treatment were found effective by recording higher mortality of fruit borer and fruit fly pupae in the laboratory. Application of two sprays at 12 and 14th week (marble stage) and one spray at 16th week (maturation stage) after 50 per cent flowering recorded minimum infestation and was more economical than other spray schedules.

Foraging Behaviour and Palynology of Indian Bee, *Apis cerana Fabricius* Under Dharwad Conditions

K.S. HOLI

1997

Major Advisor: SHASHIDHAR VIRAKTAMATH

Studies on the foraging behaviour, bee flora, pollen and nectar sources of Indian bee, *Apis cerana Fabricius* were carried out from June, 1996 to May, 1997, in the apiary of the College of Agriculture, University of Agricultural Sciences, Dharwad.

The results of the investigations revealed that foraging behaviour was more or less similar in monsoon and winter with a peak activity of outgoing foragers, pollen and nectar foragers during 1100-1300 hr. However, in summer, there were two distinct peaks as against only one during monsoon and winter. A major peak of outgoing and pollen foragers occurred between 0700-1000 hr and peak between 1700-1800 hr. The nectar foragers were maximum between 0700-01000 hr and 1700-1800 hr.

Foraging activity had positive correlation with the

temperature and negative correlation with the rainfall and relative humidity.

Totally 132 plant species were found to yield pollen and/or nectar for *A. cerana*. They constituted 26 field crops, 27 forest trees, 22 vegetable crops, 21 ornamental plants, 19 fruits and plantation crops and 17 herbs, shrubs and bushes.

Palynological investigations of 2808 pollen loads revealed 38 plant species as pollen yielders, out of which 15 were categorised as major, 17 secondary and six minor sources.

Pollen analytical study of 11 honey samples indicated the presence of *Eucalyptus* spp., *Bignonia venusta* Miq., *Bauhinia purpurea* L., *Filicium decipens* Wild., *Moringa oleifera* Lam., *Azadirachta indica* Juss and *Pithecolobium dulce* Benth., as dominant sporomorphs.

Methods of Vermicomposting under open Field Conditions and Management of Natural Enemies of Earthworm (*Eudrilus eugeniae*) kinberg

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1997

MAJOR ADVISOR : Dr. K.A.KULKARNI

Investigations on the evaluation of different methods of Vermicomposting for biodegradation of organic wastes under open field conditions Vs. different season and management of natural enemies of earthworms using plant products and pesticides were undertaken in field conditions in the Main Research Station, University of Agricultural Sciences, Dharwad from November, 1996 to August, 1997.

Brick column method of vermicomposting proved to be the best method of biodegradation of wastes than other methods during winter season. Brick column method recorded higher significantly lower number observed in the pit method of vermicomposting. Similarly the resultant biomass (3020.48-3287.60 g) and vermicompost (52.43-53.95kg) produced in brick column method was significantly more than pit method vermicomposting (2378.78-2428.83 g biomass and 39.00-41.73 kg vermicomposting produced). Similarly, heap method of vermicomposting produced significantly more amount of earthworm population (2572.00-2675.50), biomass (2939.13-3164.65 g) and vermicomposting (48.63-50.35 kg) vs. pit

method of vermicomposting. Within the pit method, pits with polythene sheeting (41.73kg) had produced significantly more amount of vermicomposting than pits without polythene sheeting (39.00 kg). Similar trend was observed during summer and rainy seasons also.

Different natural enemies encountered were ants (*Componotus Compressus* (Fabr.) and *Dorylus labiatus* Shuk), termites (*Odontotermes obesus* (Rambur), centipedes (unidentified), slugs (*Deroceras reticulatum* Muller), toads (*Bufo melanostictus* (Schn.)) and flatworm (*Bipalium* sp.).

Sweetflag rhizome powder (*Acorus calamus*) @ 20 grams/kg of feed was found to be significantly superior over control by recording least count of different natural enemies and it had reflected ultimately on the significantly higher production of vermicompost. While clerodendron leaf dust @ 10 grams/kg of feed was toxic to earthworms. Drenching with chlorpyrifos 20EC @ 2ml/litre of water controlled ants and termites during all seasons.

Abstract of Theses

Effect of *Metarhizium anisopliae* (Metsch.) Sor. on *Tetranychus neocaledonicus* Andre and its Predator *Amblyseius ovalis* Evans on Okra

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1998

MAJOR ADVISOR : Dr. M.MANJUNATHA

Investigation on the efficacy of *Metarhizium anisopliae* on eggs, active immature and adults of spider mite *Tetranychus neocaledonicus* a serious pest on okra and its predator *Amblyseius ovalis* were carried out. The LC 50 for active form of mites was 1.9×10^3 spores/ml. Highest mortality is 92.82 percent for adult, 72.93 percent for immature and 87.82 percent for the eggs in 1.8×10^4 spores/ml under laboratory conditions. Among the eight treatments evaluated against *T. neocaledonicus* in the green house, 3×10^4 spores/ml + dicofol (0.03%) registered greater mortality. Considerable mortality was also observed in predator *A. ovalis* under green house conditions.

Among the eight treatments of fungi + dicofol evaluated under field conditions, highest mortality was 88.35 per cent in 1.5×10^4 spores/ha + dicofol (0.03%).

Reduction in the mite population was related to incidence of fungus at seven and 15 days after the spray application. Dosage level of 1.5×10^4 spores/ha + dicofol (0.03%) and 1.5×10^{14} spores/ha + dicofol (0.015%) exerted significant mortality on mite population. Considering the B:C ratio evolved due to use of fungus + dicofol the highest ratio is (50.45:1) in 1.5×10^{14} + 0.015 followed by 1.5×10^{14} + 0.03 (44.26:1) and dicofol 0.03 per cent (40.96:1).

AGRICULTURAL MICROBIOLOGY

Interaction Effects of *Glomus fasciculatum* and *Trichoderma harzianum* on *Sclerotium rolfsii* in Tomato

SOMALINGAYYA N. KICHADI

1997

MAJOR ADVISOR : Dr. M. N. SREENIVASA

An experiment was conducted at Agricultural College, Dharwad, during kharif season of 1996 to study the interaction effects of VA mycorrhizal fungus, *Glomus fasciculatum* and/or a saprophytic fungus, *Trichoderma harzianum* on soil borne root pathogen *Sclerotium rolfsii* in the presence of biogas spent slurry in tomato.

Mycorrhizal spore counts and per cent root colonization were found to be significantly highest in the plants inoculated with both *G. fasciculatum* and *T. harzianum* and given biogas spent slurry as compared to uninoculated control plants while it was least in the plants inoculated with *S. rolfsii* alone. *Trichoderma harzianum* population was significantly highest in the rhizosphere soil of plants inoculated with *T. harzianum* and given biogas spent slurry and it was least in plants inoculated with *S. rolfsii* alone. The shoot P concentration, plant height and plant dry weight were

significantly highest in the dual inoculated plants given biogas spent slurry while it was lowest in plants inoculated *S. rolfsii* alone. The percentage colonization by *S. rolfsii* was significantly lowest in the rhizosphere soil of dual inoculated plants given biogas spent slurry as compared to rhizosphere soil of plants inoculated with *S. rolfsii* alone. The disease severity index (DSI) was minimum in dual inoculated plants given biogas spent slurry. The number of fruits and fruit weight per plants were significantly highest in dual inoculated plants given biogas spent slurry as compared to uninoculated control plants.

Combined inoculated of *G. fasciculatum* and *T. harzianum* in presence of biogas spent slurry was the best in suppressing the colonization of pathogen. The interaction effects of both these fungi in the presence of biogas spent slurry resulted in not only increase in P nutrition, plant growth and yield but also suppressed *S. rolfsii*.

Use of Sugarcane By-products as Substrate for Cultivation of Oyster Mushroom (*Pleurotus sajor-caju* (Fr.) Singer)

B. S. CHANDRASHEKHAR

1997

MAJOR ADVISOR : Mrs. VEENA SAVALGI

Studies were conducted on sugarcane by-products (sugarcane trash, milled bagasse and crushed bagasse) as substrate for raising crop of *Pleurotus sajor-caju* for yield as well as the suitability of the spent straw as manure. Milled bagasse and sugarcane trash revealed highest sporophore

yield of *P. sajor-caju* when treated with sodium hydroxide (at 4 and 2%) and calcium hydroxide (at 4 and 3%). Among sodium hydroxide treated combinations, sugarcane trash and milled bagasse promised highest bio-efficiency of *P. sajor-caju*, similar combination performed better when substrates were

treated with calcium hydroxide. But, calcium hydroxide treatment was found to be inferior on sporophore yield over sodium hydroxide treatment. This above mentioned substrate combination treated with sodium hydroxide also revealed highest bio-efficiency and protein content of sporophores on amending with soybean grits (1%) over rice bran (1%). Even similar trend was noticed in calcium hydroxide treated combination of substrate. But paddy straw was found to be a superior substrate for bio-efficiency and protein content of *P.*

sajor-caju when amended with soybean grits (1%). Even spent substrate of paddy straw obtained after mushroom harvest showed greater influence on the yield of brinjal and plant dry matter production when used as manure (FYM). Whereas, in sugarcane by-products, sodium hydroxide treated and soybean grits amended substrate on application as FYM resulted in moderately good yield and plant dry matter brinjal over calcium hydroxide treated and amended substrate.

Plant Growth Promotional and Biocontrol Potential of *Pseudomonas fluorescens* in Groundnut

VIKRAMAPPANNA

1997

MAJOR ADVISOR : Dr. P. U. KRISHNARAJ

The potential of two *Pseudomonas fluorescens* strains, FPD-10 and FPD-15 was assessed by studying their root colonization potential, ability to suppress *Sclerotium rolfsii* Sacc. in soil, interactive influences with *Bradyrhizobium* spp. and ability to promote overall plant growth under pot culture conditions.

FPD-10 had a better potential to colonize the roots than FPD-15. In unsterile soil, it increased in population to nearly nineteen folds indicating its high competitiveness with native population of microorganisms. FPD-10 and FPD-15 increased the root biomass by nearly 92 per cent and 58 per cent respectively over uninoculated control. The inoculation of FPD-10 and FPD-15 significantly increased the nodulation by both *Bradyrhizobium* strains and increased the shoot N

concentration in the plants receiving dual inoculation.

There was notable increase in the shoot N concentration due to inoculation of preincubated mixtures at all stages of crop growth. FPD-10 and FPD-15 multiplied efficiently in the unsterile soil and brought down the percentage of infected pods. The plants inoculated with FPD-10 and FPD-15 were extremely vigorous and neither stunted nor wilted. It was observed that FPD-15 had mineral phosphate solubilization (MPS) ability. FPD-10 had marginal MPS activity but produced large amounts of slime.

FPD-10 was found to be a highly potent biocontrol agent causing 140% increase in healthy pod number, 89% increase in healthy pod weight and 78% decrease in infected pod number over captan treatment.

Studies on Post-harvest Preservation of Tomato and Beans Against Spoilage Microorganisms

B. RAGHAVENDRA RAO

1997

MAJOR ADVISOR : Dr. A. R. ALAGAWADI

Post-harvest spoilage of tomato and beans and their chemical control were studied by considering the spoilage susceptibility of these two vegetables. The microbial analysis of the healthy tomato and beans samples from field and market during three different months, representing three different seasons, showed higher microbial load in the samples collected from market compared to ones collected from field. The two vegetables sample during August showed higher fungal load whereas those collected during March showed higher bacterial load. Out of 17 isolates obtained from tomato and beans six fungal species belonging to the genera *Fusarium*, *Aspergillus*, *Alternaria*, *Cladosporium*, one yeast (*Hansenula*) and a bacterium (*Pseudomonas*) caused spoilage of tomato and a lone fungal isolate, *Malusella aeria* caused spoilage of beans and is a new record on beans.

The *in vitro* evaluation of three biocides indicated that Carbendazim was most effective followed by Mancozeb and

Sanosil in inhibiting all spoilage fungi isolated from tomato and beans except *Alternaria alternata* on which Mancozeb was most effective. However, Carbendazim and Mancozeb were not effective against *Pseudomonas* whereas Sanosil was most efficient on this bacterium.

The *in vitro* studies on the effect of biocides on shelf-life and post-harvest qualities of tomato and beans indicated that Carbendazim 500 ppm and Sanosil 10000 ppm were most effective in extending the shelf-life and maintenance of post-harvest qualities. These two treatments showed lowest spoilage percentage, reducing sugar content, pectin methyl esterase activity and cellulase activity but recorded highest ascorbic acid content. The dipping time of five minutes showed higher shelf-life and maintenance of above said post-harvest qualities in both tomato and beans compared to one and two minutes dipping. Storage of the two vegetables in cold storage (5°C) further improved the shelf-life and post-harvest qualities.

Abstract of Theses

Post Harvest Preservation of Mango and Guava Against Spoilage Microorganisms

ARATI BHAT

1997

MAJOR ADVISOR : Dr. J. H. KULKARNI

A study was conducted on the post harvest spoilage and their control by biocides in mango and guava. The *in vitro* effect of Sanosil and two check chemicals viz. Carbendazim and Mancozeb on spore germination, mycelial weight and mycelial growth of spoilage fungi was studied. Three spoilage fungi namely *Pestalotiopsis mangiferae* Stey. and *Aspergillus fumigatus* Fresenius, *Rhizopus stolonifer* Lind. were isolated from spoiled mango and guava respectively. Fruits collected from marked had higher microflora than those collected directly from the orchard. The minimum inhibitory concentration of three biocides against spore germination of *Pestalotiopsis mangiferae* was 1,000 ppm in Carbendazim and 5,000 ppm in Sanosil and Mancozeb, whereas in *Aspergillus fumigatus* application of Carbendazim, Sanosil and Mancozeb at 1,000 ppm in each case completely inhibited spore germination. However, in *Rhizopus stolonifer* the spore germination was completely inhibited in Carbendazim and Mancozeb at 1,000

ppm and in Sanosil at 5,000 ppm. Mycelial weight and hyphal growth were also controlled by all the three biocides at higher concentrations, but the growth was not checked completely. *In vitro* studies the effect of biocides on shelf life and post harvest qualities of fruits were maintained for longer period and spoiler was reduced significantly. Carbendazim (500 ppm) and Sanosil (10,000 ppm) dipped fruits maintained low TSS, reducing sugar, PME and high ascorbic acid content compared to untreated fruits. In cold storage there was no spoilage upto 10 days in mango and treatment with Carbendazim (500 ppm), Sanosil (10,000 ppm) and Mancozeb (1,000 ppm) could extend shelf life upto 20 days. The TSS, reducing sugar and PME were low in treatment with Carbendazim 500 ppm and Sanosil 10,000 ppm. But ascorbic acid content and titrable acidity were high compared to all other treatments. Hence, Carbendazim (500 ppm) and Sanosil 10,000 ppm treated fruits for five minutes maintained high post harvest quality and low spoilage.

Studies on Microbial Diversity and Their Activity in Soil Under Bamboo Plantation

K. S. MAHESHKUR

1997

MAJOR ADVISOR : Dr. A. R. ALAGAWADI

Investigations were carried out on the rhizosphere microflora of bamboo as well as their population and activities under leaf litter of bamboo plantation during different seasons. The enumeration of microflora in the rhizosphere of different species of bamboo grown at different locations indicated that *Dendrocalamus strictus* harboured maximum number of total bacteria and N_2 fixers whereas *Bambusa arundinaceae* recorded highest number of P solubilizers and *Bambusa vulgaris* recorded highest population of fungi and actinomycetes. Bamboo plants grown in medium black soil showed higher population of different groups of microorganisms than those grown in red soils. Out of 32 representative major bacterial isolates obtained from bamboo rhizosphere, 16 were found to be N_2 fixers, six were P solubilizers and 10 were predominant general bacterial isolates. The N_2 fixers mainly belonged to the genera *Azotobacter* and *Azospirillum*. The P solubilizers belonged to *Pseudomonas*, *Xanthomonas* and *Erwinia*. Predominant bacterial isolates belonged to *Bacillus*, *Erwinia*, *Pseudomonas* and *Xanthomonas*.

Among N_2 fixers, *Azospirillum* isolates were found to fix higher amount of nitrogen than *Azotobacter* isolates. In case of P solubilizers, strains PSER-1 and PSER-2 showed maximum solubilization of tricalcium phosphate with maximum reduction in pH and of the broth. All N_2 fixers and P solubilizers were found to produce IAA and GA. Inoculation of bamboo seeds with selected efficient nitrogen fixers or P solubilizers either individually or in combination showed increased growth of bamboo seedlings. In general single inoculation treatments gave better results than combined inoculations. All the inoculation treatments enhanced the seed germination root and shoot length as well as dry matter accumulation of bamboo seedlings.

The microbial load and enzyme activities in soil under leaf litter of bamboo were significantly higher than that of control soil (unplanted soil). Among the bamboo plant densities, the soil under highest plant density showed maximum population of bacteria, fungi, actinomycetes, N_2 fixers, P-solubilizers and cellulose degraders, as well as dehydrogenase, urease and phosphatase activities.