

Agricultural Entomology

University of Agricultural and Horticultural Sciences, Shivamogga
Ph.D. theses abstracts produced in Agricultural Entomology

1. Studies on Survey, Molecular Characterization and Management of Sucking Pests in Tomato with Special Reference to Whitefly, *Bemisia tabaci* Gennadius

(ABHISHEK, M. S.)

ABSTRACT

The present investigation was carried out on survey, molecular characterization, screening of cultivars and management of sucking pests in tomato with special reference to whitefly (*Bemisia tabaci* Gennadius) during 2018-2020 at College of Agriculture, Shivamogga. Survey was conducted to record the incidence of sucking insect pests and their natural enemies at Shivamogga, Davangere, Chikkamagalur, Bangalore Rural, Chikkaballapur and Kolar districts at fortnightly intervals during *Rabi* 2018-19 and Summer 2019. The sucking pests which noticed during the survey were three species of whiteflies, one species each of aphids and thrips. The whitefly species recorded during the survey were *Bemisia tabaci*, *Aleurodicus dispersus* and *Aleurothrixus trachoides*. The aphid *Aphis gossypii* and thrips *Frankliniella occidentalis*. Totally eight species of natural enemies were recorded, which include seven species of predators and one species of parasitoid. The sucking pests collected were sequenced and barcoded at 658bp region of the mitochondrial cytochrome oxidase subunit 1 gene. The mtCOI based phylogeny and pairwise divergence analysis supported the existence of three genetic groups of *B. tabaci* namely Asia II-1, Asia II-5 and Asia II-7. From the divergence study it is clear that these genetic groups share <4% divergence among themselves and more with others. Totally twelve tomato cultivars were found screened against sucking pests. The cultivars Arka Rakshak, Arka Samrat and PHS 448 were resistant to whiteflies. The cultivars LHT Pooja, PHS 448, Arka Rakshak and Arka Samrat were resistant to both aphids and mealybugs. The relative efficacy of bio agents, botanicals and insecticide tested under field conditions, indicated that spiromesifen 240SC @ 2ml/l, azadiractin-5 per cent @ 2ml/l and fish oil rosin soap @ 2ml/l were the most effective treatments in reducing the whiteflies, aphids and mealybugs population, respectively. The highest C:B ratio of 1:3.41 was noticed in azadiractin-5 per cent, followed by spiromesifen 240 SC (1:3.38).

February, 2021

(B.C. Hanumanthaswamy)
Major Advisor

2. Studies on Ecological Engineering and Biorationals for Management of Major Insect Pests in Paddy Ecosystem

(RAGHAVENDRA YALIGAR)

ABSTRACT

Studies on ecological engineering and biorationals for the management of major insect pests in paddy ecosystem were carried out in Agricultural Research Station and Krishi Vigyana Kendra, Gangavathi during *kharif* and *rabi*-summer of 2016-17, 2017-18 and *kharif* 2018. The influence of five ecological engineering bund crops (cowpea, sesamum, okra, marigold and sunhemp) on the incidence of brown plant hopper (BPH), white backed planthopper (WBPH), green leafhopper (GLH), yellow stem borer (YSB) and leaf folder (LF) and natural enemies on paddy revealed that significantly low population of BPH (12.66/hill), WBPH (8.09/hill), GLH (1.84), dead heart (3.53%) and Leaf damage by LF (2.01%) were recorded in paddy+Cowpea, followed by sunhemp and marigold. Paddy+cowpea attracted significantly more number of natural enemies *viz.*, mirid bugs, coccinellids, spiders, carabid beetle and egg parasitoids, followed by paddy+marigold and paddy+sunhemp. Highest paddy grain yield was obtained in paddy+cowpea (45.92 q ha⁻¹), followed by paddy+sunhemp (43.34 q ha⁻¹) and paddy+ marigold (42.94 q ha⁻¹). Evaluation of biorationals in cowpea based paddy ecosystem revealed that among biorationals *Metarhizium anisopliae* recorded lowest BPH (5.81/hill), WBPH (4.42/hill) and GLH (0.99/hill) and *Bacillus thuringiensis* was found effective against stem borer (2.26% dead heart) and leaf damage by LF (1.37% leaf damage). Out of the three modules evaluated against major pests of paddy, recommended plant protection schedule (RPP) was found superior against plant hopper, stem borer and leaf folder which was found to be the best and effective module for the management of major paddy pests with higher C: B ratio (2.03) compared to ecological engineering module (1.92) and farmers practice (1.46). Cowpea based ecologically engineered module which recorded maximum natural enemy population which is eco-friendly was found on par with (RPP). Hence, this can be encouraged for the management of paddy insect pests.

November, 2021

(B.K. Shivanna)
Major Advisor

Agronomy

1. Evaluation of Pearl Millet and Pigeonpea Cultivars through Fertifortification for Nutritional Security in Semi Arid Tropics

(EPPALA JEEVANA LAKSHMI)

ABSTRACT

Field experiments were conducted during *Kharif* season of 2018 and 2019 at Hiriyur, UAHS, Shivamogga, to evaluate the performance of pearl millet and pigeonpea cultivars through fertifortification for nutritional security. In the first experiment four micronutrient management strategies were tested on three pearl millet cultivars. Here, the application of recommended FYM enriched with deficit zinc and iron + PGPR + NPK achieved significantly higher grain yield of pearl millet (1919 kg ha^{-1}) and Fe content (73.70 ppm) in the grain. Further higher gross returns (50439 ha^{-1}), net returns (27205 ha^{-1}) and B:C (2.17) were also obtained with the same. Among the pearl millet cultivars, ICMH 1202 reported higher grain yield (2097 kg ha^{-1}), gross returns (54932 ha^{-1}), net returns (32477 ha^{-1}) and B:C (2.44) with higher zinc (48.02 ppm) and iron (79.31 ppm) accumulation followed by ICTP 8203 Fe variety. The interaction of EFYM + PGPR applied in ICMH 1202 achieved significantly higher grain yield (2203 kg ha^{-1}), Zn (50.52 ppm) and Fe (83.88) content in the pearl millet grain.

Biofortification in intercropping system was tested in second experiment with seven treatments. The intercropping system of pearl millet (ICTP 8203 Fe) and pigeonpea (ICPL 161) in 3:1 row proportion along with application of enriched FYM + PGPR + NPK achieved higher grain (1494 kg ha^{-1}) and seed (431 kg ha^{-1}) yields of pearl millet and pigeonpea, respectively, with 1.07 LER. The sole crop of pigeonpea along with soil application of deficit iron and zinc + recommended FYM + NPK achieved higher pearl millet equivalent yield (2932 kg ha^{-1}), gross (72772 ha^{-1}) and net (43353 ha^{-1}) returns with a B:C of 2.47. Accumulation of grain iron in pearl millet (80.15 ppm) was higher in enriched FYM + PGPR treatment, while for pigeonpea (82.94 ppm) it was soil application of micronutrients. Further, foliar application improved grain zinc content in both the crops.

2. Performance of Promising Greengram Varieties (*Vigna radiata* (L.) Wilczek) as Influenced by Sowing Dates, Planting Density and Fertilizer Levels under Rain Fed Situation in Southern Transitional Zone of Karnataka

(ASHWINI, M.)

ABSTRACT

Agronomic investigation was carried out to study the suitable agronomic practices for greengram varieties as influenced by sowing dates, planting density and fertilizer levels under rainfed situation in Southern Transition Zone of Karnataka during *Kharif* 2015 and 2016 at College of Agriculture Shivamogga.

To meet the objectives each experiment consisted of 12 treatments laid out in RCBD with factorial concept replicated thrice. The experiment-I involving three varieties *viz.*, KKM-3, PDM 84-178 and SBM-1 and four dates of sowing *viz.*, July 15th, July 30th, August 15th and August 30th. Among the varieties KKM-3 recorded higher seed yield (806 kg ha⁻¹), haulm yield (3206 kg ha⁻¹) and B:C (1.68). In different dates of sowing, the crop sown on July 15th recorded higher seed yield (965 kg ha⁻¹), haulm yield (3783 kg ha⁻¹) and B:C (2.02) over other date of sowing. In interaction, variety KKM-3 sown on 15th July recorded higher seed yield (1252 kg ha⁻¹), haulm yield (4912 kg ha⁻¹) and B:C (2.58). In experiment-II, the treatment consisted of three different varieties *viz.*, KKM-3, PDM 84-178 and SBM-1, two spacing *viz.*, 30 cm × 10 cm and 45 cm × 10 cm and two fertilizer levels *viz.*, 100 % recommended dose of fertilizer (25:50:25 NPK kg ha⁻¹) and 125 % recommended dose of fertilizer (31.25:62.5:31.25 NPK kg ha⁻¹). Among varieties KKM-3 recorded higher seed yield (1056 kg ha⁻¹). Among spacings significantly higher seed yield (925 kg ha⁻¹) was recorded with 30 cm × 10 cm spacing. Among fertilizer level, application of 125 per cent recommended dose recorded higher seed yield (953 kg ha⁻¹). In interaction effect, higher seed yield (1225 kg ha⁻¹) was noticed with variety KKM-3 sown at spacing of 30 cm × 10 cm with application of 125 per cent recommended dose of fertilizer than other interactions.

March, 2021

Narayan S. Mavarkar

Major Advisor

**Genetics
and Plant
Breeding**

University of Agricultural and Horticultural Sciences, Shivamogga
Ph.D. theses abstracts produced in Genetics and Plant Breeding

1. Assessment of Variability in Okra (*Abelmoschus esculentus*(L.) Moench) Generated Through Mutations

(SASIPRIYA, S)
ABSTRACT

The present study was executed in two open-pollinated varieties of okra, namely, Arka Anamika and Arka Abhay, at College of Agriculture, KSN UAHS, Shivamogga, during 2019-2021. The research intended to assess the variability induced through genetic (using gamma radiation) and epigenetic (using two HDAC inhibitors, namely sodium butyrate and trichostatin- A) mutations. Analysis of variance for all the traits in the first and second mutant generations revealed the existence of substantial amount of variability. Remarkable differences in the mean values of most of the traits were observed in response to different doses of gamma radiation and varied doses and incubation times of the chemicals. A spectrum of chlorophyll mutants (chlorina, xantha and viridis), leaf, flower and fruit mutants were noticed in the gamma-irradiated treatments. Noticeable variations for flowers, leaves and fruits, delayed flowering, male and female sterility were observed among the epigenetic treatments. A peculiar flower mutant lacking purple pigmentation on the backside of the petals, induced by sodium butyrate treatment, was found to inherit to the next generation, proving the trans-generational mode of epigenetic inheritance. High estimates of genetic parameters were observed for number of branches and fruits per plant, fruit length, number of internodes and number of seeds per fruit among genetic and epigenetic mutants. The analysis of correlation coefficients indicated that fruit yield per plant had significant positive association with almost all the traits except for days to first flowering and test weight. Number of fruits per plant, fruit weight and number of internodes had exhibited highest positive significant correlation with the yield. The highest positive direct effect on total fruit yield per plant was recorded by number of fruits per plant followed by fruit weight. The mutant lines were evaluated in the second generation and superior lines were selected for early flowering habit, high yield per plant and other important yield attributing traits.

November, 2021

(Dushyantha Kumar B.M.)
Major Advisor

Plant Pathology

University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Plant Pathology

1. Investigation on Epidemiology, Molecular Characterization and Management of
Phytophthora meadii(McRae) Causing Fruit Rot of Arecanut

(BALANAGOUDA PATIL)

ABSTRACT

Of late, fruit rot(*Phytophthora meadii*) has appeared as serious melody owing major threat to arecanut production leading to significant economic losses. Investigations were conducted to understand spatio-temporal distribution, morpho-molecular characterization, pathogenic and cultural variability, biochemical alterations during host-pathogen interaction and farmers' friendly management aspects. In the spatio-temporal distribution patterns, disease was isotropically distributed in malnad and coastal regions with disease severity (12.25 to 51.33 %) contrastingly it was less prevalent in maidan region. Disease progress over time was initiated early (1st week of July) in malnad and coastal regions compared to maidan region delayed up to September. Morphological, pathological and molecular comparisons were made for 48 isolates of *P. meadii* obtained from varied geographical boundaries of Karnataka in respect of sporangial morphology, growth pattern, virulence assay, phylogenetic analysis and principal component analysis. Majority isolates were confirmed as *P. meadii* but some coastal region isolates showed association of *P. parsiana* based on morphological identification, cultural characteristics and multi locus gene sequencing (*ITS*, *TEF1- α* , *β -tub* and *Cox-II*). There were six morpho types, six colony groups, three fitness or virulence groups were identified which indicated high polymorphism, diversity and dynamic nature of the pathogen. Biochemical studies emphasized that, peroxidase (PO), β -1, 3 glucanase, superoxide dismutase (SOD), phenols, and catalase activities were enhanced and found to be changing in leaves of inoculated plants compared to uninoculated plants. *In vitro* and *in vivo* assays evidenced that, among 13 fungicides, eight were found effective in mycelial growth, sporangial production and zoospore inhibition under laboratory conditions. Foliar application of Mandipropamid 23.4% SC @ 5 ml/liter or Bordeaux mixture @ 1% and soil application Fosetyl-Al 80 % WP amended briquettes @ 100 g / palm at monthly interval were found significantly effective in reducing the fruit rot disease severity with increased yield under natural epiphytotic conditions.

March, 2021

(H. Narayanaswamy)
Major Advisor

2. Investigations on Basal Stem Rot of Arecanut Caused by *Ganoderma* spp. and Its Management

(BACHU RAGHAVENDRA)

ABSTRACT

Among several diseases affecting arecanut, basal stem rot caused by *Ganoderma* spp. is one of the important constraints for arecanut production. During two-year roving surveys, *i.e.*, 2019-20 and 2020-21, Shivamogga district recorded mean maximum disease incidence, followed by Davanagere district. With the help of detection studies, the pathogen was detected from the roots of six, eight, and nine-year-old arecanut palms. Among different media tested, malt extract agar was found superior in supporting the mycelial growth of the pathogen. After molecular characterization, three species were found to be associated with basal stem rot *viz.*, *G. ryvardeenii*, *G. boninense*, and *G. applanatum*. PCR diagnosis by two sets of genus-specific primers of *Ganoderma viz.*, *Gan* 1, *Gan* 2, and ITS-3, *Gan* ET showed amplification for all the isolates, indicating that all belong to genus *Ganoderma*. Whereas with the species-specific primer of *G. lucidum*, amplification was not observed for all the isolates indicating that none are *lucidum* species. Among different bio-agents tested against *G. ryvardeenii*, *Trichoderma virens* was found effective, followed by *T. harzianum*. Out of several fungicides tested against *G. ryvardeenii*, Hexaconazole 5% EC, Tebuconazole 250 EC, Flusilazole 40% SC Azoxystrobin 11% SC + Tebuconazole 18.3% SC, and Hexaconazole 5% SC + Validamycin 2.5% SC was found effective even at 100 ppm. Integrated disease management studies revealed that soil application of 10 lts of Hexaconazole 5% EC @ 2 ml/litwater/palm at half-year interval followed by soil application of *T. virens* enriched with 2 kg neem cake/ palm 15 days after chemical application found effective, where a slight increase in disease index (4.87 %) over the initial and maximum nut yield (9.70 kg/palm in 2020 and 11.12 kg/palm in 2021) was recorded.

November, 2021

(B Gangandhara Naik)
Major Advisor

3. Epidemiology and Management of Bacterial Leaf Stripe of Arecanut

(NANDEESHA K. L.)

ABSTRACT

Bacterial leaf stripe is an emerging disease in arecanut caused by *Xanthomonas vasicola* pv. *arecae* which infects during the early stage of the crop growth (1-6 years), resulting in the death of the plants. Considering the importance of the crop and magnitude of this disease, investigations were undertaken to study the pathogen and disease thoroughly in bringing out appropriate management practices to mitigate the disease effectively. Survey conducted during 2019-20 and 2020 - 21 revealed, highest disease incidence and severity was noticed in Davanagere district, whereas, disease occurrence was not observed in Tumakur and Uttara Kannada districts. Growth of pathogen isolates on seven different nutrient media showed considerable variation with respect to colony colour, size, shape, appearance and mucoidness. Among the media tested, Nutrient Glucose Agar (NGA) media supported best growth of all the isolates. The biochemical profiling of the pathogen isolates showed positive reaction to catalase test, liquefaction of gelatin, KOH test, methyl red test ammonia production, starch hydrolysis and hydrogen sulphide production. Whereas, the negative reactions were observed in fluorescent test and gram staining. PCR amplification of ≈ 1490 bp region corresponding to 16S rRNA gene was amplified and ≈ 491 bp corresponding to *gyrB* loci was targeted from pathogen isolates through polymerase chain reaction (PCR) using 16S rRNA and *gyrB* specific primers. Weather parameters viz., intermittent rainfall, temperature maximum (35.53 and 35.60 °C) and minimum temperature (21.26 and 21.80 °C), along with relative humidity maximum (83.29 and 77.00 %) and minimum relative humidity of 50.57 and 37.00 per cent were found favourable for the disease development and its severity during 2019-20 and 2020-21. *Trichoderma harzianum* was found to be effective under *in-vitro*. Whereas, Kasugamycin + Copper oxychloride (Conica) was found to be an effective chemical both under *in-vitro* and field conditions.

November, 2021

(B Gangadhara Naik)

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

1. Transformation and Use Efficiency of Phosphatic Fertilizers as Influenced by Humic Substance in Acid Soil of Southern Transition Zone of Karnataka

(SAGAR, R.)

ABSTRACT

An incubation study and a field experiment was conducted to know the transformation of phosphorus as influenced by humic substance in acid soil. Humic substance was extracted from FYM, found to be rich in carbon (37.08%) and oxygen (50.73%) and tested at three levels in combination with three phosphatic fertilizers *viz.*, SSP, DAP and rock phosphate. The results of incubation study revealed that application of P fertilizer with increased dose of humic substance increased available-P, saloid-P and organic-P and decreased the Al-P, Fe-P, reductant soluble P, occluded P and Ca-P throughout the incubation period especially when rock phosphate combined with humic substance @ 60 mg kg⁻¹ as compared to P fertilizers without humic substance treatments. P fixation was lower (35.31%) in the treatment receiving rock phosphate + humic substance @ 60 mg kg⁻¹, while the absolute control treatment recorded the maximum P fixation capacity (60.34%). In the field experiment, all the P fractions were decreased with crop growth period and significantly higher plant height, number of leaves, tillers, number of panicles per hill and number of grains per panicle was recorded in the treatments receiving combined application of rock phosphate + humic substance @ 75 L ha⁻¹, compared to individual application of P. Significantly higher grain and straw yield of aerobic rice was recorded in the treatment receiving rock phosphate + humic substance @ 75 L ha⁻¹ with 61.40 and 75.91 q ha⁻¹, respectively with higher benefit to cost ratio (2.16) and net return. Phosphorus use efficiency (PUE) was found to increase with increase in humic substance levels, however higher PUE of 51.67 per cent was found for high yielded treatment. The saloid-P, organic-P, available-N and available-P in soil exhibited positive and significant correlation with pH, OC, PUE and grain yield in contrast to other P fractions.

October, 2021

(Thippeshappa, G. N.)

Major Advisor

2. Effects of Liquid Bioformulation and NPK-Fertigation on Soil Nutrient Dynamics, Microbial Activities and Yield of Aerobic Rice

(YACKOB ALEMAYEHU ADEME)

ABSTRACT

A two-season field experiment was conducted to assess the effect of liquid bioformulation (LBF) applied alone or combined with NPK-fertigation on soil microbial and chemical properties at different growth stages of aerobic rice under drip-irrigation conditions. Nine treatments were tested: (T₁) absolute control in which no external nutrients were applied except drip-irrigation; (T₂) a conventional soil application practice of RDF (CP) against which all the other treatments were compared; (T₃) 100 per cent RDF through drip-fertigation (NPK₁₀₀); (T₄) 75 per cent RDF through drip-fertigation (NPK₇₅); (T₅) 50 per cent RDF through drip-fertigation (NPK₅₀); (T₆) LBF co-applied with 100 per cent RDF through drip-fertigation (LBF+NPK₁₀₀); (T₇) LBF co-applied with 75 per cent RDF through drip-fertigation (LBF+NPK₇₅); (T₈) LBF co-applied with 50 per cent RDF through drip-fertigation (LBF+NPK₅₀); and (T₉) LBF applied twice at 1000 L ha⁻¹ (LBF). The results showed that soil microbial biomass carbon (MBC), dehydrogenase, urease, and acid phosphatase activities were significantly ($p < 0.05$) responded to LBF co-applied with NPK-fertigation, whereas alkaline phosphatase (ALP) did not show significant differences between treatments. Largely, LBF addition showed an immediate increase in bacterial and fungal load compared to the CP treatment, but to a less extent in actinomycetes. The rhizosphere soil microbial index (RSMI) revealed that LBF co-applied treatments had an influence on the overall condition of microbial properties over the CP. The abundance of P fractions was in the decreasing order of: Fe-P > Al-P > Red-P > Ca-P > Saloid-P > Occ-P. The availability of N and P in CP consistently decreased with increasing growing stages in both seasons, whereas it tended to increase in LBF co-applied treatments. Averaged over the season, the grain yield and total biomass of rice significantly ($p < 0.05$) increased in LBF+NPK₁₀₀ (which was at par with LBF+NPK₇₅) treatment and increased by 30.3–37.8 per cent and 19.3–32.4 per cent for the summer and *Kharif* seasons, respectively, as compared with CP treatment. The highest net monetary return (188,902 Rs. ha⁻¹) and benefit-cost ratio (3.97) were recorded from LBF+NPK₁₀₀, although the values were comparable with LBF+NPK₇₅. LBF applied alone did not show additive effects in most of the parameters studied. Considering the improvements of soil chemical and microbial properties and crop performance, it can be concluded that substituting about 25 per cent of mineral NPK-fertilizer with LBF could bring about agronomic and ecological benefits in aerobic rice production.

September, 2021

(Sarvajna B. Salimath)

Major Advisor