Agricultural Entomology

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Agricultural Entomology

1. TAXONOMIC STUDIES ON SPECIES COMPLEXES OF FRUIT FLIES OF TRIBE DACINI (DIPTERA: TEPHRITIDAE: DACINAE) IN INDIA

(ABHISHEK, V.)

ABSTRACT

Roving surveys undertaken during 2022-24 across India including Western Ghats, northeast India, Andaman Islands and examination of fruit flies deposited at National Insect Museum, ICAR-NBAIR, Bengaluru, UASB GKVK and Natural History Museum, London led to the identification of 85 species of fruit flies belonging to 3 genera namely *Bactrocera* Macquart, *Dacus* Fabricius and *Zeugodacus* Hendel in 15 subgenera of tribe Dacini belonging to nine species complexes viz., *dorsalis, nigrotibialis, trilineatus, scutellaris, tau* and *watersi* species complexes of which three complexes viz., *bipustulata, rubigina and crabroniformis* are newly proposed from the current study. Six new species were described during the course of the study viz., *Bactrocera kyrdemkulai* Abhishek and David, *Dacus nagarathnae* Abhishek, David and Hancock and *Zeugodacus nasivittatus* David and Abhishek from Meghalaya; *Bactrocera ettinabhuja* Abhishek and David and *Dacus venkateshi* Abhishek and David from Karnataka; *Zeugodacus sinuvittattus* David and Abhishek from Himachal Pradesh. Two putative new species belonging to *Bactrocera* and *Dacus* from Andaman Islands attracted to Zingerone were also collected. An updated checklist of fruit flies of tribe Dacini from India was prepared which include 110 species with six new records viz., *Bactrocera abbreviata* (Hardy), *Bactrocera gombokensis* Drew and Hancock, *Bactrocera ochroma* Drew and Romig, *Bactrocera profunda* Tsuruta and White, *Bactrocera wuzhishana* Li and Wang and *Dacus vijaysegarani* Drew and Hancock. Male and female postabdominal structures were studied including the external morphology and morphometrics along with an updated key to all the members of species complexes recorded from India. The specific region of mitochondrial cytochrome oxidase I (mtCOI) gene of 36 fruit fly species DNA was amplified and the accession numbers were obtained by submitting the sequences to the NCBIs GenBank. Phylogenetic analysis using morphological and molecular characters using maximum likelihood method based on mtCOI revealed that *Bactrocera* and *Dacus* are monophyletic, whereas *Zeugodacus* was polyphyletic. Besides, host plant data and lure responses of all the collected species were also recorded.

December, 2024

(Pradeep, S.)
Major Advisor

2. SPECIES DIVERSITY OF HYMENOPTERAN PARASITOIDS IN DIFFERENT CROP ECOSYSTEMS

(DARSHAN R.)

ABSTRACT

The study on species diversity of hymenopteran parasitoids in different crop ecosystems was carried out by Department of Entomology, College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga during 2021-2023. During the survey, a total of 42 species of hymenopteran parasitoids belonging to 33 genera and 12 families *viz*., Ichneumonidae, Braconidae, Eulophidae, Encyrtidae, Scelionidae, Eurytomidae, Chalcididae, Signiphoridae, Aphelinidae, Trichogrammatidae, Proctutropidae and Pteromalidae were documented from the collections of 1379 specimens from 22 different host insects from three districts *viz*., Shivamogga, Davanagere and Chitradurga. Among all the parasitoid species recorded, the highest numbers (498) were recorded from *Copidosoma floridanum*, followed by *Telenomus* sp. 2 (175 individuals). In Shivamogga district, 454 hymenopteran parasitoid specimens were collected. In Davanagere and Chitradurga districts, hymenopteran parasitoid specimens collected were 747 and 178, respectively. Among 42 hymenopteran parasitoid species collected, 25 species represented ten families which were collected from Shivamogga district, 16 species represented nine families from Davanagere district and 12 species represented eight families from Chitradurga district. In the present study, a total of 42 species of hymenopteran parasitoids were recorded from different host plants *viz*., rice, maize, cabbage, cotton, coconut, brinjal, cashew, crape jasmine, tobacco, field bean, soybean, arecanut, cocoa, bhendi and pongamia. In the present research, 42 parasitoids were collected from different host insect stages *viz*., egg, larva, pupa and adult. Among them, maximum parasitoid species (20) were collected from larval stage of host insects, followed by egg stage (9), adult stage (7) and pupal stage (6). Molecular identification of 10 hymenopteran parasitoid species was carried out using mtCOI gene. During the current research both the number of families and species of hymenopteran parasitoids found in organically grown maize ecosystem were higher (5 and 6, respectively) than those found in naturally grown and crop grown using farmers' practice where in recommendations of package of practices were adopted (4 in each).

January, 2024

(Jayalaxmi Narayan Hegde.)
Major Advisor

3. STUDIES ON THE PIGEONPEA POD FLY, *Melanagromyza obtusa* (MALLOCH) (DIPTERA: AGROMYZIDAE) AND ITS MANAGEMENT IN PIGEONPEA ECOSYSTEM

(NAGARJUAN, T. N .)

ABSTRACT

Pigeonpea, *Cajanus cajan* is a vital legume crop known for its nutritional value and soil enriching properties. Pod fly, *Melanagromyza obtusa* is a significant pest affecting pigeonpea, causing considerable yield loss by damaging developing seeds. Effective management of pod fly is crucial for sustainable pigeonpea production. A roving survey across Bagalkote, Vijayapura, Kalaburagi and Bidar districts revealed the highest maggot (4.71) and pupal (13.60) populations per 100 pods, with the highest pod (19.42%) and seed damage (9.83%) observed in Bidar district. Seasonal incidence studies on the long-duration variety BSMR 736 indicated that the pigeonpea pod fly maggot population peaked 32.00 per 100 pods during 48th MSW (Meteorological Standard Week). The highest pupal population (61.00), with increased pod (36.52%) and seed damage (25.45%) was recorded in the first fortnight of January (2nd MSW). Maximum and minimum temperatures had a significant positive influence on maggot population, whereas these variables negatively impacted pupae, pod and seed damage. Morning relative humidity positively influenced maggot populations but had a negative impact on pupae, pod and seed damage. Conversely, afternoon relative humidity negatively affected maggots, pupae, pod and seed damage. Maximum temperature influenced 40 per cent grain damage, while minimum temperature influenced 77 per cent damage. Morning and afternoon relative humidity did not significantly affect grain damage. Crop loss estimation studies on variety BRG-5 indicated relative yield loss of 23.53 per cent seed damage per hectare. Among the different molecules evaluated, fipronil 4% + thiamethoxam 4% w/w SC @ 1ml/l showing the lowest mean population of pod fly and highest per cent reduction over control. These were followed by fipronil 15% + flonicamid 15% WDG @ 0.5g/l and imidacloprid 17.8 SL@0.4ml/l. Chlorfluzauron 5.4 EC @3.5ml/l was the least effective treatment in reducing pod fly population and damage, compared to the standard check imidacloprid 17.8 SL @0.4ml/l.

November, 2024

(Shivanna, B. K.)
Major Advisor

Agronomy

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Agronomy

1. PERFORMANCE OF CHICKPEA (*Cicer arietinum* L.) AS INFLUENCED BY SOWING WINDOWS AND DROUGHT MANAGEMENT STRATEGIES UNDER CENTRAL DRY ZONE OF KARNATAKA.

(VIGNESH)

ABSTRACT

The field experiments on varieties and sowing windows and drought management strategies were conducted at ZAHRS, Hiriyur in *Vertisols* during *rabi* 2021-22 and 2022-23 using split plot design. The first experiment consisted of four varieties (JAKI-9218, JG-11, BGD-103 and SA-1) as main plots and three sowing windows (1st and 2nd FN of November and 1st FN of December) as sub plots. Among the varieties, JAKI-9218 recorded significantly higher seed yield (12.52 q ha^{-1}) and net returns (₹ 26,968 ha^{-1}) as compared to the variety BGD-103 (10.71 q and ₹ 17,403 ha^{-1}, respectively). Among the sowing windows, sowing of chickpea during 1st fortnight of November produced significantly higher seed yield and net returns (14.55 q and ₹ 38,038 ha^{-1}, respectively) as compared to 1st fortnight of December sown chickpea (8.43 q and ₹ 5,166 ha^{-1}, respectively). The second experiment consisted of land configurations (Broadbed-Furrow and Flatbed) as main plots and six drought management strategies (seed priming with $CaCl_2$ @2%, seed priming with PEG-6000 @10% and hydrogel @2.5 kg ha^{-1}, with and without foliar spray of KH_2PO_4 @1.5% at 30 and 45 DAS) and a control as sub-plots. In late sown chickpea (2nd FN of November), the seed yield and net returns were significantly superior under BBF (14.06 q and ₹34,017 ha^{-1}, respectively) compared to flatbed sowing (13.10 q and ₹27,948 ha^{-1}, respectively). Significantly higher seed yield and net returns were produced with application of hydrogel @2.5 kg ha^{-1} + foliar spray of KH_2PO_4 @1.5% (14.91 q and ₹ 36,292 ha^{-1}, respectively). The timely sowing of chickpea variety JAKI-9218 during 1st fortnight of November can obtain maximum yield and economic benefits under Central Dry Zone of Karnataka. Under delayed sowing, BBF along with application of hydrogel @2.5 kg ha^{-1} + foliar spray of KH_2PO_4 @1.5% also increase the seed yield and net returns.

November, 2024

(M. Hanumanthappa)
Major Advisor

2. COMPARATIVE ASSESSMENT OF DIFFERENT FARMING TYPES IN GROUNDNUT BASED INTERCROPPING SYSTEM UNDER SOUTHERN TRANSITION ZONE OF KARNATAKA

(AKARSH, S. V.)

ABSTRACT

A Field experiment was conducted at Zonal Agricultural and Horticultural Research Station, Navile, KSNUAHS, Shivamogga during *kharif* 2021 and 2022 in sandy loam soil. The experiment was laid out in split plot design where main plots consist of three farming types *viz*., conventional farming, organic farming and natural farming and sub plots consist of five cropping systems *viz*., groundnut + maize (4:1) intercropping, groundnut + finger millet (4:1) intercropping, sole groundnut, sole maize and sole finger millet forming 15 treatment combinations which were replicated thrice. Results revealed that higher growth parameters and yield parameters were recorded in conventional farming among farming types and in sole groundnut among cropping systems. Conventional farming recorded nine and 22 per cent higher groundnut pod yield than organic farming and natural farming, respectively. Groundnut equivalent yield in groundnut intercropped with maize and finger millet were 12 and one per cent higher than sole groundnut, respectively. Further, higher soil nutrient status, soil beneficial microbial population and enzymatic activity was higher in organic farming followed by natural farming. However, higher nutrient uptake by crop was recorded in conventional farming. Net returns (Rs. 57483 ha^{-1}) received from conventional farming was greater than organic and natural farming even under premium price for organic products however, benefit cost ratio was on par with natural farming. Intercropping of groundnut with maize and finger millet recorded higher soil nutrient status, biological activity (soil beneficial microbial population and enzymatic activity), net returns and B C ratio than sole groundnut. Interaction of farming types and cropping systems recorded non significant values except for system nutrient uptake and groundnut equivalent yield.

October, 2024

(H. K. Veeranna)
Major Advisor

3. EFFECT OF NANO UREA, ZINC, ENRICHED ORGANIC MANURES AND NITROGEN LEVELS ON GROWTH, YIELD AND QUALITY OF SUNFLOWER (*Helianthus annuus* L.) IN SOUTHERN TRANSITION ZONE OF KARNATAKA

(SIDDHARTH HULMANI)

ABSTRACT

At the Agricultural and Horticultural Research Station (AHRS), Bavikere, two field experiments were conducted on red sandy loam soil to investigate the effects of nano urea, zinc, enriched organic manures and nitrogen levels on sunflower growth, yield and quality. The experiments were conducted during the *rabi* seasons of 2021-22 and 2022-23. The first experiment, laid out in a factorial randomized complete block design (RCBD) with three replications, evaluated the response of sunflower to nitrogen levels, foliar application of nano urea and zinc. Twelve treatment combinations, including a control were tested. Results showed that the treatment receiving 125% recommended dose of nitrogen (RDN) with two sprays of nano urea @ 0.4% and zinc spray @ 1% significantly outperformed the other treatments, recording a higher seed yield (2285 kg ha^{-1}), oil yield (913 kg ha^{-1}), net returns (₹ 93425 ha^{-1}) and benefit-cost ratio (2.92). The second experiment with RCBD design and replicated thrice, assessed the impact of nitrogen levels and enriched organic manures on sunflower. Nine treatments were evaluated. The application of 100% RDN along with enriched arecahusk compost (applied on N equivalent basis to recommended FYM) resulted in higher seed yield (2035 kg ha^{-1}), oil yield (802 kg ha^{-1}), net returns (₹ 89735 ha^{-1}) and benefit-cost ratio (3.03). From the two experiments, we can conclude that two viable approaches have emerged to increase sunflower productivity and profitability. For limited availability of organic resources, the application of 125% of the RDN with two sprays of nano urea @ 0.4% and 1% zinc spray is recommended. Alternatively, with abundant availability of organic resources, the application of 100% RDN with enriched areca husk compost is suggested. These strategies ensure nutrient adequacy, promote soil health and enhance economic returns, catering to the diverse needs and goals of farmers in Southern Transition Zone of Karnataka.

October, 2024

(C. J. Sridhara)
Major Advisor

4. USE OF CROP SIMULATION MODEL TO SIMULATE THE RESPONSE OF MAIZE TO NITROGEN AND IRRIGATION LEVELS

(NIVEDITHA, M. P.)

ABSTRACT

Field experiments were conducted at Centre for Climate Resilient Agriculture, College of Agriculture, Shivamogga during summer 2023 and 2024 on red sandy loam soil to simulate the response of maize to nitrogen and irrigation levels with the use of crop simulation model to find out optimum nitrogen and irrigation level for higher productivity of hybrid maize and validation of CERES-Maize model. Two experiments were laid out in factorial randomized complete block design (RCBD) with three replications. The first experiment comprised of three maize hybrids (P-3304, NK-6514 and CP-818) and four nitrogen levels (75, 100, 125 and 150% N). The results revealed that P-3304 hybrid recorded significantly higher grain yield (10050 kg ha^{-1}). Application of nitrogen at 125 per cent recorded significantly higher grain yield (10469 kg ha^{-1}), plant height (223.58 cm), number of leaves (10.67) and total dry matter production (487.30 g $plant^{-1}$) at harvest over rest of the nitrogen levels. The second experiment consisted of two irrigation intervals (irrigation at five and ten days interval) and four irrigation levels (1.0, 0.8, 0.6 and 0.4 CPE). Irrigation at five days interval recorded higher grain (7094 kg ha^{-1}) yield. Irrigation application at 1.0 CPE recorded significantly higher grain yield (9393 kg ha^{-1}) over rest of the irrigation levels. In DSSAT CERES-Maize model grain yield was compared between observed and simulated results to evaluate model performance. The model was accurately simulating maize grain yield under varying hybrids, nitrogen levels, irrigation intervals and irrigation levels. This study provides farmers with practical guidance on optimal nitrogen levels, hybrid selection and irrigation practices to maximize maize production and ensuring efficient resource use.

December, 2024

(S. Sridhara)
Major Advisor

Genetics and Plant Breeding

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

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

1. GENOMIC SELECTION TO DEVELOP DISEASE RESISTANCE AND ENHANCE FRUIT QUALITY TRAITS IN TOMATO (*Solanum lycopersicum* L.)

(KEERTHIRAJ B.)

ABSTRACT

A study was carried out to develop a Genomic Selection model and to simultaneously select superior recombinants that will allow for developing disease-resistant, better quality and high-yielding hybrids. A diverse panel of multi-bi-parental populations consisting of 37 populations was developed by utilizing 48 superior inbred lines which belong to both round and square-round types of tomato. A total of 1619 individuals from 37 crosses were advanced to F_3>>F_4 generation through single seed descent method. Test-cross hybrids were developed from F_4 individuals, which were evaluated for yield and yield-related traits including quality traits at two locations across targeted *kharif* and *summer* in 2022. Results revealed significant variations among all the genotypes for all the traits. A significant positive correlation was identified for total yield per plant (GTYLD.P) with foliage health (FLGH), average fruit weight (AFW) and fruit firmness (FF). TaqMan genotyping was employed to obtain genotypic data after which the process of quality assurance and quality check identified 329 polymorphic SNP markers followed by 197 SNP markers with a minimum minor allele frequency of five *per cent*. The optimization process for the size of Training Population (TP) and markers set revealed that the accuracy of predicted Genomic Estimated Breeding Values (GEBVs) for all four key traits increased with the size of TP and marker set. Prediction Accuracies (PA) by ten different statistical models through a ten-fold cross-validation approach revealed the highest PA for GTYLD.P (0.39) and FF (0.35) by rrBLUP model, FLGH (0.34) by two models BayesA and BayesC and AFW (0.79) by Bayesian LASSO. In the independent validations, the PA was higher for all traits in full-sib population followed by half-sib and unrelated populations. Independent validations also confirmed that updating the TP and ensuring accurate phenotypic data is pivotal in achieving higher PA.

August, 2024

(R. Lokesha)
Major Advisor

2. STUDIES ON GENETIC AND ENVIRONMENTAL INTERACTION IN ADVANCED MAGIC LINES OF RICE (*Oryza sativa* L.) FOR DIFFERENT AGRO-CLIMATIC ZONES OF KARNATAKA

(HIREMATADA GANGADHAR)

ABSTRACT

Rice being an important staple food crop of the world is severely affected by various biotic and abiotic stresses. The current imperative is to combine desirable traits of different varieties and identify high yielding stable rice genotypes suited to varied agro-climatic regions with combined resistance towards biotic and abiotic stresses. In this context, the present investigation was carried out at ZAHRS, Shivamogga, involving MAGIC lines of rice (MF_6) developed by crossing eight elite founder varieties having suitable traits. The variability studies among the lines revealed higher GCV, PCV, heritability and GAM for majority of traits. Studied correlation and path coefficient analysis of the traits tillers per plant, productive tillers per plant, panicle length, number of spikelets per panicle, number of filled grains per panicle, panicle fertility, test weight and length/breadth ratio were positively associated with yield. Euclidian cluster analysis based on *k-means* grouped 100 MAGIC lines into eight clusters with maximum inter-cluster distance between cluster VIII and cluster V. The maximum contribution towards total divergence was from number of filled grains per panicle (21.69 %). Screening of MAGIC lines resulted in identification of promising lines namely; ML-1-1-2-1-39 and ML-2-10-5-1-18 for submergence tolerance and ML-2-8-8-2-23, ML-1-3-6-1-6, ML-2-7-3-1-2, ML-2-8-3-1-11, and ML-1-2-5-1-41 for blast reaction. The stability analysis was evaluated at ZAHRS-Shivamogga, AHRS-Kattalagere, AHRS-Ponnampete and ZAHRS-Mudigere. The MAGIC line ML-1-15-2-1-3 was most stable for grain yield, whereas the line ML-1-9-12-1-21 showed stable performance for most of the growth and yield contributing traits across the test locations. The MAGIC lines ML-2-7-2-10-51, ML-1-1-3-1-9 and ML-1-3-1-1-49 with least Genotypic Selection Index, showcased high stability with better performance. Hence, the identified promising lines could be further evaluated in farm trials and large-scale demonstrations at farmer's field.

January, 2024

(R. C. Jagadeesha)
Major Advisor

3.GENOME WIDE ASSOCIATION STUDIES FOR LOW SOIL PHOSPHOROUS TOLERANCE IN RICE (*Oryza Sativa* L.)

(HARISHA T)

ABSTRACT

Soil phosphorus (P) deficiency poses a growing challenge to rice cultivation globally, as it hampers the crop's growth and reduces productivity. Developing rice varieties with better adaptation to low soil P levels is a key strategy for promoting sustainable agriculture. The present investigation was carried out to identify the genomic regions associated to low soil P tolerance. An association panel of 245 rice genotypes along with 6 checks were screened in low P and normal P plots for various root architectural and yield attributing traits during *Rabi* 2021-22 and *Kharif* 2022 using augmented block design. Significant deviation among test genotypes were observed for all traits studied in both seasons under both conditions. Grain yield per plant showed significant and positive association with number of tillers, number of productive tillers, plant height, panicle length, thousand grain weight, spikelet fertility, shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight under low P condition. The study has also evaluated 25 rice genotypes of Shivamogga for low P tolerance. Germplasm lines *viz*., Akkalu, Doodaalur, Kanjaddu, Neerambade, Dambarsali, Karidadi and Kartha along with varieties such as Sahyadri kempumukthi and Jyothi biliya were outperformed low P tolerant check Swarna for grain yield and considered as tolerant lines. Genotyping of the association panel was performed using 1k-Rice custom Amplicon (1k-RiCA). Genome wide association studies revealed a total of 205 marker-trait associations (MTAs) for all the traits across seasons and conditions, in which 122 and 83 MTAs identified for low P and normal conditions respectively. The study also discovered 12 pleiotropic SNPs and 14 stable MTAs. Validation of the identified MTAs is crucial for utilization in marker-assisted breeding. Overall, this study gives valuable insights to the molecular mechanism underlying low P tolerance in rice.

August, 2024

(R. Lokesha)
Major Advisor

4. GENETIC STUDIES THROUGH GENERATION MEAN ANALYSIS, PHENOTYPIC AND MOLECULAR CHARACTERIZATION FOR SUBMERGENCE TOLERANCE IN RICE (*Oryza sativa* L.)

(ANILKUMAR LALASING CHAVAN)

ABSTRACT

The present experiment was carried out at ZAHRS, Shivamogga to evaluate genetic parameters related to submergence tolerance in 50 multiparent advanced generation inter cross (MAGIC) lines of rice along with eight checks, Analysis of variance revealed significant variations for all the traits, which indicates ample amount of variation in both submergence stress and control population. These genotypes were subjected for submergence screening and scoring was done according to IRRI standard guidelines. Molecular characterization for submergence tolerance also carried using 78 SSR markers which exhibited PIC value ranging from 0.73 to 0.09 illustrating high range of polymorphism in the population, marker trait association revealed R^2 value of 6.83 and 7.18 for RM1287 and RM8094 markers with the traits, number of tillers and number of filled grains per plant respectively. Generation mean analysis using six parameter model in cross Sahyadri Kempumukthi × Swarna sub1 revealed duplicate epistasis for traits, days to 50 *per cent* flowering, days to maturity, plant height, number of tillers per plant, panicle length, number of filled grains per panicle length breadth ratio and complementary epistasis recorded for traits, panicle fertility, test weight and grain yield per plant. The significance of additive gene effects for majority of the traits indicated that substantial improvement in yield can be achieved in rice by exploiting fixable components of genetic variance leading to the development of promising varieties in rice for submergence prone areas like low lands of hill zone in Karnataka. Markers with highest R^2 value from this population can be used for marker assisted selection (MAS) programs. Three genotypes (ML-1-1-2-1-39-15, ML-1-3-2-1-25-11 and ML-1-7-8-1-7-12) which are high yielding and tolerant to submergence were identified from this study can be proposed for multi-location trials to identify stable performing submergence tolerant genotype and can be utilized in developing potential varieties.

December, 2024

(Dushyanthakumar B. M.)
Major Advisor

5. PHENOTYPIC, MOLECULAR CHARACTERIZATION AND GENERATION MEAN ANALYSIS FOR SALINITY TOLERANCE IN RICE (*Oryza sativa* L.)

(SHARADA H. B.)

ABSTRACT

A study on salinity tolerance in rice was conducted using 50 MAGIC (Multi-parent Advanced Generation Inter Cross) lines and eight checks during *kharif* 2023 at ICAR-CSSRI, Karnal, under control and stress conditions (soil EC-8.00 dS/m, pH-7.5) in a randomized complete block design. Concurrently, a hydroponic study at the College of Agriculture, Navile, Shivamogga, evaluated MAGIC lines under NaCl concentrations (0mM, 80mM, 100mM and 120mM) during the early vegetative phase. The IRRI salt injury scale identified four and one tolerant line during vegetative and reproductive phases respectively. 66 SSR markers were utilized for molecular characterization which generated 108 alleles with the number of loci per primer varying from 1-5. The PIC value ranged from 0.034 to 0.98, depicting wide range of polymorphism within the lines studied. Clustering based on 66 markers generated six clusters with saline tolerant lines under cluster I, and saline susceptible lines under cluster VI. Based on single marker analysis markers *viz.*, RM333, RM237, RM336, RM162, RM215, RM2 and RM253 (R^2:12.451, 12.387, 11.834, 10.151, 9.948, 8.436 and 7.607 respectively) had highest R^2 values, which were associated with traits *viz.*, number of filled grains per panicle (NFG), number of tillers per plant (NT), Na^+/K^+ and root length under salt stress condition, making them useful for marker-assisted selection. The MAGIC line, ML-2-10-5-1-18 (M51) identified as both saline tolerant and high yielding, holds potential for multi-location and farm trials in Karnataka's coastal zone and salinity tolerance breeding programs. Additionally, generation mean analysis of the cross Sahyadri Kempumukthi × FL478 under saline conditions revealed duplicate epistasis for traits like panicle length, NFG, NT, and grain yield per plant. These traits can be improved via one or two cycles of biparental mating followed by recurrent selection. This study provides critical insights for developing salt-tolerant, high-yielding rice varieties.

December, 2024

(Dushyanthakumar B. M.)
Major Advisor

Plant Pathology

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Plant Pathology

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1. INVESTIGATIONS ON YELLOW LEAF DISEASE OF ARECANUT

(PREMALATHA, K.)

ABSTRACT

Yellow leaf disease (YLD) one of the most serious disease of arecanut in Chikkamagaluru and Dakshina Kannada districts of Karnataka. The disease symptom appears as yellowing of older leaves at the tips, followed by wilting and drooping. Eventually, the entire crown leaves turns yellows, wilts and falls off, leaving the bare trunk and affected kernels emits foul smell. Upon severity, disease known to cause 80 to 90 percent yield loss. Ambiguity prevails over the etiology of the disease which necessitated to re-examine both biotic and abiotic factors and their impact on yellow leaf disease of arecanut. The present study was conducted at Centre of Excellence, Dept. of Plant Pathology and Referral Soil Testing Laboratory, College of Agriculture, Shivamogga, IIHR, Bengaluru, College of Horticulture, GKVK,UHS Campus, Bengaluru and at Sringeri. Metagenomic analysis and molecular characterization revealed the presence of "*Candidatus* Phytoplasma aurantifolia" in YLD affected palms and scanning electron microscopic studies revealed presence of phytoplasmal bodies indicating its association with the disease. Early detection studies revealed the presence of phytoplasma in five year old palms and annual crops used as indicator hosts didn't revealed the presence of phytoplasma. Nutrient status in healthy and diseased affected gardens revealed the variation in the availability of both macro and micro nutrients. Diseased samples showed presence of higher amount of calcium, iron, manganese and copper, coupled with increased intensity of yellowing of the disease. Soil microflora studies revealed the presence of higher microbiome in healthy garden than diseased gardens. Among the microbes isolated from the soil, *T. asperellum* were found to be higher. However, among the bacterial population higher of gram-positive bacterial colonies were recorded. The present study revealed the association of phytoplasma with diseased palms whereas, microbial and nutrient status of the soil showed indirect correlation with YLD affected areca.

March, 2024

(B. Gangadhara Naik)
Major Advisor

2. INVESTIGATIONS ON BASAL STEM ROT OF COCONUT INCITED BY *GANODERMA* SPP. IN SOUTHERN PARTS OF KARNATAKA

(MANOJ, H. K.)

ABSTRACT

Basal stem rot of coconut caused by *Ganoderma* spp. is a lethal disease affecting coconut production in major coconut growing areas accounting to severe yield loss. *Ganoderma* spp. has a wide host range attacking varieties of palms, forest species, avenue and fruit trees. In the current study, two-year random roving survey was conducted in major coconut growing districts of southern Karnataka *viz.*, Tumkur, Hassan, Chikkamagaluru, Chitradurga, Davanagere, Mandya, Mysuru, Udupi, Shivamogga and Dakshina Kannada. Maximum disease incidence was observed in Tumkur (26.73 % & 27.95 %) followed by Hassan (23.31 % & 24.36 %) and minimum disease incidence was observed in Dakshina Kannada (5.89 % & 6.74 %) during 2021-22 and 2022-23 respectively. The colour, shape, pileus diameter, stipe, attachment pattern, margin pattern and surface pattern of sporocarps varied greatly in coconut and other related hosts. Molecular characterization revealed that, four species *viz., G. gibbosum, G. lucidum, G. applanatum and G. australe* were found to be infecting coconut and seven species *viz., G. ryvardenii, G. boninense, G. casuarinicola, G. gibbosum, G. mizoramense, G. carnosum* and *G. tropicum* were associated with other related hosts. Correlation between coconut basal stem rot and soil physico-chemical properties indicated that, disease development has strong positive correlation co-efficient with soil pH (0.59 & 0.64) and strong negative correlation co-efficient with organic carbon (-0.75 & -0.76) during 2021-22 and 2022-23 respectively. Evaluation of different modules revealed that 'module C' *i.e.,* root feeding with tebuconazole 50 % + trifloxystrobin 25 % WG @ 0.2 % (Quarterly intervals) + soil application of FYM (50 kg/palm/year) enriched with microbial consortia [*Trichoderma harzianum* + *Pseudomonas fluorescens* + *Bacillus megaterium* (50 g/palm)] followed by application of neem cake (5 kg/palm/year) was found effective, where less disease index (17.22) and maximum nut yield (88.44 nuts/palm) was recorded compared to other modules and control.

August, 2024

(R. Ganesha Naik)
Major Advisor

3. INVESTIGATIONS ON BANDED LEAF AND SHEATH BLIGHT OF MAIZE INCITED BY *Rhizoctonia solani* f. sp. *sasakii* EXNER

(RASHMI D)

ABSTRACT

Banded leaf and sheath blight disease incited by *Rhizoctonia solani* f. sp. *sasakii* Exner is prevalent in most of the maize growing regions of India. Random survey carried out in five major maize growing districts of Karnataka during 2022 and 2023 revealed highest mean per cent disease index in Shivamogga (54.46 %) whereas, least PDI was observed in Chitradurga (27.13 %) district. Virulence analysis of forty *Rhizoctonia solani* f. sp. *sasakii* isolates on maize hybrid LG 36601 revealed the highest disease severity of 47.38 per cent with the isolate MLSB-38. All the forty isolates were isolated from different geographical locations and were confirmed as *Rhizoctonia solani* f. sp. *sasakii* by their cultural, morphological and molecular characteristics. The obtained ITS sequences of all isolates were deposited in NCBI GenBank and their accession numbers were accessed. Further pathogen confirmation was done by using specific primers (GMRS-3, SMS-RS1 and AG1-1A). Vegetative compatibility of pathogen isolates using *R. solani* AG-1 tester strain, showed high fusion frequency of above 85 per cent. However, among different responses, C3 (complete anastomosis) was found to be the most common reaction observed, suggesting the possibility of appearance of new pathogenic strains in nature. Cross-infectivity studies on several weeds revealed that the pathogen is capable of infecting most of the weed hosts examined except two weeds (lantana and sessile joyweed). *In vitro* studies revealed that 10 per cent tulsi and turmeric in botanicals, whereas, among bioagents *Trichoderma harzianum* and with the fungicides, Carbendazim 12 % + Mancozeb 63 % WP at 200 ppm proved to be most effective against pathogen. In polyhouse and field tests, the IDM practice (tulsi+turmeric @ 20%, *Trichoderma harzianum* and Carbendazim 12 % + Mancozeb 63 % WP @ 0.2 %) found to be the most effective for managing banded leaf and sheath blight of maize.

December, 2024

(B. Gangadhara Naik)

Major Advisor

Soil Science and Agricultural Chemistry

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in

Soil Science and Agricultural Chemistry

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1. ASSESSMENT OF SECONDARY NUTRIENT STATUS IN ARECANUT (*Areca catechu* L.) GROWING SOILS AND THEIR MANAGEMENT IN MALNAD REGION

(RESHMA, K.)

ABSTRACT

A survey was taken up in the year 2022 in arecanut gardens of three selected taluks of Malnad region *viz*. Koppa, Sringeri and Thirthahalli. The soil samples were collected at surface (0-30 cm) and sub-surface depths (30-60 cm) and were characterized for secondary nutrient status. The pH of surface samples varied from slightly acidic to very strongly acidic and showed minor decline with depth. In all the three taluks, surface samples consistently exhibited a low soluble salt concentration. The results showed that 66.7 per cent of samples from Koppa, 56.7 per cent of samples from Sringeri and 53.3 per cent of samples from Thirthahalli showed deficiency in calcium (Ca) status whereas, 70.0 per cent of samples from Koppa, 63.3 per cent of samples from Sringeri and 73.3 per cent of samples from Thirthahalli showed deficiency in magnesium (Mg) status. All the soil samples from all the three taluks showed medium status for sulphur (S) content. Based on the assessed results from survey, an experiment was taken up at Agricultural and Horticultural Research Station (AHRS), Thirthahalli, Shivamogga to study the effect of graded levels and sources of Ca and Mg on their availability at different growth periods in arecanut from 2021 to 2022. Among the two different sources (lime + $MgSO_4$ and dolomite), calcitic limestone combined with magnesium sulphate increased soil acidity and soluble salt concentration more rapidly than dolomitic limestone, which proved that lime combined with magnesium sulphate was a better secondary nutrient source than dolomite. The application of Ca and Mg as nutrient source at an optimum dose of 600 g of lime per palm + 200 g of $MgSO_4$ per palm along with the RDF (T_5) showed improvement in exchangeable levels of Ca and Mg, along with an increase in available S in the soil.

January, 2024

(Sarvajna B. Salimath)
Major Advisor

2. STUDIES ON NPK DYNAMICS IN SOIL UNDER MAIZE AND GROUNDNUT BASED INTERCROPPING SYSTEMS IN RAINFED SITUATION

(SANTOSH)

ABSTRACT

A field experiment was conducted at Agricultural and Horticultural Research Station (AHRS), Bavikere, Tarikere taluk, Chikkamagaluru district, Karnataka during *Kharif* season of 2019 and 2020 to studies on NPK dynamics in soil under maize and groundnut based intercropping systems in rainfed situation and was laid out in split-plot design in which intercropping systems as main plot (M); M_1-Maize sole crop, M_2-Maize+Soyabean intercrop (4:2), M_3-Maize+redgram intercrop (8:2) and the second experiment with split-plot design as M_1-Groundnut sole crop, M_2-Groundnut + redgram intercrop (8:2), M_3-Groundnut+finger millet intercrop (4:2) and subplot as; S_1-Control, S_2-Rec. NPK(150:75:40), S_3-75 % of Rec. NPK(150:75:40)+Rec. FYM(7.5 t ha^{-1}), S_4-100 % of Rec. NPK(150:75:40)+Rec. FYM(7.5 t ha^{-1}), S_5-125 % of Rec. NPK(150:75:40)+Rec. FYM(7.5 t ha^{-1}) and were replicated in thrice. Among intercropping systems, maize+redgram with 125 per cent of Rec. NPK(150:75:40)+Rec. FYM(7.5 t ha^{-1}) recorded significantly higher maize plant height(242.34 cm), grain yield(6668.69 kg ha^{-1}) and stover yield (7931.3 kg ha^{-1}) and in maize+soybean intercropping systems higher plant height(238.02 cm), grain yield(4772.4 kg ha^{-1}) and stover yield(5788.29 kg ha^{-1}) of main crop was recorded over other treatments. Maize based intercropping systems significantly higher total uptake of nitroge(64.99 kg ha^{-1}), phosphorus(18.46 kg ha^{-1}) and potassium(69.34 kg ha^{-1}) was recorded in maize with S_5 over other treatments. Groundnut based intercropping systems, significantly higher number of pods per plant(33.48), pod weight per plant(26.33 g), test weight(35.02 g), pod yield(1575.53 kg ha^{-1}) and haulm yield(2512.54 kg ha^{-1}), total uptake of nitrogen (79.54 kg ha^{-1}), phosphorus(27.23 kg ha^{-1}) and potassium(54.17 kg ha^{-1}) recorded in 100 per cent of Rec. NPK(25:50:25)+ Rec. FYM(7.5 t ha^{-1}) over other treatments and S_5 was recorded significantly higher soil available nitrogen(246.92 kg ha^{-1}), phosphorus(46.25 kg ha^{-1}) and potassium(221.43 kg ha^{-1}) over other treatments after harvest. Similar trend was also observed on NPK fractions.

February, 2024

(Ganapathi)
Major Advisor

3. STUDIES ON CARBON, NITROGEN FRACTIONS AND SOIL PROPERTIES AS INFLUENCED BY DIFFERENT FARMING SYSTEMS UNDER CENTRAL DRY ZONE OF KARNATAKA

(KAYITHA VILAKAR)

ABSTRACT

A survey was taken up in 2022-23 in three selected taluks of the central dry zone *viz*. Hiriyur taluk (Chitradurga Dist.), Jagalur taluk (Davanagere Dist.) and Sira taluk (Tumakuru Dist.). The soil samples were collected in organic, conventional farming systems and barren lands in rainy, winter and summer seasons covering 0-30 cm, 30-60 cm and 60-90 cm depths. The majority of the soil samples (54 %) were noticed in neutral soil reaction, acidic (10 %) and alkaline (36 %). 73 per cent of the soil samples showed low and minor (2 %) of the samples recorded high in SOC (g kg^{-1}). 81 per cent of the soil samples were enlightened in low and 19 per cent with high in soil available N (kg ha^{-1}). In soil available P_2O_5 (kg ha^{-1}), the percentage of the samples listed with high was 6 and 45 per cent of samples displayed as low. In soil available K_2O (kg ha^{-1}), 38 per cent of the soil samples exhibited low, whereas, 11 per cent of samples marked with high. All soil labile carbon, nitrogen fractions, stocks, secondary nutrients, Fe, Mn, Zn and Cu were peaked in 0 to 30 cm, rainy season and organic farming, depressed in 60 to 90 cm, summer season and barren land. But, pH, BD and TIC followed reverse trend. Interestingly, soil available N, P_2O_5 and K_2O were registered higher in conventional farming than organic farming. Among all, organic farming, rainy season and 0 to 30 cm were bestowed.

December, 2024

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Major Advisor

Silviculture and Agroforestry

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Ph.D. theses abstracts produced in Silviculture and Agroforestry

1. ASSESSMENT OF SUPPORTING AND REGULATORY SERVICES IN COFFEE BASED AGROFORESTRY IN CENTRAL WESTERN GHATS

(DEEPTHI DECHAMMA N.L.)

ABSTRACT

The present study was conducted to assess supporting services (litter dynamics) and regulatory services (carbon sequestration and soil properties) in tree based landscapes *viz*., *Coffea arabica* with native shade trees, *Coffea arabica* with monoculture shade trees, *Coffea canephora* with native shade trees, *Coffea canephora* with monoculture shade trees and natural forests in two bioclimatic zones (evergreen and moist deciduous vegetation type) of Kodagu. Carbon sequestration potential of different land use systems ranged between 203.89 to 820.38 Mg C ha^{-1} in evergreen vegetation type and 182.42 to 631.12 Mg C ha^{-1} in moist deciduous vegetation type. Soil organic carbon (SOC) varied from 22.83 to 53.90 Mg ha^{-1}. In both the bioclimatic zones, forests exhibited higher carbon sequestration potential and SOC, followed by *C. arabica* with native trees. Soil physico- chemical and biochemical properties were significantly influenced by vegetation type, land use and soil depths. Forests and *C. arabica* with native trees exhibited higher values for soil properties and *C. canephora* with monoculture shade trees exhibited comparatively lower values. The mean annual litterfall production ranged from 2662.7 to 8387.0 Kg $ha^{-1}year^{-1}$, with highest litterfall under evergreen forest and the least under *C. canephora* with monoculture shade trees in moist deciduous vegetation type. The litter decomposition rate was faster in forests during season 1 (July to February) with higher decay rate coefficient and half-life values. The initial litter quality parameters varied with land use systems, vegetation types and seasons. SOC map was generated for coffee agroforests through co- krigging and SOC values ranged from 0.53 to 3.76 per cent. The study highlights the importance of incorporating native trees to ensure long- term sustainability of coffee agroforests.

October, 2024

(G.M. Devagiri)
Major Advisor