Agricultural Entomology

University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Agricultural Entomology

1. **Survey, Feeding Preference of Lesser Grain Borer *Rhyzopertha dominica* (Fab.) and Maize Weevil *Sitophilus zeamais* (Motsch.) and their Management on Stored Maize**

(NARAYANA SWAMY K. C)

ABSTRACT

Investigation was carried out during 2016-2018 at the department of Agricultural Entomology, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga on lesser grain borer *Rhyzopertha dominica* and maize weevil *Sitophilus zeamaisin* stored maize. Survey revealed that among the three districts selected in Karnataka, the highest number of stored insect pests were recorded in Shivamogga district as compared to rest of districts and lowest number of pests were recorded in Chitradurga district. Various storage insect pests were noticed in three disricts. Among different storage insect pests the *Sitophilus oryzae* was most dominant, whereas *Trogoderma granareum* was least dominant in all the above three districts. Evalution of different storage containers revealed that maize seeds stored in polythene bags of 700 gauge was found to be most effective in reducing seed damage and number of adult survival without affecting the moisture content and seed weight loss by *R. dominicaand S. zeamaisupto* 120 days after treatment followed by plastic containers and glass bottles. Based on different biological parameters the maize hybrids Hema and CP818 proved tolerant against both *R. Dominica* and *S. zeamais*. The hybrids RMH-462, Nithyashree and NK6607 were more susceptible based on oviposition period, fecundity and developmental period. Evaluation botonicals and animal origion bioproducts revealed that application of Acarus calamus rhizome powder @ 2 per cent were found to be most effective against both *R. dominica* and *S. zeamais* even 180 days after storage followed by *Annona squamosa* @ 2 per cent and cow dung ash powder @ 2 per cent and maintained seed quality parameters above minimum seed certification standards.

June, 2019

(Hanumanthaswamy, B. C.)
Major Advisor

2. Molecular Characterization of Green Peach Aphid, *Myzus persicae* (Sulz.) and its Transmission Efficiency of Potato Viruses

(KAVITA HEGDE)

ABSTRACT

The present investigation on molecular characterization of Myzuspersicae and their endosymbionts was carried out during 2017-2019. At the same time, the transmission efficiency of two major potato viruses ie., PVY and PLRV and colony developmental behaviour on potato varieties was studied. Efforts were also made in field condition to understand the influence of primary infection of viruses in seed tubers and its effect on secondary spread of PVY. All the 124 M. persicae populations collected from various geographical regions in Deccan Plateau of India on diverse host plants exhibited 95 per cent nucleotide similarity with M. persicae. The phylogenetic analysis formed eight different clusters separately suggesting the host associated genetic differences within M. persicae population in Deccan Plateau of India. A primary bacterial endosymbiont, Buchneraaphidicolawas successfully detected by 16S rRNA gene sequence analysis in all the populations collected. Transmission efficiency analysis of five geographically separate M. persicae clones showed the efficient transmission of PVY and PLRVbut at different rate. Hassan clone and Chickmagalur clone were efficient transmitters of PVY and PLRV, respectively than Belgaum, Chikkaballapura and Dharwad clones. Among the three antibiotics (tetracycline, rifampicin and ampicillin trihydrate), tetracycline @ 50 µg/ml was most efficient in reducing the transmission efficiency of PLRV. Colony development behaviour results showed that KufriJyothi and FC 3 varieties were more preferred by adults and nymphs of M. persicae than FL 1533. Aphids were found preferring mixed infected plants (PVY + PLRV), than healthy and single infection of PVY and PLRV. When 100 per cent healthy tubers of KufriJyothi were used for sowing, the virus incidence was significantly low (21.67%) and recorded the maximum average plant height (54.24 cm), number of stems per plant (4.83), number of tubers per plant (5.79) and yield per plant (374.23 g) in Kharif 2018. The similar trend was recorded in Rabi 2018-19. Among the different insecticides evaluated, thiamethoxam 25 WG @ 0.5g/l was found to be superior with the maximum yield (20.38 t/ha, 20.79 t/ha and 20.58 t/ha) and cost: benefit ratio (1:4.32, 1:5.20 and 1:4.56) in Rabi 2017-18, Kharif 2018 and pooled as well, respectively.

October, 2019

(Kalleshwaraswamy, C. M.)
Major Advisor

3. Bio-ecology and Evaluation of Different Management Modules against Spider Mite, Tetranychus macfarlanei Baker and Pritchard (Acari: Tetranychidae) on Cucumber

(LATHA M)

ABSTRACT

Investigations were carried out on bio-ecology and evaluation of different management modules against spider mite, Tetranychus macfarlanei on cucumber between 2016 and 2018 at College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga. The survey revealed that incidence of spider mite was observed in all the places. Tetranychus macfarlanei Baker and Pritchard was the most common species found in Shivamogga district. The highest mean population (19.14±2.1 mites/sq. inch) of spider mites recorded in Shivamogga taluk followed by Honnali taluk of Davangere district (12.31±1.1mites per sq. inch).Among eleven places; higher mean mite population was seen in Polyhouse condition. Correlation studies revealed that maximum temperature, predatory mite and predatory coccinellids showed highly significant positive correlation. The total life period occupied by T. Macfarlanei varied from 21.60 to 27.46 days with an average of 24.90±1.98 days in male and 29.13 to 32.87 days with an average of 31.40±0.98 days in female. The innate capacity of increase (rm) and finite rate of increase (λ) of T. Macfarlanei reached maximal values (0.123 and 1.131) at 32ºC. The mean generation time (T) and doubling time (DT) were shortest (12.31 and 2.43) at 32ºC. All the life stages of predatory mite preferred eggs followed by larval instars and least were on adults and duetonymphal stages of spider mite. Among the four modules evaluated against spider mite in cucumber grown under polyhouse condition during Kharif and summer season, lowest mean mite population was recorded in M1-Chemical intensive module (4.30 mites per sq. inch) in Kharif and M2-IPM module (5.37 mites per sq. inch) in summer season. Highest B: C ratio (3.63 and 4.34) was obtained with M2-IPM module and offered highest yield (33.12 and 30.04 t ha-1) in Kharif and summer crop.

December, 2019

(M. Manjunatha)
Major Advisor

Genetics and Plant Breeding

University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Genetics and Plant Breeding

1. Studies on heterosis for fruit yield, quality and Yellow Vein Mosaic Virus resistance in Okra (Abelmoschus esculentus L.Moench.)

SHASHIKALA S KOLAKAR

ABSTRACT

The present investigation on screening, heterosis and combining ability for fruit yield, quality and resistance to Yellow Vein Mosaic Virus (YVMV) in Okra [*Abelmoschus esculentus* (L.) Moench] was carried out during summer and kharif seasons of 2016 and summer season of 2017 at Zonal Agricultural and Horticultural Research Station, Brahmavar and Department of Genetics and Plant Breeding, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga respectively.

The results of the experiment revealed that, there were significant variation among the genotypes for fruit yield and its component traits and incidence of YVMV disease. Broad sense heritability and genetic advance was higher for almost all the characters studied. Direct and indirect association analysis revealed that number of fruits per plant had highest direct effect followed by average fruit weight on fruit yield per plant. Diversity analysis for all the genotypes based on Mahalanobis D2 values were grouped into twelve clusters. Cluster I was largest consisting of 30 genotypes. YVMV incidence contributed maximum followed by average weight of fruit for the divergence. None of the genotype was immune or free for the YVMV disease incidence.

Heterosis study recorded that the crosses which had significant heterosis over standard check were IC45818 × IC43735 for days to 50 per cent flowering, IC45818 × VRO103 for plant height, Arka Abhay × Halubende for fruit length, IC45980 × Halubende for average weight of fruit and IC45980 × Parbhani Kranti for fruit yield per plant. These hybrids can be used for exploitation of hybrid vigour on commercial scale. Combing ability analysis revealed that both general and specific combing ability variance were highly significant for almost all the characters. Parents IC45818, IC45980, Parbhani Kranti, Arka Abhay and Halubende were proved to be good general combiners and Arka Abhay × Halubende was good specific combiner for most of the fruit yield and its component traits. Lowest incidence of YVMV disease was recorded in the cross IC45980 × Halubende. The biochemical analysis recorded higher nitrogen and sugar contents in susceptible genotypes while mucilage content, peroxidase activity and polyphenyl oxidase activity were higher in resistant genotypes. Genotypes IC45818, IC43735, IC45980, NO.135 and UAHS1-1 with the low disease incidence values can be further tested in hot spots to confirm their potentiality.

June, 2019

(Gangaprasad, S)
Major Advisor

2. Assessment of Morpho-physiological, Molecular Parental Diversity and Heterosis for Salinity Tolerance in Rice (*Oryza sativa* L.)

(MADHURI, R.)

ABSTRACT

The present investigation composed of 100 rice genotypes conducted at Farmer's field, Thyavanige, Davangere district, Karnataka were screened under augumented design along with five checks during Kharif2016. Analysis of variance revealed that significant differences present among the genotypes for the ten quantitative traits studied. High estimates of PCV (45.29%) and GCV (42.65%) was observed for chlorophyll content followed by yield (39.02%) and (36.51%) indicated wide range of variability for these traits. Based on screening results, Kishora, Kartha and Ragoli were identified as salt tolerant genotypes at reproductive stage.Six susceptible high yielding genotypes were selected and hybridized with five tolerant rice genotypes in Line x Tester fashion to produce 30 F1s. F1s were evaluated at ICAR- Central Soil Salinity Research Institute, Karnal, Haryana and Farmer's field, Thyavanige, Davangere district, Karnataka during Kharif2017 and Kharif2018, respectively in Randomised Complete Block Design with two replications. Among the hybrids, Pusa-44 x CSR 10 and Sarjoo-52 x CSR 27 were identified as best specific combiners for grain yield/ha under salinity condition for Karnal and Davangere location, respectively. Parental molecular diversity was assessed using 500 SSR markers, out of these 168 markers has exhibited polymorphism between eleven parents. The similarity coefficient ranged from 0.22 to 0.81. The maximum similarity coefficient was observed betweenPR-123 and CSR 36 (0.48) which indicated that these genotypes were more closely related. While, the minimum similarity value of 0.15 was observed between the genotypes CSR 30 and CSR 66, which indicated that these two varieties were highly divergent. Correlation was negatively significant for grain yield/ha (r =- 0.40 and - 0.39) under both the saline situation and significant positive correlation for grain yield / ha (r =0.34) was estimatedfrom the estimates of SSR based molecular divergence and mid parent heterosis.

August, 2019

(Dushyanthakumar, B.M.)
Major Advisor

Plant Pathology

University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Plant Pathology

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1. Molecular Detection and Management of Mycotoxigenic Fungal Contamination in Maize (Zea mays L.)

(AJITHKUMAR, K.)

ABSTRACT

Mycotoxin contamination in maize is the major post harvest constraint, affects quality and quantity of the produce, there by affects exporting of maize and effects on human as well as animal health. The survey results revealed that, the maximum per cent severity of mycotoxigenic fungus in the field was noticed in Shivamogga, Koppal (8.70) and Haveri district (17.64) as against the least severity in Raichur district with 3.81 and 2.38 during 2017-18 and 2018-19, respectively. The higher per cent incidence in godowns and markets was recorded in Shivamogga (40.40) and Ballari (58.67) districts whereas minimum incidence was recorded in Haveri (22.73%) during 2017-18 and Mandya, Shivamogga (31.87%) during 2018-19. Culturally and morphologically identified *Aspergillus flavus* isolates were further confirmed molecularly, wherein the ITS region of rDNA of all 20 isolates were amplified at 550 bp. For toxigenic conformity, isolates were amplified with aflJ-R, aflJ-F and were also detected through ELISA and the results revealed that, all the isolates were toxigenic in nature. Twenty isolates of *Fusarium* spp. were confirmed as Fusarium verticillioides based on cultural and morphological characters, of which only 18 F. verticillioides isolates were amplified at 550 bp with ITS primers. For toxigenic conformity isolates were amplified with VERTF-1, VERTF-2 and were also detected through LC-MS and the results revealed that FM-6, FM-15, FM-16 and FM-19 were positive for fumonisin production. The response of 125 maize germplasm for mycotoxigenic fungi showed that none of them expressed immune or resistant reaction. An integrated approach was attempted for the management of mycotoxin contamination in maize. The soil enrichment with neem cake, T. harzianum, P. fluorescens and foliar spray of carbendazim were effective in reducing the infection with maximum yield of 60.59 and 57.61 q/ha and highest BC ratio of 3.34 and 3.15 in first and second circumstances, respectively.

August, 2019

(M. K. Naik)
Major Advisor

2. Studies on the Impact of Increasing Temperature and CO2 on Fusarium Wilt Disease of Chickpea (Cicer arietinum L.)

(SUDHARANI)

ABSTRACT

The Fusarium wilt of chickpea caused by Fusarium oxysporum f. sp. ciceris (Foc) is one of the major production constraints in many parts of the world. Under changing climatic scenario, elevated CO2 and temperature have shown potential impact on host pathogen interaction, plant resistance mechanisms and pathogen virulence. Hence, the present study was focused to assess the impact of elevated CO2 (ambient, 550 and 700 ppm) and temperature (25, 30 and 35 °C) on incidence of Fusarium wilt of chickpea in JG 62 (susceptible) and WR 315 (resistant) cultivars,. Irrespective of temperature, the incubation period was delayed in elevated CO2 (550 and 700 ppm) when compared to ambient CO2 condition. In JG 62 at 25 °C and 30 °C with ambient and 700 ppm CO2 combination, maximum disease incidence of 100 per cent was observed when compared to 550 ppm CO2. Moreover, at 35°C least disease incidence was recorded in all combination of CO2. To improve the resistance level, attempts were made to understand the molecular basis of chickpea x Foc interaction through quantitative PCR (qPCR) to quantify the expression of several candidate chickpea defence and Foc virulence related genes in both cultivars. As compared to elevated CO2, the expression of defence and virulence response genes in chickpea inoculated seedlings were highly up-regulated in ambient CO2 condition in combination with 25 and 30 °C when compared to 35 °C. Our results suggests that among the different defence related genes studied, peroxidise gene is highly expressed in WR 315 cultivar, there by restricting the Foc colonization by providing an evidence of efficient defense mechanism in the resistant cultivar. Moreover, in JG 62 secreted in xylem (SIX 14) gene was highly expressed as a virulence gene as it mainly helps in colonization of Foc by defeating its defense in susceptible cultivar.

September, 2019

(B. Gangadhara Naik)
Major Advisor

3. Investigation on Maize Cyst Nematode *Heterodera zeae* Koshy et al. in Karnataka

(RANI, N.)

ABSTRACT

Maize is considered as the queen of cereals and third most important crop after rice and wheat. *Heterodera zeae* reported to cause significant losses in maize. However, little work has been initiated on this tiny hidden enemy of maize crop in Karnataka. Hence, the present investigation on maize cyst nematode *H. zeae* was undertaken. Survey was conducted in all the 13 major maize growing districts of Karnataka which revealed that, it was widespread and distributed in all the surveyed districts. Sandy loamy soil and monocropping system supported the maximum nematode infection. All the genotypes grown were found susceptible for *H. zeae*. Haralahalli, Katihalli, Isuru, Siddapura, Goravarahatti and Chiluru-kadadakatte villages recorded highest cyst hence were considered as 'hot spots' for H. zeaein Karnataka. Total life cycle was completed within 23 days after inoculation of second stage juveniles. Twelve plants belonging to family Poaceae were found to be hosts for *H. zeae*. Morphology and morphometrics comparisons of eggs of Chitradurga, Davanagere and Shivamogga populations showed maximum length. Second stage juveniles of Chitradurga population appeared longer, while maximum tail length was noticed in Chitradurga and Davanagere population. Cysts were lemon-shaped, fenestra was ambifenestrate. The highest mean value of cyst body length, width and cone top height was observed in Chitradurga population. Molecular study using PCR amplification at 1050 bp and restriction of the same indicates that, variation was present among ten populations. Among different bio-agents, botanicals and green nano products, *Trichoderma harzianum*, papaya leaf extract, and ZnPfs, were found best under in-vitro juvenile mortality test. Field management study during 2017 and 2018 revealed that, application of consortium of P. fluorescens + T. harzianum + B. subtilis at 20g/m² was found most effective in reducing nematode population, cysts with increased yield and maximum B:C ratio in both the locations and seasons tested.

October, 2019

(H. Ravindra)
Major Advisor

Soil Science and Agricultural Chemistry

University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in

Soil Science and Agricultural Chemistry

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1. Status and Behaviour of Zinc in Soils under Paddy Land Cover of Hilly Zone in Karnataka

SHRUTHI, T. M.

ABSTRACT

An investigation was carried out in order to study the dynamics of zinc in soils under paddy land cover of hilly zone in Karnataka. Soil samples were collected from twelve taluks under the zone and were analyzed for chemical properties, available zinc status, fractionation and adsorption behavior of zinc. A pot experiment was conducted to study the response of paddy for different levels of zinc application and to find the critical nutrient limit of zinc for rice crop.

Results of the study indicated that the pH of paddy soils of hilly zone varied from 3.13 to 7.05, out of this, only 0.52 per cent of soils were neutral in soil reaction and remaining 99.48 per cent soils were recorded the acidic pH. Organic carbon status in soils varied from 2.1 to 27.3 g kg^{-1}. Further, 5.22, 20.63 and 74.15 per cent of the soils were found to be low, medium and high in organic carbon status, respectively.

DTPA extractable zinc status in soils varied from 0.20 to 6.62mg kg^{-1}, it was noticed that 85.38 per cent of the soils were recorded suffiecint.The contribution of different fractions to the total zinc was in the order of water-soluble < carbonate bound < organic matter bound < easily reducible manganese bound < iron and aluminum oxide bound <sorbed zinc < residual zinc. Zincadsorption ranged from 56.32 to 973.18 µg g^{-1} as the zinc concentration increased from 5.00 to 220.00 µg ml^{-1} in the equilibrium solution.

The results of pot culture experiment indicated that application of $ZnSO_4$ @ 25 kg ha^{-1}recorded highest yield and wason parwith soil treated with $ZnSO_4$ @ 20 kg ha^{-1} and it revealed that, critical limit for zinc in soil is 1.08 mg kg^{-1} for the recorded yield and zinc concentration in soil. By considering the redefined critical limit of zinc, it showed that 42 per cent of soils studied were deficit in available zinc.

February, 2019

(H. M. Chidanandappa)
Major Advisor

2. Soil Properties as Influenced by Levels of Biochar and FYM Application under Aerobic Rice-Pulse Cropping System

(ARUNKUMAR, B. R.)

ABSTRACT

Two field experiments were conducted at ZAHRS, Navile, UAHS, Shivamogga, during summer and *Kharif* 2018 to know the effect of biochar and FYM on soil properties, soil carbon pools, yield of aerobic rice and green gram. The experiment was planned in RCBD design with 16 treatments consisting of four levels of biochar at 2, 4, 6 and 8 t ha-1 and two levels of FYM at 5 and 10 t ha^{-1} which were applied alone and in combinations. The recommended dose of fertilizer was applied commonly to all the treatments with three replications.

The result revealed that combined application of 8 t ha^{-1}biochar + 10 t ha^{-1} FYM with RDF(100:50:50 kg ha^{-1}) to soil significantly influenced the soil BD, porosity, MWHC, FC, PWP and water stable aggregates, pH, EC,CEC, available nutrients status, soil enzymes and microbial biomass compared to absolute control and RDF alone treatments. Soil carbon pools *viz*., potassium dichromate and permanganate oxidizable carbon and soil microbial biomass carbon contents were significantly increased due to combined and alone application of biochar and FYM compared to absolute control and RDF alone. The TOC and TC contents in soil increased with increase in biochar rate but statistically non-significant effect. Combined application of biochar @ 8 t ha^{-1}+ FYM 10 t ha^{-1} with RDF recorded significantly higher aerobic rice grain6184.0kg ha^{-1} and straw 7724.0 kg ha^{-1}yield and yield parameters viz. number of panicles $hill^{-1}$ and number of grains $panicle^{-1}$. Residual effect of applied @ biochar 8 t ha^{-1} + FYM 10 t ha-1 with RDF (20:50:50 kg ha^{-1}) increased the soil physical, physico-chemical, available nutrients status, soil carbon pools, soil enzymes, microbial biomass and significantly higher yield of green gram (871.0 kg ha^{-1}) and stover (1708.0 kg ha^{-1}) as compared to absolute control and RDF alone.

September, 2019

(Thippeshappa, G. N.)
Major Advisor

3. Productivity of Foxtail Millet (*Setaria italica* L.) and Dynamics of NPK in Soil as Influenced by NPK Levels

(KANTHARAJ, T.)

ABSTRACT

Field experiments were conducted at Zonal Agricultural and Horticultural Research Station, Navile, Shivamogga during 2017 and 2018 to study the influence of NPK levels on productivity of foxtail millet and their dynamics in soil. Three levels of nitrogen (0, 15 and 30 kg N ha-1), two levels of phosphorus (0 and 15 kg P2O5 ha-1) and three levels of potassium (0, 10 and 20 kg K2O ha-1) were tried in a factorial randomized block design with three replications.

Results of the experiments indicated that the combination N30P15K20was found to have significantly higher positive influence on plant height (130.2cm), number of tillers row length-1 (49.3), number of leavesplant-1 (25.8), panicle length (18.3cm), grain yield panicle-1 (6.15g),test weight (3.79g), grain yield ha-1(1388.6 kg) and straw yield ha-1 (2834.6 kg) of foxtail millet compared to all other treatment combinations. The extent of individual influence of nutrients at higher levels was lesser than the combined application of N30P15K20, which enhanced significantly superior interaction effect on growth, yield and quality indices of foxtail millet. The nutrient content and uptake by foxtail millet was significantly superior in N30P15K20 compared to other combinations. The NPK combination at N30P15K20enhanced the values of grain quality indices viz., crude fibre (8.4%), protein (12.5%), zinc (3.2 mg 100g-1) and iron (4.6 mg 100g-1).

Increase in the levels of NPK and their combinations were increased the available N and P2O5 status in post-harvest soil. However, the treatment receiving N30P15K20 recorded significantly higher available N (173.9 kg ha-1) and P2O5 (29.1 kg ha-1). The available K2O (54.25 kg ha-1) values significantly reduced with increased N levels during consecutive of two years study. The dynamics in post-harvest soil revealed that the greater reduction in organic-P and K fractions with increase in N levels except nitrogen and inorganic-P fractions.

November, 2019

(H.M. Chidanandappa)
Major Advisor