Agricultural Entomology

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

1. Taxonomy, Distribution and Diversity of Termite (ISOPTERA) Fauna of Western Ghats

VIDYASHREE, A.S. ABSTRACT

Western Ghats is one of the important biodiversity hot spots in the world, rich in flora and fauna including insects. The diversity of termites from this region has been poorly described. Studies were made to identify the species diversity existing in Western Ghats with their distribution pattern. A total of 42 termite species belonging to 13 genera and six subfamilies under two families viz., Rhinotermitidae and Termitidae were recorded. Termitidae was the most dominant family which represented 97.99 per cent with 37 species in eleven genera. Among the subfamilies, Macrotermitinae contributed the highest (81.11%) followed by Amitermitinae (7.36%), Nasutitermitinae (6.68%), Termitinae (2.84%), Coptotermitinae (1.34%) and Heterotermitinae (0.67%) in the overall collections. Highest number of species (18) collected belongs to two genera, namely Microtermesand Odontotermes of the subfamily Macrotermitinae. An illustrated identification key was developed for the termite species collected in the study area. The morphological identification is consistent with the molecular findings. Statistically distinct 16S rRNA profiles were observed in Amitermitinae, Macrotermitinae, Nasutitermitinae and Rhinoterminae. Species diversity and richness varied across three habitats. The forest habitat had more number of species (12) than plantation habitat (10) and pasture habitat (7). Distribution maps were developed for all collected species, however, the following species recorded in only one locality which includes Coptotermeskishori, C. heimi, Heterotermesbalwanti, Eurytermesbuddha, E. assmuthiassmuthi, O. bhagwatii, O. globicola, Nasutitermesgardneri, 0. horni. 0. peshawarensis, Trinervitermesnigrirostris, Angulitermesfletcheriand Dicuspiditermesincola. All the collected specimens were deposited in Department of Entomology, UAHS, Shivamogga.

March, 2017

(Kalleshwaraswamy, C.M.) Major Advisor

2. Reproductive Status, Burrowing Behaviour and Nonchemical Management of *Leucopholis* spp. (Scarabaeidae: Coleoptera) Infesting Arecanut

ADARSHA S. K.

ABSTRACT

Investigations on the reproductive status of adult beetles emerged and their burrowing behaviour was conducted between 2015 and 2017. Various nonchemical management strategies were also evaluated under field condition. Peak emergence of females was observed between 18:40-19:20 hrs, when light intensity fell to 83.62 lux. The highest number of males approached to virgin female at 18:50 hrs (15.99 lux) and terminated at 19:20 hrs (0.26 lux). Leucopholis lepidophora showed a unique mating behaviour with copulation period of 74.60 ± 6.61 min. Most of the emerged beetles were virgin females (51.62 %). Among the different female-baited traps evaluated, bucket trap with the plastic box was found to be significantly superior (14.14±0.9 males/trap/week). Mated females found to burrow deeper than male and virgin female beetles. Evaluation of different commercial formulations of entomopathogenic nematodes, bioagents and plant products indicated *Bacillus thuringiensis* 20g/palm was found to be effective whereas commercial formulations of EPNs such as Soldier, Grub terminator and Calterm super were found to be moderately effective against white grubs. Plant products also reduced the grub population which was not significant. However, in all the experiments, insecticide *i.e.*, Imidacloprid 17.8 SL @ 1.5ml/palm was found to be most promising followed by Chlorpyriphos 20 EC 6ml/palm. Underground drainage system with gravel soil and stone application was most effective among all the treatments and recorded the lowest larval population both around the palms (0.74 larvae/palm) and in between the palms (0.43 larvae/palm). Application of gravel soil and stone did not affect the physical property, chemical property and major nutrients like 'Phosphorus' and 'Potassium' except 'Nitrogen' in the soil. Insecticidal spray (Imidacloprid 17.8 SL @ 0.50ml/lit) with flooding for eight days brought the larvae to an upper surface of 15 cm and reduced the grub population of both L. lepidophora and L. burmeisteri.

October, 2017

(B. K. Shivanna) Major Advisor

3. Survey, Comparative Development of Rice Weevil, *Sitophilus oryzae* L. in Different Split Legumes and its Management Using Botanicals and Modified Atmospheric Methods NANDINI ABSTRACT

During 2015-17 an investigation was carried out at the Department of Agricultural Entomology, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga and Department of Processing and Food Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Raichur on Sitophilus oryzae L. in different split legumes. The survey of rice weevil, S. oryzae infestation and its larval parasitoid, Theocolax elegans (Westwood) was known to exist only on the split field bean dhal, split red gram dhal and split bengal gram dhal. Among the tested split legumes, the comparative development of rice weevil, S. oryzae was better in split field bean dhal being the most highly preferred host. The physical and biochemical analysis revealed that there was significant increase in adult population, protein, ash and moisture content and reduction in fat, fiber and carbohydrates. With respect to management of S. oryzae in split field bean dhal, among the different concentrations of tested plant products, sweet flag rhizome powder at one per cent was found to be significantly superior followed by cashew nut shell powder. Evaluation of two formulations of different plant products revealed that, solid formulation was found to be significantly superior compared to gel formulation. However, sweet flag rhizome powder at one per cent was found as effective as malathion (standard check). The effect of modified atmospheric gas concentrations showed that M1 (80 % N2: 0% O2: 20 % CO2) found to be significantly superior. Whereas, the effect of modified atmospheric gas (O₂ and CO₂) concentrations along with sweet flag rhizome powder at one per cent revealed that T_1 (80 % N₂: 0 % O₂: 20 % CO₂ + SF 1 %) was significantly superior with cent per cent mortality and no weight loss.

September, 2017

(M. Manjunatha) Major Advisor



University of Agricultural and Horticultural Sciences, Shivamogga

Ph.D. theses abstracts produced in Agronomy

1. Performance of Aerobic Rice based Intercropping System through Fertigation Technique in Southern Transition Zone of Karnataka

REKHA BADALINGAPPANAVAR

ABSTRACT

Field experiment on performance of aerobic rice based intercropping system through fertigation technique was conducted during *Kharif*2015-16 and 2016-17 atShivamogga. First experiment consists of two land configuration techniques and five intercropping systems laid in split plot design with three replications. Second experiment was laid in FRCBD on five intercropping systems to evaluate two levels of fertilizerssupplemented with foliar fertilization under rainfed conditions.

The results revealed that, raised bed method recorded higher rice yield of 55.09 q ha⁻¹(10 % higher) and water productivity of 118.28 kg ha-cm⁻¹(11% higher) over flatbed method. Among different intercrops, rice+french bean and rice+carrotrecorded 68.64 and 62.62 per cent higher rice equivalent yield with monetary advantage of ₹ 69,560 and 70,829 ha⁻¹, respectively and hence achieved higher B:C (3.20 and 2.92) compared to sole crop of rice.

Aerobic rice grown under rainfed situation indicated that, treatment receiving 100 per cent RDF supplemented with foliar spray of one per cent each 19:19:19 and 13:0:45 at maximum tillering stage and grain filling stage, respectively recorded significantly higher grain (39.39 q ha⁻¹) and straw yield (49.92 q ha⁻¹) thereby achieved 14.57 and 13.55 per cent higher compared to 75 per cent RDF with same dose of foliar fertilization. Among different intercrops rice+french bean and rice+carrot gave significantly higher rice equivalent yield of 78.36 q ha⁻¹ (73.32 %) and 73.25 q ha⁻¹ (62.02 %), respectively compared to sole crop of rice (45.21 q ha⁻¹) with monitory advantage of ₹ 42,481 and 40,203 ha⁻¹, respectively there by achieved higher B:C (3.93 and 3.71) compared to sole crop of rice.

Cultivation of aerobic rice through fertigation registered 42.99 and 100.32 per cent higher yield and water productivity, respectively and achieved 61.08, 72.83 and 72.83 per cent use efficiency of NPK respectively, over conventional method of fertilizers under rainfed conditions.

August, 2017

(H. K. Veeranna) Major Advisor

Genetics and Plant Breeding

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

1. Generation Mean Analysis for Cured Leaf Yield and Quality Traits in Flue Cured Virginia Tobacco (*Nicotiana tabacum* L.)

NETRAVATI

ABSTRACT

Tobacco is an important commercial crop in view of revenue generation, export earning and employment potential. Among all types of tobacco, Flue Cured Virginia (FCV) is the major exportable tobacco type and is mainly used in cigarette manufacturing. The yield levels in FCV tobacco has stagnated at 1500-1700 kg/ha in Karnataka. In the present situation of increasing input costs, to make tobacco cultivation more profitable to the farmers, it is necessary to breed varieties with an yield levels of 3000kg /ha or more. Considering the above facts and the economic importance of the crop, the present investigation was carried out at the College of Agriculture, University of Agricultural and Horticultural Sciences, Navile, Shivamogga during *Kharif* season of 2016, to understand the inheritance pattern of leaf yield and quality traits using biometrical technique - Generation Mean Analysis. Experimental material consisted of six generations of two crosses (TB-70 x TB-102 and TB-100 x TB-102) produced by crossing new donar parents for high yield and quality *viz.*, TB-70, TB-100 and TB-102. Gene effects for leaf yield and leaf quality traits were estimated.

Generation mean analysis revealed that dominance and dominance based gene effects were involved in the expression of most traits along with duplicate epistatis for most of the characters viz., like days to flowering, plant height, leaf area, fresh leaf yield, cured leaf yield, top grade equivalent in both crosses and leaf length, leaf area chlorophyll content and all leaf quality traits except reducing sugar (L) which could be exploited by biparental mating in segregating generations followed by pedigree selection.

A wide range of variability was observed for most of the traits under study in F_2 populations of both the crosses. High heritability coupled with high genetic advance was observed in leaf area per plant, fresh leaf yield, cured leaf yield, top grade equivalent and leaf quality traits indicating additive gene action and scope for practicing selection. In both the crosses, characters leaf length, leaf breadth, leaf area, fresh leaf yield and top grade equivalent showed significant positive correlation and days to flowering recorded negative correlation with cured leaf yield. Therefore, selection should be practiced by considering these characters for direct improvement of cured leaf yield.

The present study, revealed that the cross TB-70 x TB-102 was the potential source for improving the cured leaf yield and its component traits without sacrificing the quality and can be advanced for subsequent generation for identifying the promising cultivars.

January, 2017

(H. D. Mohan Kumar) Major Advisor

2. Studies on Submergence Tolerance Mechanism in Rice Germplasm Lines with Relation to Genetic, Molecular and Physiological Aspects

NISHANTH G.K ABSTRACT

The present investigation consisted of 525 rice germplasm lines laid out in augmented design to screen them for submergence tolerance in rainfed lowland areas of Nagara, Shivamogga during Kharif 2015. Among germplasm lines none of the lines have recorded 100% survival, twohave recorded 95-99% survival, 68 lines falls under 75-94% survival, under 50-74% survival rate 230 lines were observed. The lines which recorded more than 50 per centsurvival rate were selected to studyphysiological basis of tolerance, yield and yield related traits during Summer 2016. The analysis of variance indicated the presence of significantly higherdifference among the germplasm lines for most of the characters studied. High heritability was observed for all the traits. Genetic advance as per cent mean was high to moderate, yield per plant and number of productive tillers per plant recorded very high genetic advance as per cent mean.Cellulose content before submergence was maximum in IET21330 (251.40 mg/g) and minimum in KHP-10 (207.50 mg/g). Cellulose content after submergence highest in IET21330 (230.50 mg/g) and lowest was in KHP-10 (199.75 mg/g).Range for hemicellulose content was 118.75 mg/g (IET16907) to 135.00 mg/g (IET21465) in before submergence condition while in after submergence condition was 84.00 mg/g (IET14819) to 107.00 mg/g (IET21465). Cellulose and hemicellulose content depletion after submergence was more in susceptible germplasm lines compared to tolerant lines. Two allele specific SSR markers SC3 and ART5 were screened across 65 germplasm lines to find out the presence or absence of Sub1A and Sub1C locus responsinle for tolerance. Twelve lines have recorded positive to presence of Sub1A locus and 15 lines recorded positive to presence of Sub1C locus. Thirteen SSR markers revealed presence of high diversity.IET21464 was identified as suitable line with high yield for both submergence and non submergence condition. IET21465, AC38575, AC35323, IET21330 and IET6074 are the significantly superior, stable, physiological and molecularlevel.

August, 2017

(Dushyanthakumar, B. M) Major Advisor Plant Pathology

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

1. Diversity of *Exserohilum turcicum* (Pass.) Leonard and Suggs. and Genetics of Resistance vis-à-vis Integrated Management of Turcicum Leaf Blight in Maize

MANU T. G.

ABSTRACT

Maize is third major cereal crop of India. Among the diseases affecting maize, turcicum leaf blight (TLB) caused by Exserohilum turcicum is of worldwide importance. Survey for the incidence of turcicum leaf blight revealed that, the highest PDI among seven districts was noticed in Chickmagaluru district. Thirty two isolates from different parts of southern Karnataka showed significant differences in relation to radial growth, colony character, pigmentation and spore characters on potato dextrose medium.Shivamogga isolate was found to be fast growing and carrot agar, rye agar A, potato dextrose broth and Richard's broth were found to be better media. In nutritional studies, mannose and asperginewere found to be the best carbon and nitrogen sources respectively. Molecular variability studies showed that the primers SSR 23 and SSR 24 were polymorphicand variability exists among the isolates. Screening of germplasm revealed that, only nine lines were found to be resistant to the TLB diseaseat both the locations and during both the years. The six generation mean analysis indicated the significance of additive, dominance and additive x additive gene effects for TLB andbased on the opposite signs of [h] and [l] gene effects indicated the presence of duplicate gene interaction in the genetic control of turcicum leaf blight in the crosses CML 502 x CML 511 and CM 202 X CML 509. The SSR marker, bmc1767 acts as dominant marker and is tightly linked to the resistant trait against TLB. Among the fungicides, Tebuconazole, Propineb and Carbendazim 12% + Mancozeb 63%, whereas, amongthe botanicals, garlic bulb extract and bio-agent Trichodermaharzianum -2 were found to be effective in inhibiting the mycelial growth of E. turcicumin-vitro. In field conditions, spraying of Propiconazole showed least PDI with more yield and BC ratio in both years and at both locations.

March, 2017

(B. GangadharaNaik) Major Advisor

2. Studies on Pomegranate Wilt Complex Incited by *Ceratocystis fimbriata* Ell. and Halst. and *Meloidogyne incognita* Kofoid and Chitwood

IMRAN KHAN, H.S ABSTRACT

Pomegranate wilt complex incited by Ceratocystis fimbriata and Meloidogyne incognita is one of the important diseases which affect the crop in major growing regions of Karnataka. The disease was noticed in all districts surveyed in Karnataka, ranging from 17.11 per cent in Chickmagalur district to 33.91 per cent in Koppal district. Maximum incidence of wilt was observed in red sandy loam (38.40 %) and maximum soil population of Meloidogyne incognita recorded in Koppal district with RKI of 5.0. Cultural studies revealed that malt extract agar was found to be the best source for growth of all the isolates. Interaction studies revealed combined inoculation of C. fimbriata and M. incognita recorded least shoot, root growth and fastened the wilt incidence. Dendrogram obtained from RAPD analysis indicated three major clusters formed which separated Cf-R from rest of the isolates, The isolates from Cf-Ct, Cf-H, Cf-K, Cf-T and Cf-B were grouped in second cluster. While, third cluster consisting of isolates Cf-B, Cf-C and Cf-V. The average polymorphism percentage ranged from 33.33 to 83.20 per cent.RAPD profiles showed a high level of genetic variability among the isolates of C. fimbriata. Propiconazole recorded cent per cent inhibition of mycelial growth of C. fimbriata followed by hexaconazole. Trichoderma harzianum and Trichoderma viride were found to be the most effective under in vitro. Application of propiconazole along with carbofuran, neemcake and microbial consortium of T. harzianum and P. fluorescens along with vermicompost were found effective in reducing the incidence of wilt complex disease with highest B:C ratio of 2.23.

April, 2017

(H. Ravindra) Major Advisor

3. Morphological and Morphometrical Studies of *Meloidogyne graminicola* under different Soil Types of Major Rice Growing States of India

NARASIMHAMURTHY, H. B ABSTRACT

Of late, rice root-knot nematode (Meloidogynegraminicola) has emerged as a major threat throughout the world and it has occupied a place of 'National Pest' owing to its severity. This is a major constraint in successful rice cultivation leading to significant loss to the rice grower. Studieswere carried out with respect to morphology, morphometrics, identification of races, survival strategies under different soil and moisture regimes, galling pattern, biology and management using biocontrol agents. Morphological and morphometrical comparisons were made for 12 populations of *M. graminicola*, collected from different agroecological regions of India namely, Gujarat, Hyderabad, Assam, New Delhi, Orissa, Uttar Pradesh and different districts of Karnataka viz., Shivamogga, Mandya, Davanagere, Chikmagaluru, Kodagu and Udupi in respect of eggs, second stage juveniles and females by employing Duncan's Multiple Range Test and Multivariate Analysis with standardized Canonical discriminant function. Out of 12 M. graminicola populations, three populations namely, New Delhi, Shivamogga and Hyderabad appeared quite different from typical M. graminicola. In host range studies, all the tested cultivars were infected by M. graminicola, except cotton and bhendiwhere no galls were observed on these cultivars. However, North Carolina tomato cv. Rutgers was infected by this M. graminicola, hence, it is an indication of occurrence of new species/race in this location. Survival of M. graminicola studies revealed that, the location having sandy loamy soil, acidic soil pH, with least soil organic carbon, higher nitrogen, lower phosphorous and potassium with higher moisture content in the soil which recorded higher nematode population. Different galling patterns were observed from different locations, which may be the indication of new races/ species in rice. In biology study, second stage juveniles were attracted to the roots and moved towards the root tip. The infective second stage juveniles of *M. graminicola* entered the rice roots within 24 hrs of inoculation and they started feeding and became stationary. The duration of second, third, fourth and adult female stages lasted for 1-5, 6-8, 9-12 and 28 days respectively. The total life cycle including the preparasitic stage was 25-28 days. Among different bioagents tested, application of consortium of *P. fluorescens*+*T. harzianum*was found effective in reducing the incidence of *M.graminicola* with highest B: C ratio of 1:1.32.

September, 2017

(H. Ravindra) Major Advisor

4. Investigation on Ginger Rhizome Rot Complex with Special Emphasis on *Ralstonia solanacearum* (E.F. Smith) Yabuuchi *et al.*, in Southern Transition Zone of Karnataka.

NAGARAJA, H

ABSTRACT

Rhizome rot complex is one of the major constraint in ginger cultivation. causing heavy economic loss. In present investigations carried out on various aspects of ginger rhizome rot caused by R. solanacearumduring 2014 to 2016 with respect to survey, identification characters and management. During 2014-15 and 2015-16 survey, the maximum disease incidence of 29.54 % and 30.56 % and the minimum of 15.87 % and 17.74 % were recorded in Shivamogga and Bidar districts respectively. The isolated bacterium was confirmed as R. solanacearum, gram negative, rod shaped. The bacterial colonies on TZC medium exhibited white with light pinkish center and highly fluidal with copious slime. Biochemical characters revealed that, the bacterium showed positive for acid production from maltose, sucrose and dextrose, starch hydrolysis, hydrogen sulphide production, gelatin liquefaction, gas production, KOH solubility test, urease test and catalase test. Among thirteen ginger genotypes(IISR, Calicut)screened against bacterial rhizome rot complex, Varada genotype showed moderately resistant and other 12 genotypes showed susceptible reaction both under field and glass house condition. Among the botanicals, bioagents and antibacterial chemicals tested against R. solanacearum, neem leaf extract at 20% (12.43 mm). Pseudomonas fluorescens (Shivamogga isolate) (16.85 mm) and streptocycline + copper oxychloride at 500 + 300 ppm (29.38 mm) were found superior and showed maximum inhibition zone under in vitro condition. Integrated management of rhizome rot under filed condition, rhizomes treated with Streptocycline @ 0.5 g + COC @ 3.0 g/lit of water + soil application with neem cake 3q/ha followed by drenching with bleaching powder (33%) @ 2.0 g/lit + Metalaxyl MZ @ 1.0 g/lit for three time at 20 days intervals + Ginger special spray 45 DAS for three time at 20 days interval starting with initiation of the disease was effective and recorded less disease incidence of 14.23 % with higher yield of 110.27 q/h compared to other treatments and control. There was significant increase in the percent germination of rhizomes in solarized plot when compared to non solarized plot.

September, 2017

(H. Narayanaswamy) Major Advisor

Soil Science and

Agricultural

Chemistry

Ph.D. theses abstracts produced in

Soil Science and Agricultural Chemistry

1. Soil Quality and Other Properties as Influenced by Different Land Use Systems

in Jambadahalla Subwatershed, Tarikere, Chikkamagaluru District

NETHRAVATHI, B

ABSTRACT

An investigation was under taken at University of Agricultural and Horticultural Sciences, Shivamogga during the period of 2014 to 2016 to study the soil quality and related other properties as influenced by different land use systems in Jambadahalla subwatershed, Tarikere, Chikkamagaluru district. Based on soil type and cropping pattern assessment soil sampling was done on the basis of management zones and they were analysed for physical, chemical and biological properties. Soil profile studies were taken up, ten profiles were excavated and studied in the field for their morphological features and they were analysed for chemical and biological properties. physical, chemical and biological properties as influenced by different land use systems viz., natural forest, eucalyptus, arecanut, coconut, potato and maize were studied under red soils whereas in black soils four different land use systems viz., arecanut, coconut, potato and maize were studied. Laboratory incubation studies were carried out for a period of 60 days to study the effect of different land use systems on mineralisation of added N in soils. Physical, chemical and biological properties of soils under different land use systems determined in red and biological properties of soil quality indices (SQI).

The results indicated that among the various land use systems studied in red soils significantly higher levels of water stable aggregates (WSA), organic carbon stock (OCS), total microbial activity (TMA) and other properties were recorded in forest land use systems (77.5%, 24.23 Mg ha⁻¹ and 37.9 mg CO₂-C kg⁻¹ day⁻¹) and lowest values were recorded in the intensively cultivated maize land use system. Among the various land use systems studied in black soils significantly higher levels of water stable aggregates (WSA), organic carbon stock (OCS) were recorded in maize land use system (72.36 % and 24.20 Mg ha⁻¹ respectively) as it is followed on deep, clayey textured soils and the lowest values in the potato land use system.

Natural forest (0.46) followed by eucalyptus land use system (0.42) recorded highest soil quality index and maize land use system (0.32) recorded the lowest soil quality index among the different land use systems practised on red soils. The principal component analysis identified eight soil attributes including OC, Fe, Zn, and MWD contained in eight PCs accounting for an overall cumulative variance of 81.5 per cent. Maize land use system recorded highest soil quality index (0.40) and potato the lowest soil quality index (0.28) among the different land use systems practised on black soils. The principal component analysis identified seven soil attributes including TC, Mn, Ca and MWD contained in seven PCs accounting for an overall cumulative variance of 82 per cent. Organic carbon with highest communality factor of 97 per cent was the major contributor towards the variance in soil quality index among all the soil attributes studied in both red and black soils. Soil organic carbon and bulk density recorded very high communality value in the present study and hence it is implied that soil management practices need to be adopted at the farm level that increase the efficiency of organic matter cycling and maintain favorable soil structure to improve the soil quality.

April, 2017

(T. S. Vageesh) Major Advisor