

water used for irrigation.

Unirrigated soils were leached with the respective places underground water to know the effect of irrigation on the soil characters with depth. Soil column study indicated that pH, EC, exchangeable sodium, soluble sodium, SAR and soluble anions increased with depth. Kondikoppa soil recorded highest exchangeable as well as soluble sodium content and SAR. This is due to the highest

sodium and SAR of underground irrigation water of Kondikoppa. Exchangeable as well as $\text{Ca}^{2+} + \text{Mg}^{2+}$ and K^+ decreased with the depth due to replacement of exchangeable sodium and potassium of above layers by $\text{Ca}^{2+} + \text{Mg}^{2+}$ of irrigation water. Leached soils have high pH, exchangeable and soluble sodium, bicarbonate and SAR as compared to initial soils. This is because of high pH, sodium, bicarbonate and SAR of respective underground water used for leaching.

Studies on Soil Aggregation in Vertisols of North Karnataka

S. ASHOKA KUMAR

2000

MAJOR ADVISOR : Dr. G. S. DASOG

The degree of aggregation in the surface layer of a vertisol is a key index of the soil's agricultural potential. Twenty surface soils from a number of locations cutting across different agro-climatic zones of north Karnataka were sampled including from plots where manures or other amendments were applied for a considerable time and a lone sample from Prabhunagar soil belongs to Vertic Haplustepts was included for comparison. The objective of the study to understand soil aggregation and the extent of self-mulching in Vertisols was studied.

Among the soils studied those from Devihosur, Bagalkot, Bheemarayanagudi showed high MWD (0.71-0.98 mm) and those from Dharwad, Haveri, Siruguppa, Belavatagi, Bidar and Raichur showed moderate MWD. Gangavati and Bijapur soils exhibited low MWD (0.28-0.47 mm). Among the soils studied those from Devihosur, Dharwad, Bagalkot, Bheemarayanagudi (FYM+RDF) and Haveri showed higher per cent stable aggregates > 0.25 mm and per cent aggregates stability compared to those from Bidar, Bheemarayanagudi (control) and FYM only),

Siruguppa, Belavatagi, Raichur and Prabhunagar exhibited medium content of aggregates > 0.25 mm and per cent aggregates stability. Bijapur had some what less proportion of stable aggregates and per cent aggregates stability and Gangavati was the least. Among the different indices there was good agreement between stable aggregates > 0.25 mm and per cent aggregates stability. However, MWD was bit inconsistent with these two. Therefore, per cent aggregates > 0.25 mm and per cent aggregates stability are better indices of soil aggregation than mean weight diameter.

Self-mulching property of the soils obtained a significantly positive correlation with clay content, organic carbon, exchangeable calcium and aggregation indices. According to the self-mulching index Dharwad, Bheemarayanagudi, Bagalkot soils can be classified as strongly self-mulching, those from Belavatagi, Siruguppa, Bidar, Bijapur, Devihosur soils as weakly self-mulching and the soils from Haveri, Raichur, Gangavati as non self-mulching.

Studies on Sulphur Nutrition of Onion and Garlic in Sulphur Deficient Soil of Ghataprabha Left Bank Command Area

N. SRINIDHI

2000

MAJOR ADVISOR : Dr. P. L. PATIL

An investigation on status of available sulphur in soils of Kittur Rani Channamma College of Horticulture (KRCCH), Arabhavi and studies on sulphur nutrition of onion and garlic in sulphur deficient soil was carried out in KRCCH, Arabhavi (Ghataprabha Left Bank Command Area) during kharif, 1998-99. Forty-nine soil samples from five blocks were collected for the present investigation. Two field experiments were laid out in randomised block design for onion and garlic separately which consists of five levels of sulphur (0, 20, 40, 60 and 80 kg S/ha) and were replicated four times.

Available sulphur content of about 46 per cent of the soils of KRCCH, Arabhavi were below 10 ppm and are considered to be deficient in available sulphur. Organic carbon content correlated (0.289*) positively and significantly with available sulphur.

Onion recorded maximum dry matter production of leaves and bulbs, bulb yield (33.78 t/ha) and total uptake of P at 40 kg S/ha. Highest N content of leaf and bulb, total uptake of N and K were obtained at 60 kg S/ha. Application of 80 kg S/ha registered highest TSS content (13.0%), S content of leaf and bulb, total uptake of S and residual available sulphur (27.53 kg/ha). Highest residual N was recorded at control.

Garlic obtained maximum dry matter production of leaves and bulbs, bulb yield (5.75 t/ha), N content and total uptake of K at 60 kg S/ha. Maximum total uptake of N and P was obtained at 40 kg S/ha. Application of 80 kg S/ha registered highest S content of leaf and bulb, total uptake of S and residual available S (29.46 kg/ha).

Abstract of Theses

AGRICULTURAL ENTOMOLOGY

Eco-Biology and Management of Fruit Sucking Moths

D. K. CHIKKARAJENDRA

2000

MAJOR ADVISOR : Dr. A. NAGANAGOUD

Studies undertaken at the College of Agriculture / Regional Research Station, Raichur (Karnataka, India) on fruit sucking moths (FSM) during 1999-2000 revealed an average damage of 33.10 and 15.37 per cent, respectively between August and November on sweet orange and pomegranate. The peak incidence occurred during second fortnight of October with a maximum number of immatures of *Othreis* spp. (157 immatures / 109 plants) during September month. 15 different FSM were recorded in the region, among them, *Othreis materna* (L.) and *Othreis fullonia* (Clerck) were the predominant primary piercers whereas, *Achaea janata* (L.) was the important secondary piercer.

Egg, larval and pupal period of *O. materna* averaged 2.6 ± 0.73 , 12.82 ± 0.73 days and 12.40 ± 0.48 days, respectively, while it was 3.48 ± 0.36 , 16.18 ± 0.76 and 12.40 ± 0.66 days respectively for *O. fullonia* on *Tinospora cordifolia* (Willd.). The larvae of both the species completed five instars and the full grown larva of *O. materna* and *O.*

fullonia measured an average length of 61.90 ± 1.1 mm and 66.40 ± 1.40 mm, respectively. Average pre-oviposition and oviposition period of *O. materna* was 5.75 ± 0.45 and 5.90 ± 1.30 days with a fecundity of 470 ± 64.03 eggs. While the pre-oviposition and oviposition period for *O. fullonia* was 4.70 ± 0.80 days, 3.40 ± 0.70 days with a fecundity of 565 ± 75.45 eggs.

Two larval parasitoids viz., *Euplectrus maternus* Bhatnagar (Hymenoptera : Eulophidae) and *Winthemia* sp. (Diptera : Tachinidae) were found to parasitize *O. materna* and *O. fullonia*. Average parasitism by *E. maternus* and *Winthemia* sp. was 13.23 and 47.90 per cent, respectively.

Among different management tactics evaluated against FSM, covering the fruits by polythene bags and covering of whole tree by nylon net (0.5 sq. cm. mesh) were equally effective in managing the pests, while spraying of neem based insecticides, monocrotophos and use of poison baits were found ineffective.

Bio-efficacy of Thiamethoxam as Seed Treatment and Foliar Spray Against Early Sucking Pests of Hybrid Cotton

A. R. PRASANNA

2000

MAJOR ADVISOR : Dr. M. BHEEMANNA

Studies on the bioefficacy of thiamethoxam as seed treatment and foliar spray for cotton early sucking pests were carried out at Regional Research Station, Raichur during 1999-2000. Results indicated that thiamethoxam at 10 kg/kg seed was effective at 15 and 20 days observation resulting in significant reduction in maggot population of serpentine leaf miner. The effect of thiamethoxam seed treatment revealed that the insecticide persisted upto 40 days both at 2.85 g and 4.28 g dosage levels against thrip and leafhoppers and 50 days at 10 g against leafhoppers and 55 and 60 days against aphids and whiteflies, respectively. The effect of thiamethoxam 25 WG foliar application indicated that thiamethoxam 25 WG at 25 g a.i./ha reduced both leafhoppers and thrips effectively and increased the seed cotton yield.

Under storage condition, non-significant difference was observed with respect to germination between treated and untreated seeds in a period of storage of four months.

The results on the efficacy of treated seeds of various storage periods revealed that the insecticide persisted for 40 days against leafhoppers, thrips and aphids, 30 days against whiteflies irrespective of dosages and storage periods, respectively.

There was no significant adverse effect of thiamethoxam 25 WG spray on development of *Trichoderma chilonis* and *Chrysoperla carnea*. But, there was a significant adverse effect on adult longevity of *Chrysoperla* at all the dosages tested. The results from the laboratory experiment revealed that thiamethoxam was having lesser effect on *Trichoderma*. Hence, it is possible that *Trichoderma* can be used along with thiamethoxam as seed treatment in integrated pest management.

There was a significant increase in plant height, number of leaves and fruiting bodies in thiamethoxam seed treatment and no reduction in germination and no phytotoxic effects were observed on cotton at various dosage levels.

Evaluation of Different NPV Formulations and Bioagents in the Management of *Helicoverpa armigera* (Hubner) on Sunflower

SIREESHA KUKKAPALLI,

2000

MAJOR ADVISOR : Dr. K. A. KULKARNI

Investigations on testing the efficacy of NPV purified through ordinary and deep freeze centrifuge, development and evaluation of different NPV formulations and evaluation of different bioagents under field conditions against *Helicoverpa armigera* on sunflower have revealed the following.

There was no significant effect on recovery and virulence of POB's with the increase in centrifugation speed from 2000 rpm to 10000 rpm though temperature was increased upto 38.50°C at 10000 rpm in ordinary centrifuge. Rise in temperature from -5°C to 25°C also did not have effect on recovery and virulence of POB's as the temperature was below critical temperature. Flyash based dust formulation was found to be more effective though all other three dust formulations (Chalk powder, talc and lignite)

were found significantly less effective compared to aqueous formulation. Starch based WP formulation was found to be more effective followed by bentonite and talc. Neem oil based formulation was significantly more effective compared to aqueous formulation and pundi oil based on formulation was on par with the latter.

Based on the per cent reduction in larval population overall per cent head damage and yield among the different bioagents tested NPV @ 250 LE per ha was found to be significantly more effective which was at par with the NSKE five per cent followed by *Nomuraea rileyi* (1 kg/ha), *Bacillus thuringiensis* (1 kg/ha) and *Beauveria bassiana* (1 kg/ha). However, two sprays of endosulfan (2 ml/l) at 15 days interval was found significantly more effective compared to all the bioagents.

Bioecology and Management of Spiraling Whitefly, *Aleurodicus dispersus* Russel by *Verticillium lecanii* (Zimm.) on Guava

MANJUNATH C. MALLAPPANAVAR

2000

MAJOR ADVISOR : Dr. B. S. NANDIHALLI

Studies on bioecology and management of spiraling whitefly, *Aleurodicus dispersus* Russell by *Verticillium lecanii* (Zimm.) on guava revealed that egg period ranged from 5.6 - 12.30 days. There were four nymphal instars which took 4.66 - 6.49; 3.34 - 5.58; 5.84-8.85 and 7.67-9.13 days, respectively in different seasons. Fecundity ranged from 51.8-64 eggs per female.

Studies on biology of *A. dispersus* on three different host plants guava *Acalypha* and brinjal indicated that the duration of all the stages was shorter on brinjal; intermediate on *Acalypha* and comparatively longer on guava. The main key mortality factors (sterility, predation and rainfall) were found to affect the immobile nymphal stages during both the seasons.

The seasonal occurrence of the pest revealed that spiraling whitefly populations was found throughout the year but populations were considerably low from last week of

June to third week of September, 1999 with relatively higher populations from fourth week of September to first week of June, 2000 and attaining its peak during second and third week of April. The incidence of all three stages of *A. dispersus* both on guava and *Acalypha* had positive and significant relationship with maximum temperature and significant and negative relationship with morning and afternoon relative humidity and rainfall.

During the present investigation 102 host plants belonging to 46 families were recorded, out of which 57 were new host records from Karnataka. Among the biopesticidal treatments, higher concentration of *Verticillium lecanii* @ 1.33×10^7 and Verticel @ 7.5 g per l were found to be most effective against the pest 7, 15 and 21 DAS. Nymphs and eggs were found to be more susceptible to these treatments than adults. However, triazophos 40 EC @ 2 ml per l was found effective in controlling the pest throughout the observation period.

Abstract of Theses

Population Dynamics and Management of Defoliator Pests of Cabbage

B. DHAN RAJ

2000

MAJOR ADVISOR : Dr. R. S. GIRADDI

Seasonal abundance studies indicated that maximum population (24.18 larvae/plant) of diamondback moth (DBM), *Plutella xylostella* (L.) was noticed during third week of January in rabi season and it was lowest (0.13 larvae/plant) during third week of April to first week of May in summer season. Minimum population (0.15) of tobacco caterpillar, *Spodoptera litura* Fab. was noticed during third week of November and attained peak (12.05) in the same season (rabi) between first week to third week of January. Whereas the peak population (6.95) of cabbage leaf webber, *Crocidolomia binotalis* Zell. was observed in first week of September in kharif and lowest population (0.45) was observed in first week of May in summer season. While, maximum population (10.69) of cabbage head borer, *Heliothis undalis* (Fab.) was noticed during third week of April in summer season and lowest population (0.01) was observed during first week of August in kharif.

Among the new insecticides tested in field, spinosad

@ 0.048%, fipronil @ 0.005%, lufenuron @ 0.005% Novaluron @ 0.01%, flufenoxuron @ 0.01% and thiodicarb @ 0.15% in that order proved significantly superior in reducing the larvae of *P. xylostella*, *S. litura*, *C. binotalis* throughout the crop period. However, lufenuron, novaluron, spinosad, flufenoxuron and carbosulfan @ 0.025% proved superior in that order against cabbage head borer.

With respect to ovicidal toxicity all the tested new chemicals except fipronil exhibited good ovicidal action against 0-24, 24-48 and 48-72 hrs old eggs of *P. xylostella*, *S. litura*, *C. binotalis* and *H. undalis*.

Of the models of IPM evaluated, adoptable module with mustard trap crop was found to be the best in reducing the pest load on cabbage crop, increasing the yield tremendously compared to bio-intensive module and RPP. Mustard plants effectively trapped *P. xylostella*, *C. binotalis* and *H. undalis* population. This module also recorded higher benefit cost ratio of 4.17 over RPP.

Residual Toxicity of Insecticides, Oils and Surfactants Against Spiralling Whitefly, *Aleurodicus dispersus* Russell

D. N. KAMBREKAR

2000

MAJOR ADVISOR : Dr. J. S. AWAKNAVAR

Investigations were carried out on the different developmental stages of spiralling whitefly, *Aleurodicus dispersus* on the toxicity and bio-efficacy of fifteen insecticides, seven oils and four surfactants and their combinations in the greenhouse and under field conditions.

Triazophos (0.06%) and dimethoate (0.05%) have shown excellent performance both under laboratory and field conditions and proved to be ovicidal, ovipositional deterrent and effective against the most resistant pupal stage of the pest and recorded an adult mortality of 75 per cent at 15 DAT in laboratory conditions and 90 per cent egg mortality and around cent per cent mortality of other stages under field conditions. Dichlorvos (0.105%) and monocrotophos (0.045%) were the next best chemicals against different stages of the pest.

Among the seven oils used with four surfactants, fish oil insecticidal soap at 2.50 per cent proved to be better

which persisted for a longer time and recorded 60 per cent adult mortality at 15 DAT laboratory conditions. The next best oils were neem oil (1%) and cotton seed oil (1.0%). Under field condition also fish oil insecticidal soap was effective recording around 70, 60, 55 and 80 per cent reduction of egg masses, nymphs, pupae and adults, respectively at the end of 15 DAS. Among the plant products neem oil proved better registering around 65, 55, 40 and 75 per cent reduction in egg masses, nymphs, pupae and adults, respectively at 15 DAS.

The combination of promising insecticides with oils at their half dose was excellent in triazophos or dimethoate combination with FOIS as compared to triazophos and dimethoate alone under laboratory conditions. But triazophos and dimethoate recorded higher reduction of the pest population as compared to their combination with oils under field conditions. Further, the insecticides were found to be cheaper as compared to the oils.

Bio-ecology and Management of Sorghum Earhead Caterpillars with Special Reference to *Cryptoblabes gnidiella* (Miller)

S. B. KONGAWAD

2000

MAJOR ADVISOR : Dr. V. P. DESHPANDE

Investigations on biology of *Cryptoblabes gnidiella*, seasonal incidence and management of sorghum earhead caterpillars was undertaken at Main Research Station, University of Agricultural Sciences, Dharwad during 1999-2000.

The incidence of sorghum earhead caterpillars (*Cryptoblabes gnidiella*, *Helicoverpa armigera*, *Euproctis subnotata* and *Stenachroia elongella*) was confined to kharif season. The peak incidence of *C. gnidiella* (1.75 larvae / earhead) and *E. subnotata* (1.68 larvae / earhead) was observed during III week of October and that of *H. armigera* (1.90 larvae/earhead) during I week of October on the crop sowing during second fortnight of June.

During the season the incubation, larval, pre-pupal and pupal periods of *C. gnidiella* occupied 3.72, 13.02, 1.60 and 8.0 days, respectively. Larvae moulted four times to complete five instars. Adult longevity with food took 7.8 and 9.0 days and without food 2.5 and 3.52 days for male and female, respectively. The fecundity rate during season

was 26.88 eggs/female. The total life cycle occupied 27.60 days.

Among four botanicals and three bioagents tested against earhead caterpillars, TNAU neem oil 60 EC (3.0%), neem oil (5.0%) and NSKE (5.0%) emerged as superior by recording 72.0, 70.0 and 66.0 per cent population reduction producing a grain yield of 46.98, 46.0 and 45.50 q/ha, respectively. *Bacillus thuringiensis* and *Vitex negundo* leaf extract (5.0%) being on par with each other recorded 59.0 per cent population reduction resulting in 43.0 and 43.25 q/ha grain yields, respectively.

Among the dusts tested, malathion (5.0%) emerged as superior in reducing (84.0%) population of earhead caterpillars with the grain yield of 52.35 q/ha followed by fenval (76.0%) and lindane (72.0%) with a grain yields of 51.40 and 50.00 q/ha, respectively. The botanicals viz., neem seed kernal, *Pongamia pinnata*, *Vitex negundo* and *Clerodendron inerme* leaf dusts recorded 58.0, 58.0, 55.0 and 52.0 per cent population reduction with the grain yields of 45.75, 13.75, 12.50, 12.12 q/ha, respectively.

Evaluation of Plant Products for the Management of Diamondback Moth, *Plutella xylostella* Linnaeus on Cabbage

ROOPA S. PATIL

2000

MAJOR ADVISOR : Dr. K. BASAVANA GOUD

Investigations were undertaken to evaluate the multifarious effect of ten indigenous plant products and two commercial plant products (Honge oil and neemmark) against diamondback moth (DBM), *Plutella xylostella* Linnaeus.

Under laboratory conditions, aqueous extract of *Azadirachta indica* (7.5%) recorded maximum egg hatch inhibition of 60.02 per cent and also showed highest ovipositional repellent property with 75.00 and 83.55 per cent reduction in egg laying under no choice and free choice conditions, respectively at 24 h. Similarly, in methanolic extracts also *A. indica* (0.5%) exhibited highest ovicidal activity with 47.91 per cent egg mortality and recorded maximum reduction in egg laying of 50.33 and 62.43 per cent at 24 h under no choice and free choice conditions, respectively.

Aqueous extract of *A. indica* (7.5%) caused highest larval mortality of 76.67 per cent followed by honge oil (0.4%) with 66.67 per cent mortality at 72 h. A maximum of 46.67 per cent larval mortality was observed with methanolic

extract of *A. indica* (0.5%) at 72 h. Among aqueous extracts, both 7.5 and 5.0 per cent concentrations of *A. indica* showed highest antifeedant property with 3.92 and 5.68 per cent leaf feeding at 24 h, similar with the case of methanolic extract (6.32% leaf feeding) also.

Three promising plant products viz., *A. indica* (7.5%), honge oil (0.4%) and *Acorus calamus* (7.5%) based on their laboratory performance were selected and evaluated along with new chemicals (Carina and Rocket) against DBM on cabbage under field conditions. Four applications of *A. indica* was equally effective as that of new chemicals by recording cent per cent reduction in larval population over control after three days of fourth spray. It recorded a yield of 31.86 t per ha, being next to the new chemicals tested. Malathion (0.1%), a recommended insecticide failed to protect the crop with lowest reduction (54.03%) in larval population and also recorded lowest yield (16.70 t/ha). The highest B:C ratio of 50.96 was noticed in honge oil followed by *A. calamus* (35.05).

Abstract of Theses

Evaluation of Different Species of *Trichogramma* on Chilli Fruit Borer, *Helicoverpa armigera* (Hubner)

CHANDRASHEKHAR KEDANURI

2000

MAJOR ADVISOR : Dr. K. A. KULKARNI

Experiments were conducted to find out the parasitization by five *Trichogramma* spp on chilli fruit borer, *Helicoverpa armigera* (Hubner) in laboratory and greenhouse conditions. Along with some basic studies on the effect of food fecundity of the parasitoids, life cycle, host age preference were also carried out in addition to tritrophic interaction among chilli genotypes, *T. chilonis* and *H. armigera* and relative toxicity of recommended insecticides to chilli fruit borer against egg parasitoid.

Fecundity of the parasitoids developed on *H. armigera* eggs was found significantly different among different parasitoids, *T. chilonis* recorded high fecundity with food (10% honey) and without food. While, *T. japonicum* and *T. achaeae* recorded low fecundity / female with and without food respectively. Life cycle of the parasitoid was longest in *T. achaeae* (217.6 h) while *T. chilonis* took least period (191.2 h) on *H. armigera*. Fresh to two days old eggs of *H. armigera* were equally acceptable by all the five parasitoids while three to four days old eggs were less to least preferred.

Maximum per cent parasitization of chilli fruit borer under laboratory and greenhouse conditions was accounted by *T. chilonis* (61 & 39.93%) followed by *T. pretiosum* (51.52 & 31.08) and *T. brasiliensis* (44.25 & 28.50%), respectively. Byadgi Kaddi and Byadgi dabbi were found biocontrol friendly which recorded high parasitization while LCA-312 and GPC-82 were found least acceptable to parasitoid *T. chilonis* on *H. armigera* eggs.

The insecticides dimethoate, phosphomidon, phosalone and carbaryl were highly toxic to *T. chilonis* adults on 24 h after treatment where as dicofol, monocrotophos and endosulfan were slightly less toxic while neemmark was safe to adults.

Neemark was found to be safe while endosulfan and dicofol were relatively less toxic to immature stages of *T. chilonis* while carbaryl was the most toxic. Emergence of *T. chilonis* adults was significantly reduced when insecticides were sprayed on host eggs before parasitization. Longevity of *T. chilonis* adults that emerged from insecticide treated host eggs were found to be adversely affected.

Studies on Population Dynamics and Management of Mango Leafhoppers

H. M. GIRISH KUMAR

2000

MAJOR ADVISOR : Dr. R. S. GIRADDI

Studies on the population dynamics of mango leafhoppers conducted at Dharwad revealed the occurrence of three species of leafhoppers namely *Amritodus atkinsoni* (Leth.), *Idioscopus nitidulus* (Leth.) and *Idioscopus clypealis* (Leth.) throughout the year. The order of dominance was *A. atkinsoni* > *I. nitidulus* > *I. clypealis*. *A. atkinsoni* & *I. nitidulus* were the major species comprising 41.02 per cent and 40.18 per cent, respectively. The population of both *A. atkinsoni* and *I. nitidulus* shot up during November - December and maintained the peak activity upto March. On the contrary, *I. clypealis* remained at low density upto March. On the contrary, *I. clypealis* remained at low density upto December first fortnight, there onwards increasing trend was seen upto January, later decline in population was noticed from January second fortnight. However, the population again shot up from February second fortnight to March second fortnight. Among the three species *I. clypealis* had significant positive correlation with maximum temperature ($r=0.532$). Population of all the three species as well as total leafhopper numbers was negatively and significantly correlated to morning, afternoon and mean relative humidity.

Dead leafhoppers due to incidence of *Verticillium lecanii* (Zimm.) Viegas were found attached to plant axils and also on the undersurface of leaves. The natural incidence varied from zero (2nd fortnight of November) to 5.79 per cent (2nd fortnight of October). Incidence of *V. lecanii* and morning afternoon and mean relative humidity were positively and significantly correlated. Field collected live leafhoppers carried infection by the entomopathogens, namely *V. lecanii* and *Beauveria bassiana* (Bals.) Vuill which has indicated by their development in PDA medium in the laboratory.

Lambda cyhalothrin (0.5 ml/litre) and imidacloprid (0.25 ml/litre) were the most effective chemicals in reducing the population of the leafhoppers. Cypermethrin, profenofos, monocrotophos and acephate were the next follow, whereas fipronil and endosulfan were the least effective treatments.

Among the sequential sprays tried, sprays of Verticel followed with monocrotophos appeared to be promising in terms of reducing the pesticide load in the environment.

AGRICULTURAL MICROBIOLOGY

Beneficial Rhizosphere Microflora of Black Pepper (*Piper nigrum* L.) and Their Role in Growth of the Plant

K. RANJITHA

2000

MAJOR ADVISOR : Dr. J.H. KULKARNI

Investigations were carried out on the native population of beneficial microorganisms in the rhizosphere of black pepper and inoculation effect of selected isolates on the rooting and growth of the plant in nursery. The rhizosphere samples were collected from Sirsi and Coorg regions in Karnataka and Kasargod district in Kerala.

The study revealed a higher population of free living nitrogen fixers in rhizosphere soil. *Azospirillum* in endorhizosphere and percent root colonization (PRC) of vesicular arbuscular mycorrhiza (VAM) in samples collected from Coorg and Sirsi regions. But, the average number of phosphate solubilizers maintained the same level in all the major locations. Correlation studies revealed a significant association of soil organic carbon with population of *Azospirillum* in the endorhizosphere. PRC of VAM and the free living nitrogen fixers in soil. The available nitrogen positively correlated with PRC of VAM. The significant correlation of

Azospirillum with phosphate solubilizers confirmed the synergism among these microorganisms.

Thirty eight isolates of *Azospirillum* and 31 isolates of phosphate solubilizers were obtained in this study. The nitrogen fixation efficiency of *Azospirillum* isolates ranged from 9.4 to 23.7 mg N₂/g malate used and the phosphate solubilizing efficiency of the phosphate solubilizers varied from a Pi release of 8.1 to 19.1 mg/100ml Pikovskaya's broth. *In vitro* screening of the isolates for phytohormone synthesis indicated the varying efficiency among the isolates and a few *Azospirillum* isolates as superior ones.

Inoculation of pepper cuttings with *Azospirillum* cultures prior to planting resulted in an improved rooting percentage and better root growth compared to control. Single and dual inoculation of *Azospirillum* and phosphate solubilizing bacteria improved the vigour and nutrient status of the black pepper plants. The *Azospirillum* strains AZBR 9 and the phosphate solubilizer BRPS 16 was found to be superior *in vivo*.

Mineral Phosphate Solubilization by Fluorescent Pseudomonads

R DEEPA

2000

MAJOR ADVISOR : Dr. A.R. ALAGAWADI

Attempts were made to study the mechanism of Mineral Phosphate Solubilization by fluorescent pseudomonads by comparing the MPS and related biochemical activities amongst the MPS wild types, MPS⁻ wild types and their derived mutants. Out of 68 strains, 22 were efficient P-solubilizers. The amount of Pi released in broth ranged from 6.89% to 24.02% by these strains. The predominant organic acid produced by these strains was gluconic acid indicating the presence of direct oxidation pathway. A complete repression of MPS activity was noticed in the strains in the presence of 75 mM K₂HPO₄ or 60 mM tris. Studies on temporal release of Pi in the medium showed a linear increase in Pi with advancement of incubation period in two strains. Three other strains showed a rapid increase in Pi release up to four days and then a decrease up to seven days with further increase up to 10 days.

Out of the five most efficient strains examined for

growth promotional activity FP 94 showed maximum increase in growth and P-uptake of tomato plants. Fourteen mutants defective in MPS activity were obtained by random mutagenesis of FP 94 using nitrosoguanidine and transposon Tn5. All the MPS defective mutants showed lower Pi release in the broth than their parents. No differences were observed in the organic acid profile of wild type and their mutants. The mutants had reduced ability to promote growth and Pi uptake than wild type.

Analysis of the strains showed that in the event of phosphate stress organic acids are formed, that provide H⁺ ions and get co-transported with H₂PO₄ and HPO₄²⁻. The H⁺ ions released increase the acidity and enhance solubilization of insoluble phosphates. Presence of ammonium ions further increased the acidity. Thus, the genes are expressed in a coordinated manner according to cellular requirement based on P starvation of availability.

Abstract of Theses

Influence of Different Levels of VA Mycorrhizal Inoculum on Growth and Yield of Onion (*Allium cepa* L.)

IRANNA D. HULKOTI

2000

MAJOR ADVISOR : Dr. M.N. SREENIVASA

A pot experiment was carried out to find out the minimum number of infective propagules (IP) required for initiating VA mycorrhizal colonization and the study the influence of different levels of *Acaulospora laevis* and *Gigaspora margarita* inoculated to onion cv. Bellary red and N-53 respectively, ranging from 0 to 100 g/10 kg unsterile black clay soil on sporulation, per cent root colonization, population of P-solubilizers, free living N_2 fixers, growth and yield parameters.

The results of this experiment revealed that, the minimum number of I.P. per g inoculum to initiate root colonization was 0.19 I.P. per g of *G. margarita* in onion cv. N-53 and 1.8 I.P. per g of *A. laevis* in onion cv. Bellary red. If the number of infective propagules per g was less than the above figures, no colonization occurred.

All microbiological parameters were found better with

inoculation of efficient VA mycorrhizal inoculum in both the cultivars, as compared to uninoculated control plants. The spore count, per cent root colonization, population of p-solubilizers and free living N_2 fixers increased significantly with the increase in the level of inoculum upto 50 g per 10 kg soil and the age of the host, except spore count which increased significantly beyond 50 g also. But all these parameters increased up to 80 days after transplantation (DAT) in both the onion cultivars and decreased at 120 DAT.

The alkaline phosphatase and dehydrogenase activity, shoot P concentration, plant height, plant dry weight, mycorrhizal inoculation effect, quality and yield parameters increased significantly with the increase in the level of inoculum upto 50 g per 10 kg soil and the age of the host, beyond which further increases in these parameters were found to be non significant in both the cultivars.

CROP PHYSIOLOGY

Characterisation of Morpho - Physiological Traits for Higher Productivity in rabi Sorghum

SANJAYKUMAR N. SHIVALLI

2000

MAJOR ADVISOR : Dr. V.P. CHIMMAD

A field experiment was conducted during rabi, 1999-2000 at Main Research Station, University of Agricultural Sciences, Dharwad to assess promising rabi sorghum germplasm materials for useful morpho-physiological and biophysical traits and also to find out the potential donors with drought tolerant traits.

The genotypes differed significantly with respect to various morphological characters. Genotypes, M-35-1 took the maximum number of days from 50 per cent flowering to maturity and recorded higher grain yield. Among the genotypes, maximum LAI was recorded in IS-9244 at both 50 per cent flowering and dough stage. However, the genotypes, CR-6 and RSP-3 recorded maximum SLW at 50 per cent flowering and dough stage, respectively.

The genotypes, IS-9244, NR-35, RS-29 and DSH-4

recorded the maximum leaf, stem, panicle and total dry matter content and these genotypes also yielded higher.

Among the genotypes, RS-29 and M-35-1 recorded not only higher chlorophyll-a and total chlorophyll content in leaf at both 50 per cent flowering and dough stage but also recorded higher grain yield. Maintenance of high relative water content (RWC) in genotypes RS-652, NR-35 and NR-39 also indicates the drought tolerant character. The genotype DSH-4 recorded maximum number of veins which also had maximum grain yield.

Significant differences among the genotypes with respect to yield and yield components were observed. The genotypes, M-35-1, CR-9, NR-35, PBS-2 and RS-29 recorded the maximum grain yield with few drought tolerant characters. However, RSP-3 and M-35-1 recorded the maximum harvest index.

Morpho-Physiological Indices for Higher Productivity in Barnyard Millet (*Echinochloa frumentacea* L.)

RAGHAVENDRA

2000

MAJOR ADVISOR : Dr. M.B. CHETTI

A field experiment was conducted at College of Agriculture, University of Agricultural Sciences, Dharwad during kharif 1999 to determine the morpho-physiological indices for higher productivity in barnyard millet. It was also aimed to elicit information on variations with respect to morphological, physiological, biochemical and biophysical parameters among barnyard millet genotypes and their relationship with productivity to designate ideal plant type characters for getting higher productivity. The experiment consisted of twenty genotypes laid out in randomized block design with three replications on medium black soil under rainfed condition.

The genotypes differed significantly with respect to various morphological characters with the genotypes TNAU-86 and VL-174 having more number of green leaves, tiller number, leaf area, leaf dry weight, stem dry weight and better partitioning of dry matter into reproductive parts and these genotypes also had higher grain yield. The growth

parameters LAI, LAD, CGR, RGR and BMD were found to be positively correlated with grain yield. Among the genotypes, RAU-11 and VL-174 had better LAI and LAD at 90 DAS and these genotypes also yielded more and thus indicated the importance of these growth parameters.

The high yielding genotypes also possessed higher nitrate reductase activity, total chlorophyll and protein contents. Interveinal distance and veinload frequency differed significantly among the genotypes. Maximum number of veins and minimum IVD was observed in VL-172, S-841 and PRB-9404 which also had higher grain yield. It was also observed that grain yield had positive association with total dry matter, grain number per ear, harvest index, 1000-grain weight, biomass duration and nitrate reductase activity. Results thus revealed that for getting higher productivity in barnyard millet, the traits which were found to have significant positive correlation with yield can be incorporated successfully in breeding for ideal plant type.

Physiological Basis of Yield Variation in Onion (*Allium cepa* L.) Genotypes

DEEPA O. SARANGAMATH

2000

MAJOR ADVISOR : Dr. S.M. HIREMATH

A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad during kharif 1999 to assess the physiological basis of yield variation on onion genotypes. The experiment consisted of eight genotypes and was laid out in randomized block design with three replications.

Results revealed that the morpho-physiological traits viz., plant height and number of leaves increased upto 80 DAS and decreased thereafter. The high yielding genotypes Arka Pragathi and N-53 recorded significantly higher values for these traits and their parameters also showed significant positive association with bulb yield. The genotypes Arka Pragathi, S.M. Yellow and N-53 recorded significantly higher neck length.

The leaf dry weight increased upto 80 DAS and decreased thereafter, while, bulb dry weight and total dry weight increased upto 120 DAS and these parameters were found significantly more in Arka Pragathi and N-53. The data

on AGR, RGR, CGR, NAR and BMD indicated that, these growth parameters differed significantly among the onion genotypes. High yielding genotypes maintained significantly higher values for LAI, LAD, AGR, RGR, CGR, BMD and SLW while, SLA and LAR showed significantly lower values. Arka Pragathi and N-53 also possessed significantly higher number of stomata. The high yielding genotypes Arka Pragathi and N-53 maintained significantly higher values for total chlorophyll content and nitrate reductase activity.

The bulb yield was significantly more in Arka Pragathi, N-53 and White Marglobe. High yielding genotypes had higher values for bulb length and bulb diameter. The correlation studies indicated that bulb yield had a significant positive correlation with plant height, number of leaves, leaf dry weight, TDM, LAI, LAD, CGR, BMD, SLW, bulb length and bulb diameter. It is concluded that, the genotypes Arka Pragathi, N-53 and White Marglobe are physiologically efficient and are well suited for the transitional tract of Karnataka.

Abstract of Theses

Influence of Peg Induced Stress on Germination, Growth and Physiology in Soybean (*Glycine max* L.) Genotypes

SAVITA F. HULLUR

2000

MAJOR ADVISOR : Dr. R.V. KOTI

A laboratory experiment was conducted in the Department of Crop Physiology, College of Agriculture, University of Agricultural Sciences, Dharwad during 1999-2000 to study the influence of different levels of moisture stress (0, -3, -5, -7.5 and -10 bars induced by PEG) on germination and seedling growth in twenty soybean genotypes and also to understand the nature of stress tolerance at early seedling stage based on seed characters, physiological and biochemical parameters.

The germination per cent decreased as the level of moisture stress increased. Most of the genotypes maintained relatively higher germination per cent (<70) at moderate stress level (-5 bars) and maximum reduction in germination per cent (91.6) occurred at very high level of stress (-10 bars). Increase in the levels of moisture stress resulted in decreased seedling vigour index, mean daily germination, fresh weight and dry weight of the seedlings, whereas the root : shoot ratio increased. The genotypes differed significantly for all the characters at all the levels of stress.

Similarly, the increased levels of stress also significantly decreased the α -amylase activity, electrical conductivity and soluble protein content, whereas, the free proline content and dehydrogenase activity increased significantly. However, the genotype RAUS-9702 recorded higher germination per cent at higher levels of stress (-10 bars) and this genotype also had high seed coat thickness and free proline content as compared to other genotypes. The germination per cent was positively correlated with seedling vigour index, mean daily germination, fresh weight of the seedlings and free proline accumulation during stress.

The genotypes RAUS-9702 followed by MACS-716, Monetta, MACS-567 and JS(SH) 93-37 had higher germination per cent at very high levels of stress (-10 bars). The other characters, viz., seedling vigour index, mean daily germination, fresh weight, root : shoot ratio and proline accumulation were also found to be higher in these genotypes and hence these genotypes can be considered as stress tolerant.

Effect of Sowing Dates, Growth Regulators and Nutrients on Physiological Changes in Soybean (*Glycine max* L. Merrill)

SHIVANAND G. PATIL

2000

MAJOR ADVISOR : Dr. R.V. KOTI

A field experiment was conducted during kharif, 1999 to know the physiological basis for yield reduction due to late sowing and also to improve the yield potential in soybean by using growth regulators and nutrients at Agricultural College Farm, University of Agricultural Sciences, Dharwad. The genotype JS-335 was sown on 24th June (First), 10th July (Second) and 24th July (Third) and five treatments of foliar application of GA₃ (25 ppm), CK (10 ppm), Miraculan (500 ppm), DAP (2%) and control (water spray) were imposed at 30 DAS. The experiment consisted of 15 treatment combinations laid out following the factorial randomised block design with three replications.

Results indicated that morphological, physiological, biochemical parameters and yield and yield components differed significantly due to dates of sowing and treatments.

All the physiological parameters had higher values during first two dates of sowing with higher yield compared to third date of sowing. There was 32.7 per cent yield reduction in the third date of sowing (24th July) as compared to first (24th June) and second dates of sowing (10th July). Among different treatments, foliar application of GA₃ (25 ppm) significantly increased the number of pods, 100-seed weight and seed yield and it was closely followed by DAP (2%).

It is inferred that the sowing of soybean could be taken safely between 24th June to 10th July without much detrimental effect on seed yield due to favourable environmental conditions for the complete expression of crop growth and it was also found that the foliar application of GA₃ (25 ppm) improved the crop growth and yield at all the dates of sowing, which was closely followed by the foliar application of DAP (92%).