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Annual Report 2023

भा.कृ.अनु.प.- राष्ट्रीय कृषि कीट संसाधन ब्यूरो

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ICAR–NATIONAL BUREAU OF AGRICULTURAL INSECT RESOURCES

Bengaluru - 560 024, India

Annual Report
2023

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ICAR–NBAIR Annual Report 2023

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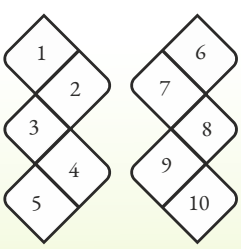

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ICAR–NBAIR Building (courtesy: Mahendiran, G.)

PREFACE

Insects constitute more than 70% of all the animal species and account for a considerable proportion of all biodiversity on the planet. This great variability is due to the specificity of the genetic, morphological, and functional aspects that different insect species have developed to successfully cope with the complex and dynamic habitats in which they live. Insects are also reliable indicators of environmental changes and resource in various economic sectors. On the other side, many insects are pests of agriculture and cause 15–20% yield loss in principal food and cash crops in India. The scenario on key pests of crops has been changing rapidly owing to climate change, injudicious use of chemical pesticides and other human interventions. Globalization and changing climates are also aggravating the occurrence and impacts of trans-boundary pests, and driving the emergence of new threats.

Studies on insect taxonomy and diversity offers great potential for managing insect pests. ICAR–NBAIR is pioneer in identification, characterization and utilization of a huge range of predatory and parasitic natural enemies and microbial pathogens in managing insect pests.

Preventing the spread of trans-boundary pests across countries and continents is difficult. Containing the spread of invasive pests requires a holistic approach. ICAR–NBAIR has the manpower and expertise in diagnosis and monitoring of new invasives and the ability to develop biocontrol interventions whenever an invasion occurs.

Recent advancements in genetic and genome editing research, augmented by the discovery of new molecular tools such as CRISPR, have revolutionised the field of genetic engineering by enabling precise site-specific genome modifications with unprecedented ease. These technologies have found a vast range of applications, including the development of novel methods for the control of insect pests.

In the year 2023, the institute continues to document the diversity of agriculturally important insects and methods involving molecular tools and non-chemical strategies for pest management.

The three divisions of ICAR–NBAIR, *viz.* Germplasm Collection and Characterization (GCC), Genomic Resources (GR) and Germplasm Conservation and Utilization (GCU) focussed on the mandate of the Bureau and churned out the following information to benefit the farmers, developmental agencies, policymakers and researchers involved in pest management.

Division of Germplasm Collection and Characterization conducted exploratory surveys for the documentation of arthropod biodiversity in India from January to December 2023 which resulted in the addition of 6063 specimens to the repository, collected from different agro-ecological regions. In addition, 23 isolates of entomopathogenic microbes were isolated and added to the repository. Fifteen new arthropod taxa were described. A total of 218 identification services were provided to researchers from agricultural universities, private companies and ICAR institutes.

Division of Genomic Resources complemented the taxonomic identity by generating DNA barcodes to identify agricultural and veterinary pests, parasitoids, predators, invasive pests, and pollinators. Molecular techniques facilitated the identification of many invasive and cryptic pests. Whole genome sequencing of two Indian insects was generated. Transcriptome analysis and RNAi machinery gene mining were carried out for identifying potential targets for RNA interference-based pest management strategies.

Division of Germplasm Conservation and Utilisation focuses on developing biological control and its compatible technologies. Housing the largest 'Live Insect and Insect-Derived Resources Repository' in Asia with 137 live insect germplasms and microbial isolates, ICAR–NBAIR has facilitated in the supply of 542.70 lakh live insects in 562 shipments and 146 shipments of microbials, to benefit the farmers and researchers. Non-chemical approaches involving semiochemicals were developed and the technologies were transferred to various firms.

To address the threat caused by the recently invaded cassava mealybug, *Phenacoccus manihoti*, ICAR–NBAIR has imported and developed the mass production protocol of the parasitoid, *Anagyrus lopezi*. Upon large scale releases of the parasitoids, the pest is under check now.

Over 115 papers were published in high-rated journals. In an attempt to celebrate the success of biocontrol, a Biocontrol Expo was organised at the Yelahanka campus of ICAR–NBAIR and more than 2000 farmers participated and got benefited.

The Annual Report is thus a compilation of our efforts and contributions in the area of basic research paving the way for applied research and technology commercialisation.

I would like to express my gratitude to Dr. Himanshu Pathak, Secretary (DARE) and Director General (ICAR) for his guidance and support. I am grateful to Dr. Tilak Raj Sharma, DDG (Crop Sciences), ICAR for his innovative ideas in research and guidance. I acknowledge the inspiration and support provided by Dr. Sunil Chandra Dubey, ADG (Plant Protection and Biosafety), ICAR.

I acknowledge the funding agencies such as ICAR, FAO, DST, DBT and other national agencies, who supported 34 externally funded projects for the financial year 2023.

I express my sincere admiration to the editorial team for bringing out the annual report in time.

I look forward to more productive years ahead.

Bengaluru
28 February 2024

S.N. Sushil
Director

1. EXECUTIVE SUMMARY

ICAR-National Bureau of Agricultural Insect Resources

Germplasm Collection and Characterisation

Exploratory surveys for the documentation of arthropod biodiversity in India during January–December 2023 yielded 124 species of Scarabaeidae (27 genera); 45 species of Tephritidae (16 genera); 31 species of Pentatomidae (27 genera); 17 species of Thripidae (11 genera); 1 species of Tessaratomidae; 6000 specimens of Hymenoptera; 2851 specimens of weevils; 278 specimens of aphids and coccids and 1143 specimens of spiders. Samples were collected from Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Lakshadweep, Maharashtra, Meghalaya, Tamil Nadu, Telangana and Uttar Pradesh. In addition, scarab specimens were also received from Arunachal Pradesh, Assam and Maharashtra for faunal studies.

Eleven isolates of *Heterorhabditis indica* and two isolates of *Steinernema indicum* were isolated from Karnataka and added to NBAIR's repository of entomopathogenic nematodes. A total of 123 isolates/species of *Steinernema*, *Heterorhabditis* and *Oscheius* nematodes were maintained on wax moth larvae.

Sixteen new taxa of insects, spiders and nematodes across the country were described. In Diptera, four new species of fruit flies, *Zeugodacus momordicae*, *Z. nasivittatus*, *Z. sinuvaittatus* and *Z. umiam*; in Hemiptera, one armoured scale, *Aulacaspis elettaria* and one pentatomid bug, *Dunnius barpetensis*; in Hymenoptera, two species of braconids, *Clinocentrus karbi* and *Syntretus curvatus*; in Thysanoptera, a new genus, *Nandithrips* and two species of thrips, *Hydatothrips longirostris* and *Nandithrips pouzolziae*; in Coleoptera, *Cnaphoscapus sternofovelus*; in Araneae, two species of spiders, *Afraflacilla adavathurensis* and *A. kerala* and in Rhabditida, two species of nematodes, *Steinernema indicum* and *S. shori* were described.

Revisionary works include a review of the Indian members of the subtribe Spinariina (Braconidae: Rogadinae); lectotype designation for *Araducta bella,* establishment of six new combinations and revision of two tribal statuses in Pentatomidae; redescriptions of two genera and six species of Pentatomidae; redescriptions of a terebrantian thrips and an armoured scale with illustrations.

New distributional records for India include three braconid genera, *Clinocentrus*, *Syntretus* and *Xynobius* and a mite genus, *Schizoglyphus*; two braconid species, *Xynobius chrysops* and *Spinaria westwoodi*; two fruit fly species, *Bactrocera abbreviate* and *Dacus vijaysegarani*; three terebrantian thrips species, *Dendrothrips glynn*, *Rhipiphorothrips concoloratus* and *Trichromothrips antidesmae*; one armoured scale, *Rutherfordia malloti* and one scarab beetle, *Cyphochilus tenzingyatsoi*.

New distributional records for the states in India include two scarab species, *Apogonia sequens* from Rajasthan and *Apogonia aerata* from Kerala; three spider species, *Langona tigrina* from Karnataka, *Phintella debilis* from Arunachal Pradesh and *Tetragnatha nitens* from South India (Tamil Nadu).

New host-parasitoid associations documented were: *Batotheca nigriceps* as a parasitoid of caterpillars feeding on *Psidium guajava*; *Spinaria spinator* for slug caterpillar on *Elaeodendron glaucum*; *Chelonus formosanus*, *Chelonus* nr. *blackburni* and *Coccygydium* sp. for fall armyworm (FAW); six parasitoid species, *Cotesia ruficrus*, *Meteorus* sp., *Glyptapanteles obliquae*, *Copidosoma floridanum*, *Campoletis chlorideae* and *Charops* sp. on the lepidopteran pest complex infesting menthol mint; five larval parasitoids, *Copidosoma* sp., *Glyptapanteles* sp., *Dolichogenidea* sp., *Aleiodes* sp. and *Parapanteles* sp. for *Helcystogramma hibisci* on *Abelmoschus moschatus*; *Diolcogaster* sp. as solitary parasitoid of *Pycnarmon cribrata* on *Vitex negundo*; *Telenomus* sp. as egg parasitoid for parasitoid of *Selepa discigera* on *Woodfordia fruticosa* and three parasitoid

species, *Trichogramma achaeae*, *T. chilonis* and *T. chilotrae* on the lepidopteran pests of menthol mint. *Trichogrammatoidea bactrae* on FAW infesting cruciferous vegetables.

New host records were: *Arachis hypogaea* for *Euphysothrips minozzii*; several host reports for three species each of Pseudococcidae, Coccidae and Diaspididae and two species of Monophlebidae.

Diagnostic keys were published for several insect taxa: Indian species of *Aulacaspis*, *Zeugodacus* and Spinariina. Annotated checklist for Indian Dryophthorinae and an updated checklist on thrips of Sikkim were prepared. Distribution map for Indian species of *Afraflacilla* and scarab species associated with sugarcane across India were prepared and geotagged. A database entitled "White grub fauna of India (Coleoptera: Scarabaeoidea: Scarabaeidae)" was prepared and published online. Generated QR codes with passport details including species identity, type locality, morphological characters, mt co1 gene sequence, DNA barcode and habitus images for economically important 20 white grub species.

A total of 218 identification services were provided to researchers from agricultural universities, private companies and ICAR institutes.

Genomic Resources

Molecular diagnostics was done for agriculturally important insect pests based on *CO1* gene, *ITS-2* gene, species specific markers, LAMP & Recombinase Polymerase Assay. Invasive pests like mango soft scale, *Fistulococcus pokfulamensis* and apple leaf blotch miner, *Leucoptera malifoliella* were identified using different molecular markers. Important pests like *Aplocera plagiata* (OQ195784), *Cydia pomonella* (OQ308608) and *Spodoptera frugiperda* (OQ352635) collected from Kashmir were identified. A species specific marker was developed for *Thrips parvispinus*. Recombinase Polymerase Assay (RPA) was developed for the molecular diagnostics and differentiation of *Zeugodacus tau* from other fruit flies like *Bactrocera correcta, Bactrocera dorsata, Bactrocera nigrofemoralis*, *Bactrocera syzygii*, *Bactrocera zonata* and *Zeugodacus cucurbitae*. RPA based molecular diagnostic assay was developed for cassava mealybug, *Phenacoccus manihoti* which made it possible to distinguish *P. manihoti* from seven other mealybug species like *Ferrisia virgata*, *Maconellicoccus hirsutus*, *Paracoccus marginatus, Phenacoccus solenopsis, Planococcus citri*, *Pseudococcus jackbeardsleyi* and *Pseudococcus longispinus*.

Biological and genetic investigations on broad mite, *Polyphagotarsonemus latus* indicated its high potential to develop resistance against various acaricides. The bioassay results for the fenazaquin-selected (FEN-SEL) population of *P. latus* exposed to diafenthiuron, dicofol, propargite and spiromesifen gave resistance ratios of 13.70, 17.55, 11.10 and 18.75 folds, respectively indicating moderate cross-resistance. Approximately 26 generations were required for a 10-fold increase in LC_{50} with a realized heritability (h^2) of 0.12 which suggests low genetic variation and high phenotypic variation.

From the *de novo* assembly of *Maconellicoccus hirsutus*, 120 CYP450 genes were mined, named, and categorized into 4 CYP clans. Around 10 genes belonging to RNAi machinery pathway were extracted from the *de novo* assembly of *M. hirsutus* and were then characterized. The key domains were predicted and the gene expression in different life stages, viz. crawler, nymph and adult were studied using qRT-PCR.

Mealybug specimens were collected from 13 states consisting of 37 locations and 60 different host plants. Morphological and molecular identification revealed that, most of the identified specimens belonged to *Phenacoccus solenopsis, Planococcus citri,* followed by *Dysmicoccus brevipes* and *Dysmicoccus neobrevipes*. Coconut was identified as a new host plant for mango mealybug, *Rastrococcus iceryoides.*

Insecticide resistant strain of *Trichogramma chilonis* was developed by giving selection pressure using emamectin benzoate 5% SG. Biochemical analysis revealed that the enzyme activities of carboxyl esterase and glutathione-s-transferase are higher in the resistant strain compared to the laboratory susceptible strain.

Microflora from black soldier fly was identified using molecular tools and was characterized using biochemical qualitative and quantitative assays. Microbial based organic waste degradation assays were conducted in the laboratory using black soldier fly associated microflora. *Bacillus subtilis* SF4-4 (GenBank Accession No. OR801702) was found to be the best producer of the hydrolytic enzymes like amylase, cellulase, protease, lipase and gelatinase. Poultry layer trials were undertaken by feeding the black soldier fly prepupal powder as a protein source in the diet of layer chicken.

Life cycle studies were carried out for isolates of *Heterorhabditis indica*, *Heterorhabditis bacteriophora*, *Steinernema abbasi*, *Steinernema carpocapsae*, *Steinernema feltiae* and *Steinernema glaseri* in four insect pest species (*Helicoverpa armigera*, *Hermetia illucens*, *Spodoptera frugiperda*, *Spodoptera litura*) which were compared with that of *Galleria mellonella*. EPN interactive functionalities were worked out among the EPN species and four insect species. Functional biology of infectivity of four nematode isolates, viz. Hi, SFNG, SCNG and DSSG with their doses and the number of insect larvae were studied.

ICAR–NBAIR EPN isolates, viz. *Heterorhabditis* sp. NBAIR EPN-IISc, *Heterorhabditis* sp. NBAIR EPN-Hb, and *S. glaseri* NBAIR EPN-DSSG cruised to find hosts; while *S. carpocapsae* NBAIR EPN-SCNG and *S. riobraave* ICAR–NBAIR EN-SrAKgel ambushed hosts. *Steinernema feltiae* ICAR–NBAIR EN-SfSFNG and *Steinernema* sp. were found to be intermediary in foraging with some characteristics of both ambush and cruise foragers.

Studies on transcriptomics of tritrophism resulted in identification of expressed bacterial toxin and related genes. MALDI-TOFF analysis and profiling of proteins during pathogenomics in *G. mellonella* and *S. frugiperda* indicated time-course relevance of certain proteins. Expressed protein details were archived at Japanese Protein Identification Data Repository, JPOST. Time-course gene expression in *G. mellonella* and *S. frugiperda* using Nanostring Custom Multiplexed assay provided information on important pathways.

Specific EPN isolates with lethal dose values and fitness attributes were identified for management of coleopteran, hemipteran, lepidopteran and stored grain insect pests. One prospective EPN isolate based on lab assays was identified for controlling thrips. Thermal range, a functional trait of EPN, was recorded for the NBAIR EPN isolates under lab conditions for better use of their formulations under different crop-climate situations.

Germplasm Conservation and Utilisation

The peak incidence of leaf folder *Parotis marginata* on Arabian jasmine was recorded during 27th SMW with 7.6 number of folded leafs/branch.

Sycanus versicolor Dohrn, a predatory stink bug was collected from the black soldier fly mass production unit of ICAR–NBAIR. Proper identification was ensured through morphological and molecular analyses. Biology, life table studies, feeding potential of *S. versicolor* were carried on different hosts. Greater wax moth, *G. mellonella* was identified as the ideal host for the mass rearing of *S. versicolor* and its feeding potential was high on okra fruit borer *Earias vitella*.

Thrips incidence was monitored on marigold. Peak incidence of thrips was observed during 38th SMW with 5.33 thrips/tap. Thrips species found on the marigold are *Thrips palmi* Karny *Thrips parvispinus* (Karny) *Thrips florum* Schmutz, *Neohydatothrips samayunkur* Kudô and *Microcephalothrips abdominalis* (D. L. Crawford).

Among the entomopathogenic fungi tested, *Beauveria bassiana* (NBAIR strain) reduced the marigold thrips population up to 54 percent compared the control. The incidence of thrips in chilly was observed from 43rd to 52nd SMW. The peak incidence was recorded during 48th SMW with 7.83 thrips/tap.

Predatory bugs and chrysopids were recorded feeding on *Thrips parvispinus* in chilli. In feeding potential study among all predators, *Orius* sp. was found to consume more number of *T. parvispinus* followed by *Geocoris ochropterus*, *Blaptostethus pallescens* and *Dortus primarius*. In cage study, maximum percent reduction in *Frankliniella schultzei* population over control was observed in *Lecanicillium lecanii* (Vl-8) +*Blaptostethus pallescens* treatment followed by Vl-8 and *B. pallescens*. *Dortus primarius* consumed more untreated *T. absoluta* eggs than Ma-4 treated *Tuta absoluta* eggs.

Explorative survey revealed the additional host plants and geographical distribution record for the recent invasive whiteflies. Further, extensive demonstrations and training on biocontrol agents for the invasive whiteflies were carried to sensitize the different stakeholders. Novel delivery system for the biopesticides using drone was attempted after obtaining remote pilot certificate and demonstrated at farmer's field.

Nest intruders and adaptive defence strategies of stingless bees during earlier stages of colony division were documented. The crowding effect of live larvae of *Tenebrio molitor* in the rearing trays over the food consumption, dry and wet weight of the larvae was studied. The temporal changes in the cannibalism of *T. molitor* and *Zophobas morio* exposed to different numbers of larvae in the rearing arena was studied. Non-bee floral visitors in fennel were documented.

Bacterial strains, *Pseudomonas fluorescens* and *Bacillus albus* were individually found effective against cabbage diamondback moth (*Plutella xylostella*). The microbial consortium containing these two bacterial strains was also found very effective against diamondback moth. Bioefficacy studies revealed that both the strains *Pseudomonas fluorescens* and *Bacillus albus* caused 65 to 72 % larval mortality with LC_{50} value of 8.85 x 10^3 cfu/ml for both the bacterial strains whereas LC_{50} value for bacterial consortium was 1.6 x 10^8 cfu/ml.

Isolation, purification and characterization of entomofungal pathogens were carried out and potential strains were deposited in ICAR–NBAIR microbial culture repository. *Metarhizium anisopliae* NBAIR–Ma35 was found very effective in management of FAW under field conditions. Invert emulsion formulation of entomofungal and entomotoxic bacteria strains were standardized for the management of fall armyworm.

Across all the essential oils tested, summated neuronal responses of *Callosobruchus maculatus* males in general were lower than females. Farnesal pheromone from *Corcyra cephalonica* male wing gland was characterized and synthesized. An international training program for the management of fall armyworm to participants from Nepal and Bangladesh was conducted with funding from USAID.

Developed methods and formulations for isolation identification, and converting pheromones into slow-release attractants for various pests: *Conopomorpha sinensis*, *Chilo sacchariphagus*, *Scirphophaga excerptalis*, *Spodoptera frugiperda*, *Amsacta albistriga, Virachola isocrates*, *Plocaederus obesus*, *Phthorimaea operculella*, *Melangromyza obtusa* and *Batocera rufomaculata*. Synthesized Octa decanal, (Z, Z)-9,12-Octa decadienal, (Z,Z,Z)-9,12,15-Octadecatrienal, and (Z,Z,Z)-3,6,9-Heneicosatriene molecules.

Recently, two invasive insect pests, apple leaf blotch miner, *Leucoptera malifoliella*, (Lyonetiidae: Lepidoptera) on apple in Union territory of Jammu & Kashmir and mango soft scale, *Fistulococcus pokfulamensis*, (Coccidae: Hemiptera) on

mango, jamun and other ornamental plants in and around Bengaluru and Hosur have been detected. Both have firmly established and continue to spread further without much scope for their containments.

All India Coordinated Research Project on Biological Control of Crop Pests

Biodiversity: Thirteen species of coccinellids and six species of syrphid fly were recorded from different cropping systems in Himachal Pradesh.

Plant diseases: NBAIR–TATP strain *Trichoderma asperellum* recorded lowest percent maize turcicum leaf blight disease index, highest growth promotion parameters and yield in maize. Same strain also recorded lowest percent rice blast, brown spot and sheath blight disease index, highest growth promotion parameters and yield in rice.

Pulses: In green gram, *Bacillus thuringiensis* NBAIR BtG4 2% @ 10ml/ lit. water was found effective in managing spotted pod borer, *Maruca vitrata*. In chickpea, seed treatment (@10 g/kg) and two soil applications (@ 5 kg/ha) with *Trichoderma harzianum* NBAIR strain at 25 & 50 days after sowing + spraying of *Bacillus thuringiensis* NIBSM Bt18 1% @10 ml/L two sprays at pod initiation and pod formation stage at 15 days interval found effective for the management of soil borne disease (Fusarium wilt) and pod borer, *Helicoverpa armigera*.

Vegetables: The entomopathogenic fungus formulation *Metarhizium anisopliae* ICAR–NBAIR Ma4 2 %WP @ 5ml/lit water was found effective against sucking pest complex infesting okra. BIPM treatment for the control of insect pests of tomato was statistically at par with chemical treatment.

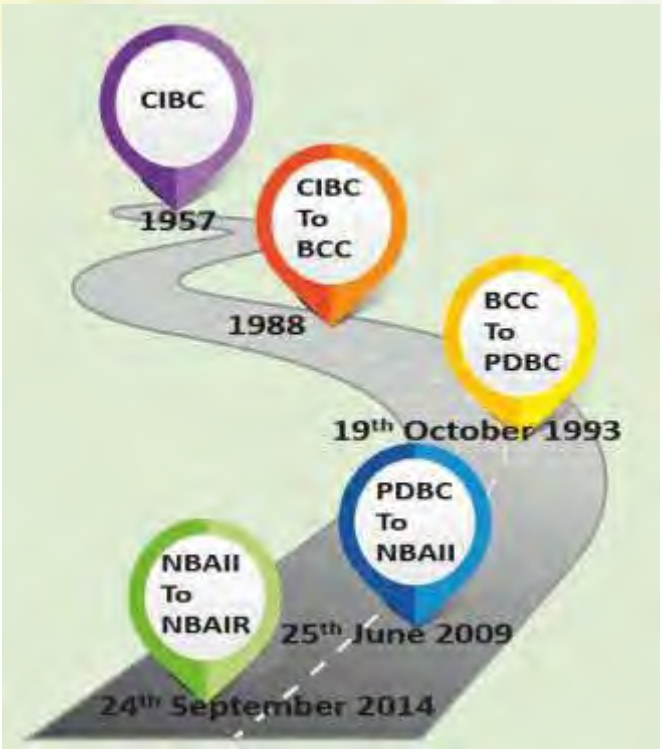
Temperate fruits: The high infestation of European red mite, *Panonychus ulmi* and two spotted spider mite, *Tetranychus urticae* (17.0 – 28%) was observed in the apple orchards of Bijbehara, Anantnag area of South Kashmir. The low infestation of codling moth, *Cydia pomonella* and less fruit damage was observed in the BIPM plots as compared to control plots in the apple orchards in Ladakh.

Plantation crops: Population of Bondar's nesting whitefly, *Paraleyrodes bondari* outnumbered rugose spiralling whitefly, *Aleurodicus rugioperculatus* in Kerala. Conservation biological control using the *aphelinid parasitoid, Encarsia guadeloupae,* neuropteran predator, *Apertochrysa sp.,* cybocephalid predator and coccinellid beetles in synergy with the sooty mould scavenger beetle, *Leiochrinus nilgirianus* reduced the invasive potential of exotic whiteflies in coconut system by 60%-70% thereby recouping the palm health in a period of four to six months in Kayamkulam, Kerala.

Tribal Subplan Programme (TSP): In Gujarat, two training and distribution programme under tribal sub plan (TSP) project in Chhotaudepur district of Gujarat were successfully conducted. The beneficiaries were distributed with tissue culture plants (pomegranate, mango, lemon, custard apple), in-house produced microbial biopesticides, Azadirachtin, pheromone traps and lures, yellow sticky traps, Knapsack sprayer, small hand operated farm implements and personal protection kit for spraying purpose. In Chhattisgarh, TSP activities were conducted at four different centers namely, Ambikapur (Surguja), Gariyaband, Dhamtari and Katghora (Korba) and about 400 tribal farmers were benefitted.

2. INTRODUCTION

ICAR–National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru had a long history of changes in names and objectives to cater effectively to the changing needs of the farming community of our country. The Indian station of the CIBC was established at Bengaluru in 1957 with the express purpose of promoting and strengthening biological control of agricultural pests including weeds in various parts of the world. Recognising the need for a national programme on biocontrol, the All India Coordinated Research Project on the Biological Control of Pests and Weeds (AICRP–BC) was launched by the ICAR with funds from the Department of Science and Technology, New Delhi in 1977 to cater exclusively to conceive and implement pest management programmes using bioagents (both indigenous and exotic) in the context of Indian Agriculture.



Having gained over a decade of experience in the field of biological control, the AICRP–BC took over the Indian Station of CIBC in 1988. The biological control programme from then on was totally national in character. This programme was coordinated by the Project Coordinator stationed at Bengaluru but under the administrative control of the National Centre for Integrated Pest Management (NCIPM), Faridabad for a short while. However, in the VIII five-year plan, the Bengaluru Centre was elevated to the Project Directorate of Biological Control (PDBC) with effect from 19 October, 1993. Subsequently in 2009, in the XI plan, the PDBC was upgraded to the National Bureau of Agriculturally Important Insects (NBAII) to act as a nodal agency for collection, characterization, documentation, conservation, exchange and utilization of agriculturally important insect resources (including mites, spiders and related arthropods) for sustainable agriculture. In the twelfth five-year plan during September 2014, the Bureau was re-named as National Bureau of Agricultural Insect Resources (NBAIR) and the bureau's activities are undertaken under three divisions. It won best ICAR Institute award in 1998 and Sardar Patel Outstanding Institution Award during the year 2015. The Bureau does not have any regional centres.

NBAIR Museum has been designated by the Ministry of Environment & Forests as the "National Repository" under the Biological Diversity Act, 2002 on 12th September 2012 for agriculturally important insects, mites & spiders. The National Insect Museum now holds around 0.25 million insect specimens which include 405 types. The Bureau has described nearly 500 new species in important insect groups such as Hymenoptera, Coleoptera, Diptera, Hemiptera, and Thysanoptera.

This is the only National Bureau under the National Agricultural Research System (NARS) that acts as the nodal agency for collection, characterisation, documentation, conservation, exchange, research and utilisation of agriculturally important insect resources

(including mites, spiders and related arthropods) for sustainable agriculture. Most of the specimens in the collection are Indian, but there is a unique representation of exotic beetles, wasps, flies and moths from various countries, including Australia, Argentina, The West Indies, Japan and USA. The museum is also unique in having one of India's largest collections of economically important taxa, including various biological control agents, viz. parasitic Hymenoptera, Coleoptera (Coccinellidae), along with major collections of groups with members which are pests, viz. Coleoptera, Hemiptera, Diptera, Lepidoptera, Thysanoptera and Orthoptera. Besides holding the world's smallest insect, *Kikiki huna*, in its collection, the museum also holds many undescribed species, and some species not found in other collections in the world. Online web diagnostic portals/web pages are hosted in NBAIR domain. Presently there are 25 databases in the NBAIR website.

ICAR–NATIONAL BUREAU OF AGRICULTURAL INSECT RESOURCES

Vision

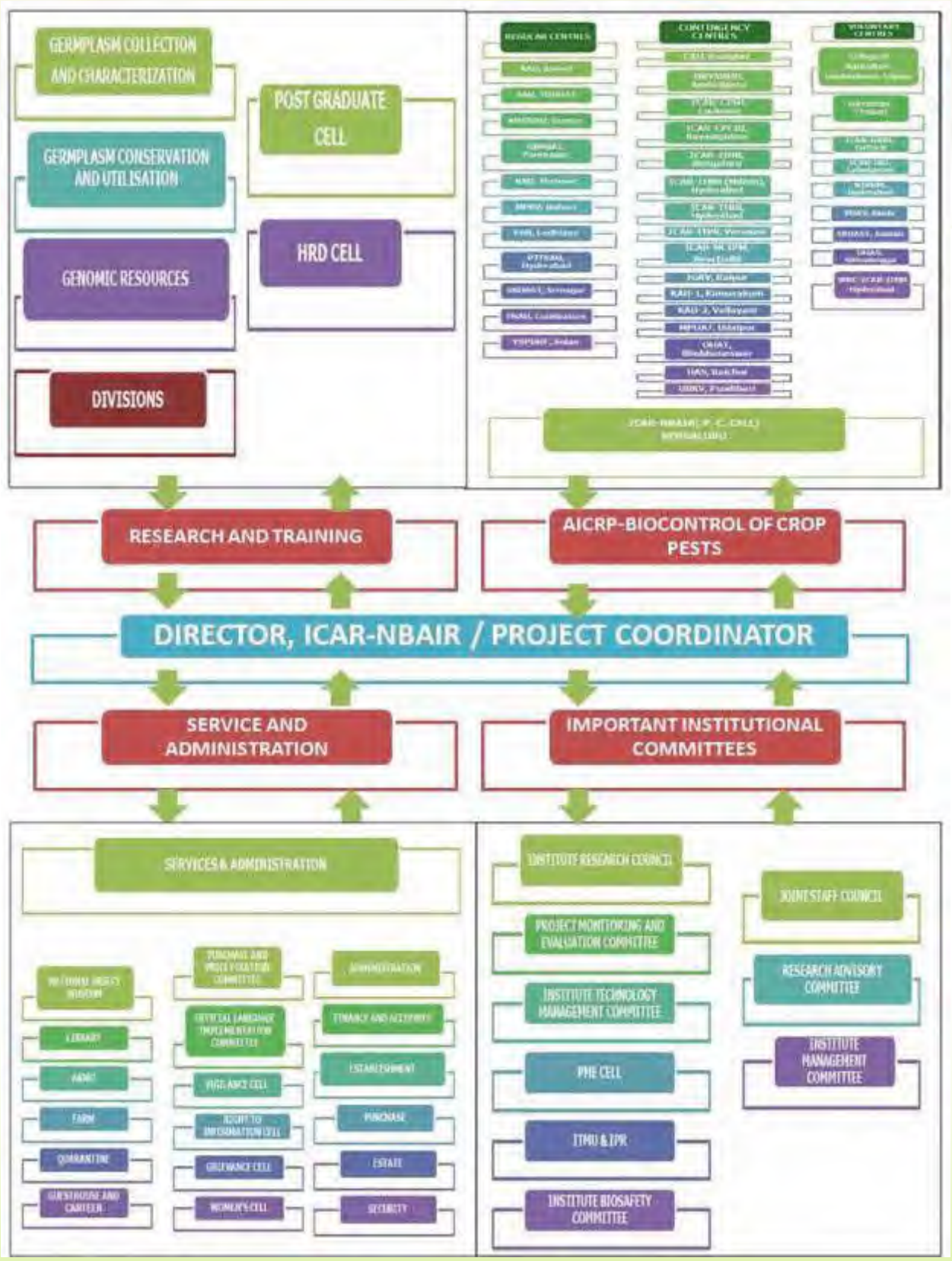
Catalogue, monitor, conserve and harness the biodiversity of agricultural insect resources, insect derived organisms and bioagents for sustainable agriculture ensuring biosafety, biosecurity and benefit sharing.

Mandate

To act as a nodal agency for collection, characterisation, documentation, conservation, exchange, research and utilisation of agriculturally important insect resources (including mites, spiders and related arthropods) and insect derived resources for sustainable agriculture.

Capacity building, development of technologies for non-chemical pest management, dissemination of technologies and forging linkages with stakeholders.

ORGANOGRAM


GERMPLASM COLLECTION AND CHARACTERIZATION
GERMPLASM CONSERVATION AND UTILISATION
GENOMIC RESOURCES
DIVISIONS
POST GRADUATE CELL
HRD CELL
RESEARCH AND TRAINING
AICRP-BIOCONTROL OF CROP PESTS
DIRECTOR, ICAR-NBAIR / PROJECT COORDINATOR
SERVICE AND ADMINISTRATION
IMPORTANT INSTITUTIONAL COMMITTEES
SERVICES & ADMINISTRATION
INSTITUTE RESEARCH COUNCIL
PROJECT MONITORING AND EVALUATION COMMITTEE
INSTITUTE TECHNOLOGY MANAGEMENT COMMITTEE
PME CELL
ITMU & IPR
INSTITUTE BIOSAFETY COMMITTEE
JOINT STAFF COUNCIL
RESEARCH ADVISORY COMMITTEE
INSTITUTE MANAGEMENT COMMITTEE

FINANCIAL STATEMENT 2023

ICAR–NATIONAL BUREAU OF AGRICULTURAL INSECT RESOURCES

HEADS	Amount (₹ in lakhs)
Pay & Allowance	1,436.31
TA	13.98
Other charges, including equipment and office building	469.24
Information technology	13.26
Works and petty works	9.31
HRD	4.80
Pension	84.46
Loan	25.00
Total	**2,056.36**

All India Coordinated Research Project on Biological Control of Crop Pests

Sl.No.	Name of the Centres	Salary	Capital	TA	RC	TSP	TOTAL (₹ in lakhs)
1	AAU, Anand	35.00	0.00	1.80	17.50	3.75	58.05
2	AAU, Jorhat	22.50	22.50	1.60	12.55	3.75	62.90
3	RARS –Anakapalli	17.50	0.00	1.25	15.95	4.50	39.20
4	PJSTAU, Telangana	17.00	0.00	0.85	7.45	2.50	27.80
5	Dr.YSPUH&F, Solan	26.00	0.00	2.10	5.75	1.50	35.35
6	GBPUAT, Pantnagar	17.50	0.00	2.10	5.75	7.00	32.35
7	KAU, Thrissur	16.00	0.00	0.90	12.20	0.00	29.10
8	MPKV, Pune	17.50	0.00	0.90	22.50	1.58	42.48
9	PAU, Ludhiana	27.50	0.00	1.80	11.00	0.00	40.30
10	SKUAST, Srinagar	22.50	0.00	1.90	3.00	2.25	29.65
11	TNAU, Coimbatore	19.60	0.00	1.55	10.00	0.00	31.15
12	MPUAT, Udaipur	0.00	0.00	0.65	1.25	4.00	5.90
13	OUAT, Bhubaneswar	0.00	0.00	0.40	0.40	0.00	0.80
14	CAU, Pasighat	0.00	0.00	1.25	7.10	0.00	8.35
15	UAS, Raichur	0.00	0.00	0.50	2.00	0.00	2.50
16	ICAR–CPCRI, Kayamkulam	0.00	0.00	1.05	3.28	0.00	4.33
17	ICAR–IIHR, Bengaluru	0.00	0.00	0.75	1.50	0.00	2.25
18	ICAR–IIRR, Hyderabad	0.00	0.00	1.20	1.40	0.00	2.60
19	ICAR–IIMR, Hyderabad	0.00	0.00	0.55	1.30	0.00	1.85
20	ICAR–IIVR, Varanasi	0.00	0.00	0.50	0.75	0.00	1.25
21	ICAR–NCIPM, New Delhi	0.00	0.00	0.65	0.50	0.00	1.15
22	IGKV, Raipur	0.00	0.00	1.15	3.50	6.42	11.07
23	KAU, Kumarakom	0.00	0.00	0.95	1.78	0.00	2.73
24	KAU, Vellayani	0.00	0.00	0.95	2.50	0.00	3.45
25	Dr. YSRHU, Ambajipeta	0.00	0.00	1.15	5.00	1.00	7.15
26	UBKV, Pundibari	0.00	0.00	0.90	2.50	0.75	4.15
27	UAHS, Shivamogga	0.00	0.00	0.00	0.75	0.00	0.75
28	SBI, Coimbatore	0.00	0.00	0.00	0.50	0.00	0.50
29	NIPHM, Hyderabad	0.00	0.00	0.00	0.5	0.00	0.50
30	SKUAST, Jammu	0.00	0.00	0.00	0.75	0.00	0.75
31	CRS, Tirupati	0.00	0.00	0.00	0.50	0.00	0.50
	Total	**238.60**	**22.50**	**29.35**	**161.41**	**39.00**	**490.86**

3. RESEARCH ACHIEVEMENTS

ICAR–National Bureau of Agricultural Insect Resources

Division of Germplasm Collection and Charterisation

Surveys and explorations

Surveys were undertaken to document the fauna of insects, spiders and entomopathogenic nematodes across Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Lakshadweep, Maharashtra, Meghalaya, Tamil Nadu, Telangana and Uttar Pradesh. Scarab specimens were received from Arunachal Pradesh, Assam and Maharashtra for faunal studies. Expeditions undertaken yielded, 124 species of Scarabaeidae in 27 genera; 45 species of Tephritidae in 16 genera; 31 species of Pentatomidae in 27 genera; 17 species of Thripidae in 11 genera; 1 species of Tessaratomidae; 6000 specimens of Hymenoptera; 2851 specimens of weevils; 278 specimens of aphids and coccids and 1143 specimens of spiders.

Description of a new genus

A new genus of terebrantian thrips, *Nandithrips* Rachana, Amarendra, Gracy and Reddy was described from India with *Nandithrips pouzolziae* Rachana, Amarendra, Gracy and Reddy as its type species. Thrips were collected from the flowers of *Pouzolzia petandra* subsp. *wightii* (Urticaceae) at Nandi hills, Karnataka.

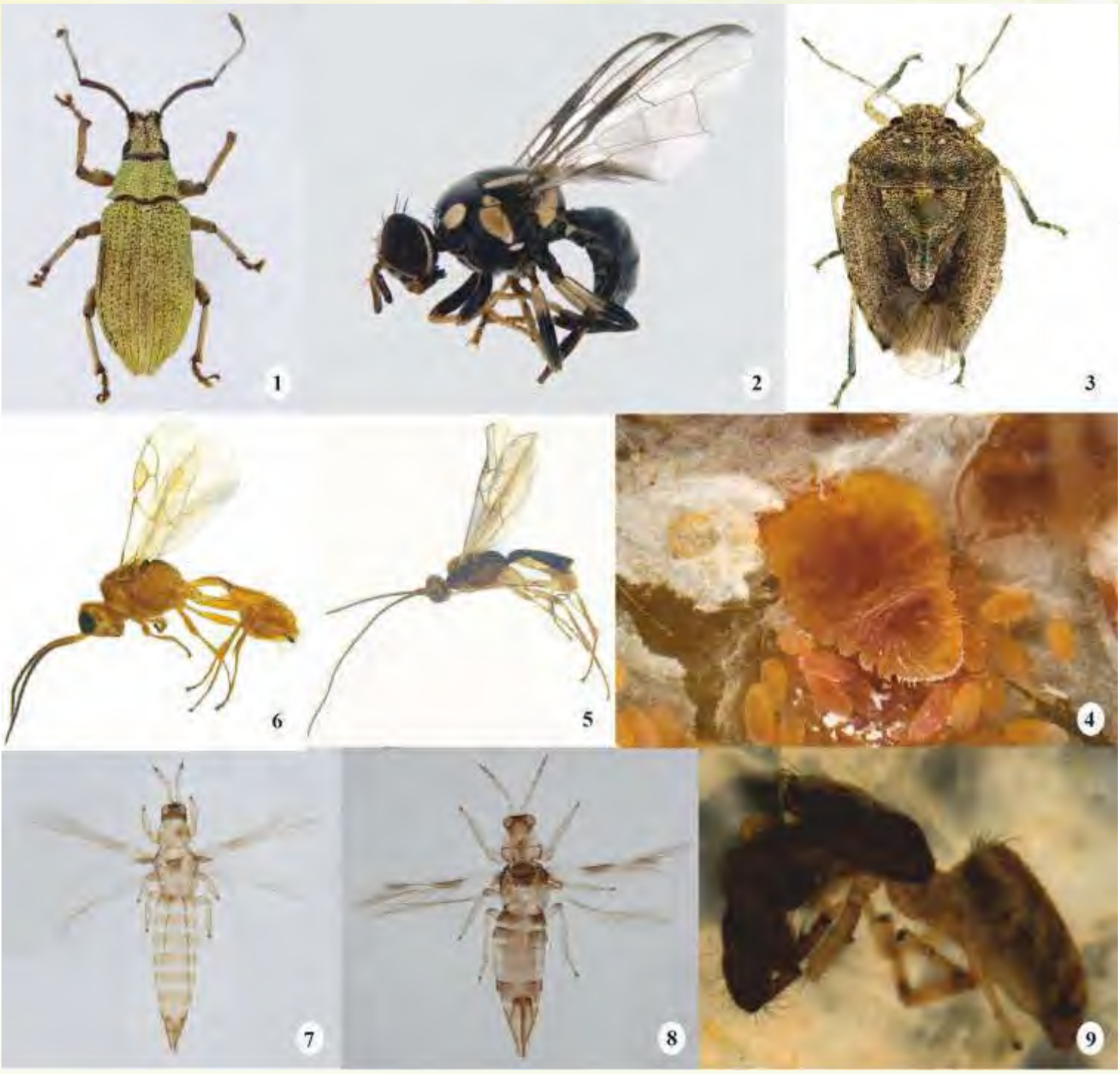
Description of new species

Eleven species of insects across various insect orders namely Coleoptera, Diptera, Hemiptera, Hymenoptera and Thysanoptera, two species of spiders and two species of nematodes were described. Four species of Tephritidae in a single genus, two species of Braconidae in two genera, two species of Thripidae in two genera, one each of Curculionidae, Diaspididae and Pentatomidae; two spider species of Salticidae in a single genus and two nematode species of Steinernematidae in a single genus were described from India (Table 1).

Table 1. List of new species described

Sl. No.	Scientific name	Family	Holotype deposited
	Coleoptera		
1.	*Cnaphoscapus sternofovelus* Mahendiran (Fig. 1)	Curculionidae	NBAIR, Bengaluru
	Diptera		
2.	*Zeugodacus momordicae* David & Ajaykumara (Fig. 2)	Tephritidae	NBAIR, Bengaluru
3.	*Zeugodacus nasivittatus* David & Abhishek	Tephritidae	NBAIR, Bengaluru
4.	*Zeugodacus sinuvaittatus* David & Abhishek	Tephritidae	NBAIR, Bengaluru

5.	*Zeugodacus umiam* David & Kennedy	Tephritidae	NBAIR, Bengaluru
	Hemiptera		
6.	*Dunnius barpetensis* Salini & Rabbani (Fig. 3)	Pentatomidae	NBAIR, Bengaluru
7.	*Aulacaspis elettaria* Joshi & Nafeesa (Fig. 4)	Diaspididae	NBAIR, Bengaluru
	Hymenoptera		
8.	*Clinocentrus karbi* Gupta & van Achterberg (Fig. 5)	Braconidae	NBAIR, Bengaluru
9.	*Syntretus curvatus* Gupta, van Achterberg & Pattar (Fig. 6)	Braconidae	NBAIR, Bengaluru
	Thysanoptera		
10.	*Nandithrips pouzolziae* Rachana *et al.* (Fig. 7)	Thripidae	NBAIR, Bengaluru
11.	*Hydatothrips longirostris* Rachana, Amarendra & Vanitha (Fig. 8)	Thripidae	NBAIR, Bengaluru
	Araneae		
12.	*Afraflacilla adavathurensis* Sampathkumar & Caleb (Fig. 9)	Salticidae	NBAIR, Bengaluru
13.	*Afraflacilla kerala* Babu, Tripathi & Caleb	Salticidae	NBAIR, Bengaluru
	Rhabditida		
14.	*Steinernema indicum* Patil *et al.*	Steinernematidae	NBAIR, Bengaluru
15.	*Steninernema shori* Soni *et al.*	Steinernematidae	NBAIR, Bengaluru



Figures 1–9. New taxa described from India. 1, *Cnaphoscapus sternofovelus* Mahendiran; 2, *Zeugodacus momordicae* David & Ajaykumara; 3, *Dunnius barpetensis* Salini & Rabbani; 4, *Aulacaspis elettaria* Joshi & Nafeesa; 5, *Clinocentrus karbi* Gupta & van Achterberg; 6, *Syntretus curvatus* Gupta, van Achterberg & Pattar; 7, *Nandithrips pouzolziae* Rachana *et al.*; 8, *Hydatothrips longirostris* Rachana, Amarendra & Vanitha; 9, *Afraflacilla adavathurensis* Sampathkumar & Caleb

Revisions/redescriptions of taxa

The Indian members of the subtribe Spinariina van Achterberg (Braconidae: Rogadinae) were reviewed. In Pentatomidae, the following new combinations were made: *Acesines sordida* (Kirby), *Dunnius laticeps* (Zheng & Liu), *Dunnius tridentatus* (Xiong & Liu), *Dunnius trifasciatus* (Xiong & Liu), *Mycterizon bellus* (Distant) and *Mormoschema immaculatum* (Distant). Two tribal statuses were revised: *M. bellus* was removed from Menidini and *M. immaculatum*, which was presently a member of Cappaeini was transferred to Eysarcorini. Lectotype was designated for *Araducta bella* (Distant). Redescribed two genera, *Acesines* Stål and *Dunnius* Distant. *Acesines bambusana* Distant, *M. bellus*, *Dunnius fulvescens*, *M. immaculatum*, *Codophila maculicollis* (Dallas), *Coptosoma variegatum* (Herrich-Schäeffer) were redescribed. Terebrantian thrips, *Euphysothrips minozzii* Bagnall and an armoured scale, *Aulacaspis madiunensis* (Zehntner) were redescribed with illustrations.

New distributional records

New distributional records for India include three braconid genera, *Clinocentrus* Haliday, *Syntretus* Foerster and *Xynobius* Foerster. Two braconid species, *Xynobius chrysops* Wu, van Achterberg, Sheng & Chen and *Spinaria westwoodi* Cameron were newly reported from India. In Diptera, two fruit fly species, *Bactrocera abbreviata* (Hardy) and *Dacus vijaysegarani* Drew & Hancock. In Thysanoptera, three terebrantian thrips species, *Dendrothrips glynn* Mound (Fig. 12), *Rhipiphorothrips concoloratus* Zhang & Tong and *Trichromothrips antidesmae* Li, Li & Zhang were recorded. An armoured scale, *Rutherfordia malloti* (Rutherford) (Fig. 10) was a new report for India. In Coleoptera, one species of scarab beetle, *Cyphochilus tenzingyatsoi* Sabatinelli was newly reported for India. A mite genus, *Schizoglyphus* Mahunka was a new report for India and the same was first time recorded on scarab larvae. Regarding new distribution records for the state; scarab species, *Apogonia sequens* Hans was recorded from Rajasthan and *Apogonia aerata* Moser from Kerala. Two salticid spider species viz. *Langona tigrina* (Simon) was reported from Karnataka and *Phintella debilis* (Thorell) from Arunachal Pradesh. The long-jawed spider species, *Tetragnatha nitens* (Audouin) (Fig. 11) was recorded from South India (Tamil Nadu).

New host-parasitoid associations

Batotheca nigriceps (Cameron) was reported to parasitise caterpillars feeding on *Psidium guajava* and *Spinaria spinator* (Guérin-Méneville) was reported to parasitise slug caterpillar on *Elaeodendron glaucum* in Karnataka. Three egg-larval parasitoids, *Chelonus formosanus* Sonan, *Chelonus* nr. *blackburni* and *Coccygydium* sp. were reported to parasitise fall armyworm in organic maize production fields.

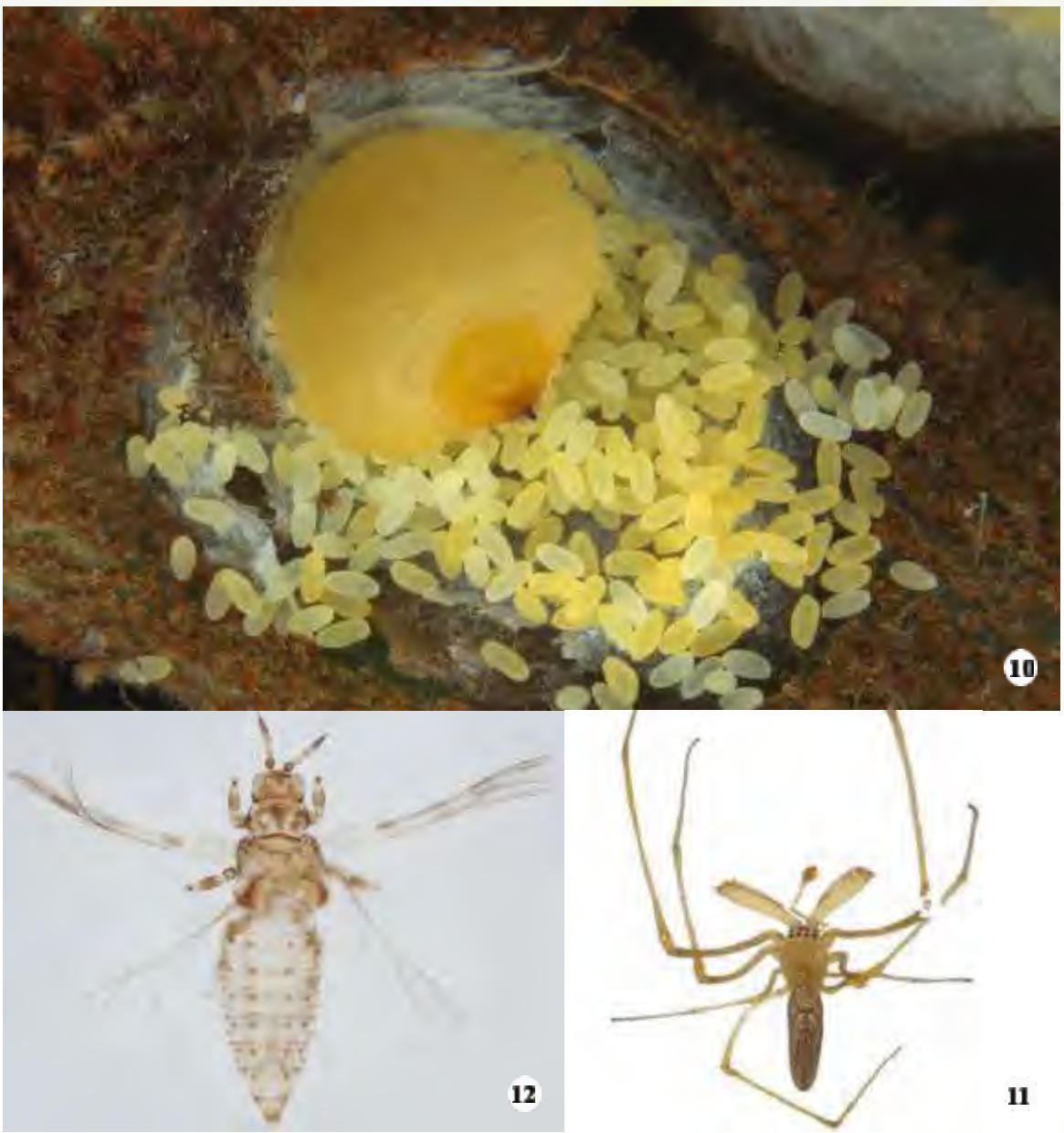
The following parasitoids associated with the lepidopteran pest complex infesting menthol mint were reported: braconid species, *Cotesia ruficrus* (Haliday), *Meteorus* sp. and *Glyptapanteles obliquae* (Wilkinson); encyrtid species, *Copidosoma floridanum* (Ashmead) and ichneumonid species, *Campoletis chlorideae* Uchida and *Charops* sp.

Parasitoids associated with various pests of medicinal plants at West Bengal were reported. Five larval parasitoids, viz. *Copidosoma* sp., *Glyptapanteles* sp., *Dolichogenidea* sp., *Aleiodes* sp. and *Parapanteles* sp. were recorded as parasitoid complex of *Helcystogramma hibisci* (Stainton) (Lepidoptera: Gelechiidae) on *Abelmoschus moschatus*. *Diolcogaster* sp. was recorded as solitary parasitoid of *Pycnarmon cribrata* (Fabricius) (Lepidoptera: Pyralidae) on *Vitex negundo*. Egg parasitoid, *Telenomus* sp. was recorded on parasitoid of *Selepa discigera* Walker on *Woodfordia fruticosa*.

Morphological and molecular characterization of platygastrid parasitoid, *Allotropa* sp. nr. *phenacocca* on cotton mealybug, *Phenacoccus solenopsis* was published.

New host records/pest records

Arachis hypogaea was reported as new host plant of *Euphysothrips minozzii* Bagnall. In Hemiptera, several new host reports were documented (Table 2). The intercepted hemipteran pests were identified (Table 3).



Figures 10–12. New distributional records for India. 10, *Rutherfordia malloti* (Rutherford); 11, *Tetragnatha nitens* (Audouin); 12, *Dendrothrips glynn* Mound

Table 2. New host plant associations of scale insects

Insect	Family	Host	Host family
Ferrisia virgata	Pseudococcidae	*Leucophyllum frutescens*	Scrophulariaceae
Pseudococcus jackbearsleyi		*Canna indica*	Cannaceae
Planococcus citri		*Sanchezia speciosa*	Acanthaceae
Planococcus bendovi		*Gmelina arborea*	Verbenaceae
Crisicoccus hirsutus		*Nephelium lappaceum*	Sapindaceae
Crisicoccus hirsutus		*Garcinia mangostana*	Clusiaceae
Pulvinaria ixorae	Coccidae	*Adenium obesum*	Apocynaceae
Coccus longulus		*Aglaonema* sp.	Araceae
Milviscutulus mangiferae		*Aglaonema* sp.	Araceae
Chrysomphalus aonidum	Diaspididae	*Plerandrae legantissima*	Araliaceae
Abgrallaspis cyanophylli		*Aechmea gamosepala*	Bromeliaceae
Lindigaspis rossi		*Stromanthe sanguinea*	Maranthaceae
Aulacaspis rosae		*Cycas revoluta*	Cycadaceae
Perissopneumon ferox	Monophlebidae	*Acalypha wilkesiana*	Euphorbiaceae
Icerya seychellarum		*Impatiens balsamina*	Balsamaceae

Table 3. Insects identified for Directorate of Plant Protection Quarantine and Storage (DPPQ&S) stations

DPPQ&S station	Date of interception	Fruit/plant imported	Country from which imported	Identified intercepted insect
Bengaluru	September 2023	Durian	Thailand	*Maconellicoccus hirsutus* *Planococcus* sp. *Pseudococcus* sp.
		Rambutan	Thailand	*Paraputo* sp.
		Mangosteen	Thailand	*Planococcus lilacinus*
Chennai	September 2023	Aster	Netherlands	*Aphis gossypii*
	January 2023	Apple	Maldova	*Eriosoma lanigerum*
Mumbai	January 2023	Kiwi	Iran	*Pseudaulacaspis pentagona*
	October 2023	Kiwi	Iran	*Pseudaulacspis pentagona*
	January 2023	Apple	Maldova	*Eriosoma lanigerum*

Development of diagnostic keys/ tools/ websites/checklists/distribution maps

Diagnostic keys to the following taxa were published

- Indian species of *Aulacaspis* Cockerell
- Indian species of *Zeugodacus* Hendel
- Indian species of subtribe Spinariina van Achterberg

Annotated checklist was prepared for Indian Dryophthorinae. An updated checklist on thrips of Sikkim was published. A distribution map of all the known Indian species of *Afraflacilla* was published. Distribution map of scarab species associated with sugarcane across India was prepared and geotagged. A database entitled "White grub fauna of India (Coleoptera: Scarabaeoidea: Scarabaeidae)" was prepared and published online. Catalogued 3575 specimens of Coccinellidae, 1207 specimens of Cerambycidae and 204 specimens of Scarabaeidae and coded 1209 specimens of Cerambycidae and 557 specimens of Elateridae preserved in the Insect Museum of NBAIR. Generated QR codes with passport details including species identity, type locality, morphological characters, *mtCo1* gene sequences, DNA barcodes and habitus images for economically important 20 white grub species.

Diversity studies

The species composition of white grubs associated with potato at Nilgiris, Tamil Nadu was determined. Out of 11 species collected from the ecosystem, seven species were found to be predominant, viz. *Holotrichia nilgiria, Miridiba coromandeliana, Maladera indica, Neoserica barberi, Anomala communis, Anomala ignicollis* and *Adoretus ovalis.* The predominant genus was *Maladera* with three species. *Maladera indica* dominated with 55% of the total population followed by *A. communis* (21%).

Division of Genomic Resources

Molecular diagnostics of invasive and emerging pests

Mango soft scale, *Fistulococcus pokfulamensis* is a soft scale which was reported for the first time from India. Samples of *F. pokfulamensis* were collected from several mango orchards of Chikkballapur district and also from Indian Institute of Horticultural Research (IIHR), Bengaluru in Karnataka. The insect specimens were molecularly characterised and accession number was generated by submitting to NCBI (Accession number: OR515185).

One of the most recent examples of host range expansion is the pear leaf blister moth/ apple leaf blotch miner (ALBM), *Leucoptera malifoliella* which is one of the serious economic pests of apple. It is considered as a significant temperate pest of apple in Asia and Europe and now, it has got introduced to Kashmir region of India. Larval populations of *L. malifoliella* collected from different localities (Anantanag, Kulgam, Pulwama, Shopian, Srinagar) across Kashmir were subjected to molecular characterisation and accession numbers were generated (OQ862291, OR514414, OR512054). Insect specimens were also received from Jammu and Kashmir, which are pests on apple, pear and many other temperate crops. The obtained accession numbers for the insect samples are as follows, *Cydia pomonella* (OQ308608), *Spodoptera frugiperda* (OQ352635) and *Aplocera plagiata* (OQ195784). Molecular identification of *Patialus tecomella* (Coleoptera: Curculionidae) (GenBank Accession No. PP054313), a notorious pest of an endangered tree, *Tecomella undulata* was done after morphology based confirmation.

Development of species specific markers for stored grain pests and *Thrips parvispinus*

Three stored grain pests, viz. *Callosobruchus maculatus*, *Sitophilus oryzae* and *Tribolium castaneum* were subjected to species specific marker studies. Different sets of primers were designed to check for the specificity and primers were identified which are specific to all the three species of storage insect pests. Evaluation of same primers with other stored grain insect pests in order to check their specificity is under progress.

Studies were also conducted for development of species

specific primers for *Thrips parvispinus*. Different sets of primers were designed to check for their specificity and were able to identify primers which amplify only *T. parvispinus*.

Recombinase polymerase assay for molecular detection

Rapid detection of the fruit fly, *Zeugodacus tau* was done by employing a Recombinase Polymerase Assay (RPA) using the primer, ZT1F-ZT1R designed based on sequence polymorphisms of *mtCo1* gene. The primer was found to be specifically amplifying only *Z. tau* and not other fruit flies like *Bactrocera correcta, Bactrocera dorsata, Bactrocera nigrofemoralis*, *Bactrocera syzygii*, *Bactrocera zonata* and *Zeugodacus cucurbitae*. The molecular diagnostic assay using RPA technique would be useful for the field level identification of the fruit fly.

Recombinase polymerase amplification based colorimetric detection assay was developed for rapid identification of invasive cassava mealybug, *Phenacoccus manihoti*. The assay was able to distinguish *P. manihoti* from seven other mealybug species like *Ferrisia virgata*, *Maconellicoccus hirsutus*, *Paracoccus marginatus, Phenacoccus solenopsis, Planococcus citri*, *Pseudococcus jackbeardsleyi* and *Pseudococcus longispinus*.

Molecular characterisation of other insects

Mealybug specimens were collected from 13 states comprising of 37 different locations from 60 host plants. The collected samples were subjected to morphological identification, and also molecular characterisation using mealybug specific primers, PCO F1 and Lep–R. Among the identified species of mealybugs, the most predominant species was *Phenacoccus solenopsis* followed by *Planococcus citri, Dysmicoccus brevipes* and *Dysmicoccus neobrevipes*. Coconut crop was found to be a new host for the mango mealybug, *Rastrococcus iceryoides*.

Honey bee samples collected from different parts of Karnataka like Bengaluru, Chetalli, Shivamogga etc. were processed for molecular characterisation using *mtCo1* gene and were identified as *Apis cerana* and *Apis mellifera*.

Genetics of acaricide resistance in broad mite, *Polyphagotarsonemus latus*

The broad mite, *Polyphagotarsonemus latus* is an important phytophagous mite that causes extensive damage to a wide range of crop species across the world. Fenazaquin, a Mitochondrial Electron Transport Inhibitor (METI), is one of the commonly used acaricides for the management of *P. latus*. The response to fenazaquin selection over generations and the risk of development of resistance was estimated through laboratory selection of a population of *P. latus*. The results revealed that repeated exposure to fenazaquin over generations resulted in decreased susceptibility (99.32 folds) of the selected population. It was observed that approximately 26 generations were required for a 10-fold increase in LC_{50} with a realized heritability (h^2) of 0.12 which suggests low genetic variation and high phenotypic variation (Fig. 13). The bioassay results for the fenazaquin-selected (FEN-SEL) population of *P. latus* exposed to diafenthiuron, dicofol, propargite and spiromesifen gave resistance ratios of 13.70, 17.55, 11.10 and 18.75 folds, respectively indicating moderate cross-resistance. The findings of the research suggest that rational application, rotation and sequential application of acaricides in the field should be considered to delay the development of resistance to fenazaquin and prolong its efficacy against *P. latus*.

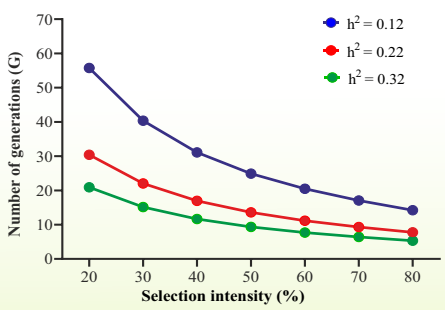


Figure 13. Effect of realized heritability on the number of generations of *Polyphagotarsonemus latus* required for a ten-fold increase in LC_{50} at different selection intensities

Evaluation of reference genes for gene expression studies in the broad mite, *Polyphagotarsonemus latus*

Investigations on the expression pattern of the genes responsible for acaricide resistance through quantitative real-time polymerase chain reaction (qPCR) require selection of one or more internal control or house-keeping genes. Since, the expression stabilities of these internal control genes vary among the species and life stages, it is indispensible to validate the expression stabilities of house-keeping genes before using one or few of them as the suitable internal control in qPCR experiments. The expression stability of six housekeeping genes, viz. actin, elongation factor (*EF-1α*), glyceraldehyde-3-phosphate-dehydrogenase (*GAPDH*), ribosomal protein 49 (*RP49*), ribosomal protein S18 (*RPS18*) and β-tubulin (*TUB*) were investigated. By integrating the results of different algorithms into the RefFinder tool, *RPS18* and *RP49* were selected as highly suitable reference genes on the basis of their stable expression pattern (Fig. 14).

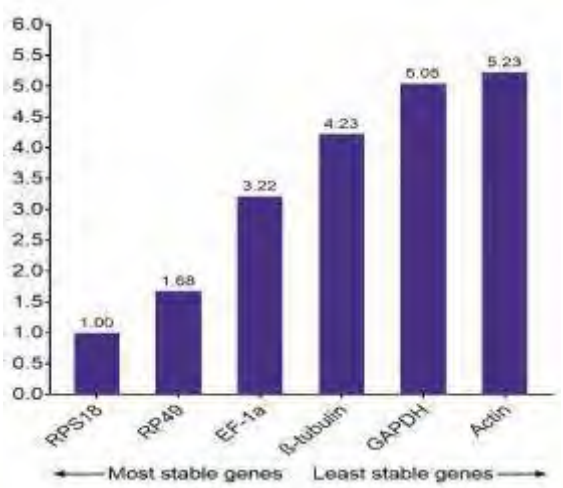


Figure 14. Expression levels of candidate reference genes in terms of the Ct-values across resistant and susceptible populations of *Polyphagotarsonemus latus*

Whole transcriptome sequencing of pink mealybug, *Maconellicoccus hirsutus* and studies on RNAi

From the *de novo* assembly of *Maconellicoccus hirsutus*, 120 *CYP450* genes were mined, named, and categorized into four CYP clans. Based on phylogeny, Clan 2 consisted of a total of eight CYPs under six families and two subfamilies while, clan 3 included a total of 48 genes under five families and 15 subfamilies. Clan 4 included 57 CYP genes under six families and 18 subfamilies. Mitochondrial clan consisted of seven CYP genes under five families. In total, 22 CYP450 families with 30 subfamilies were obtained where CYP 6 was observed as the largest family. Further, expression levels of eleven CYP450 genes, viz. *CYP4G219*, *CYP6PZ25*, *CYP4C105*, *CYP305A22*, *CYP315*, *CYP4461R1*, *CYP15A*, *CYP3638G6*, *CYP3638C1*, *CYP6TX1* and *CYP4NW1* were studied at different developmental stages by qRT-PCR.

Around 10 genes belonging to RNAi machinery pathway were extracted from the *de novo* assembly of *M. hirsutus* and were characterized. The key domains such as ArgoMid, ArgoL1, ArgoL2, Piwi, PAZ, Helicase were predicted. Further, the gene expression and validation of RNAi machinery genes by qRT-PCR in different life stages, viz. crawler, nymph and adult were studied. It was observed that the expression of RNAi machinery genes was notably elevated in both nymph and adult stages when compared to that of crawler stages. In nymphs, Argonaute-1, Argonaute-3, Dicer-1, Drosha-N and Loquacious were up-regulated. However, in adults, Argonaute-1, Argonaute-2, Argonaute-3, Dicer-2, Dicer-4, Drosha, Drosha-N, Loquacious and RISC were up-regulated (1.5 - 5.3 folds).

Development of improved strains of selected natural enemies for insecticide resistance

In order to develop insecticide resistant strains, the insecticide Emamectin Benzoate 5% SG (Proclaim) was used for giving selection pressure to *Trichogramma chilonis*. The insecticidal sprays were done starting with half the field dose, i.e., 19 mg in 100 ml/190 ppm. A total of 43 sprays were undertaken, every time with a slightly higher dose. The last spray done was with 2.85 g in 100 ml/ 28,500 ppm (which is 75 times the field dose).

Detoxifying enzyme studies were undertaken to decipher the

metabolic basis of insecticide resistance. Protein estimation of the resistant strain and laboratory susceptible strain of *T. chilonis* was done using Bradford's method by monitoring the formation of Coomassie blue-protein complex which has an absorbance maximum at 595 nm. The protein content estimated for the susceptible strain and resistant strain of *T. chilonis* were 1.935 µg/µl and 3.157 µg/µl respectively.

The carboxyl esterase activity was estimated by microplate assay using α–naphthyl acetate as substrate and Fast Blue BB salt as staining solution in the susceptible and resistant strains of *T. chilonis*. The esterases catalyse the hydrolysis of carboxylic esters to free acid and alcohol. It was measured by the product formed from substrate α–naphthyl acetate to α–naphthol which was monitored at 590 nm. The enzyme activity in nano moles/mg of protein/min for the susceptible strain and resistant strain of *T. chilonis* were 286.12 and 293.39 respectively.

Glutathione-s-transferases catalyse the conjugation of 2,4-dinitro-chlorobenzene (CDNB) with reduced glutathione to produce a yellow product that has an absorbance maxima at 340 nm which was monitored using a UV-vis-Spectrophotometer. The enzyme activity in µmoles/mg of protein/min for the susceptible strain and resistant strain of *T. chilonis* were 1742.120 and 3816.411 respectively.

Microflora associated with insects and their role in farm waste management

Fifth instar black soldier fly (*Hermetia illucens*) larvae which were reared only on kitchen waste without *Corcyra* waste (main treatment 1) yielded a total of 10 microflora and were identified using 16S rRNA gene sequences as *Bacillus cereus, Cedecea neteri, Enterobacter asburiae*, *Prestia aryabhattai* and *Prestia magaterium.* Biochemical characterization of microflora for hydrolytic enzymes like amylase, lipase, and protease using qualitative and quantitative assays revealed *Bacillus cereus* (BSFK2) to be the best degrader of starch, cellulose, protein and lipid releasing 1.01 µg of maltose, 0.99 µg mol of glucose, 0.89µg of tyrosine and 0.63 µg of paranitrophenol/min/ml followed by *Prestia magaterium* (BSFK9) and *Prestia aryabhattai* (K5). Another set of black soldier fly larvae reared on kitchen waste along with *Corcyra* waste (main treatment 2) yielded 13 microflora among which *Bacillus subtilis* (SF4-4) (GenBank Accession No. OR801702) was found to be the best producer of the hydrolytic enzymes like amylase, cellulase, protease, lipase and gelatinase releasing 1.62 µg of maltose, 1.23 µg mol of glucose, 1 µg of tyrosine and 1.16 µg of paranitrophenol respectively (Fig. 15). Based on the qualitative and quantitative analysis of these microflora, small scale degradation trial in lab condition with 6 treatments (Fig. 16) consisting of *Bacillus cereus* BSFK2, *Bacillus cereus* BSFK7, *Prestia aryabhattai* BSFK5, *Prestia magaterium* BSFK9 from T1 along with *Bacillus subtilis* SF 4-4 and *Klebsiella pneumoniae* 5-1 from T2 were undertaken. Results revealed that kitchen waste in T1 inoculated with *Bacillus subtilis* (SF4-4) showed faster degradation followed by T2 inoculated with *Bacillus cereus* (BSFK2).

Black soldier fly prepupal powder was prepared for poultry layer trials and nutrition analysis was carried out after feeding as a protein source in the diet of layer chicken. White leghorn layers were used and response criteria like egg production, feed intake, feed conversion ratio, egg weight and egg quality were measured after replacing routine diet with protein source for 3 months. The study was undertaken in collaboration with ICAR–NIANP, Adugodi, Bengaluru.

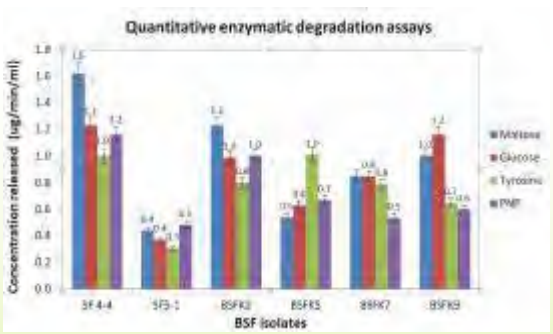


Figure 15. Quantitative enzymatic degradation assays with black soldier fly associated microflora

Figure 16. Small scale organic waste degradation trial with black soldier fly associated microflora

Studies on entomopathogenic nematodes

Biology and functionality of EPN isolates

Life cycle studies were carried out for native isolates of two species of *Heterorhabditis* and four species of *Steinernema* in four insect pest species (*Helicoverpa armigera, Hermetia illucens*, *Spodoptera litura*, *Spodoptera frugiperda*) and were compared with that of *Galleria mellonella.* EPN interactive functionalities were worked out among the EPN species and four insect species. Functional biology of infectivity of four nematode isolates, viz. Hi, SFNG, SCNG and DSSG with their doses and the number of insect larvae were studied. Number of larvae that penetrated the insect hosts over time recorded a positive correlation at 8 and 24 hours of exposure with the increased concentration of nematodes per larva. Further, the number of IJs which penetrated the larvae recorded a negative correlation with the host larval number at each single concentration at 8 and 24 hours of exposure period. Dose dependent mortality was recorded at all doses at 24, 36 and 48 hours of exposure. The larval mortality was relatively lower at different concentrations and exposure periods when the number of host larvae were increased from single to five larvae per treatment.

ICAR–NBAIR EPN isolates, viz. *Heterorhabditis* sp. NBAIR EPN-IISc, *Heterorhabditis* sp. NBAIR EN-Hb, and *Steinernema glaseri* NBAIR EN-DSSG cruised to find hosts; while *Steinernema carpocapsae* NBAIR EN-SCNG and *Steinernema riobrave* ICAR-NBAIR EN-SrAKgel ambushed hosts. *Steinernema feltiae* ICAR-NBAIR EN-SfSFNG and *Steinernema* sp. were intermediary in foraging with some characteristics of both ambush and cruise foragers.

Thermal range, a functional trait of EPN, was recorded for the NBAIR EPN isolates under lab conditions using *G. mellonella.* Thermal niche breadth for reproduction was widest for *S. glaseri* (16–35°C) and the narrowest for *S. carpocapsae* (20–30°C). *Steinernema riobrave* (20–35°C), and *Steinernema* sp. (20–35°C) were more adapted to warm temperature for reproduction, and *S. feltiae* to cooler temperatures (15–25°C). Although heterorhabditids are endemic to warmer climates, the upper thermal limits and temperature optima differed between *Heterorhabditis indica* and *Heterorhabditis bacteriophora*.

Expression profiling of genes by Nanodrop nCounter array

Time-course gene expression in *G. mellonella* and *S. frugiperda* was studied using Nanostring Custom Multiplexed assay. In this study, NanoString technology gene expression quantification platform was used to study the expression of toxin genes causing infections from bacteria (*Photorhabdus* and *Xenorhabdus*), nematode (*H. indica, S. riobrave, S. carpocapsae*) specific genes for detection and immune related genes from the infected insects. Accession IDs of *Spodoptera frugiperda* for the transcript samples include GSM 5929282, GSM 5929283, GSM 5929284, GSM 5929285, GSM 5929286 and GSM 5929287, while the Accession IDs of *G. mellonella* samples are GSM 5929288, GSM 5929289 and GSM 5929290 under the Bioproject PRJNA11794/GES197737.

MALDI-TOF analysis and profiling of proteins during pathogenesis indicated time-course relevance of certain proteins. Expressed protein details were archived at Japanese Protein Identification Data Repository, JPROT. The accession number for the first set of submission is PXD048520 for ProteomeXchange and JPST002452 for jPOST. The accession number for the second set of submission is PXD048759 for ProteomeXchange and JPST002455 for jPOST.

Draft DNA genome sequence of *Xenorhabdus* and *Photorhabdus* sp.

Ten samples of symbiotic bacteria associated with entomopathogenic nematodes were isolated, DNA extracted, quality tested and the DNA was used for whole genome sequencing using high throughput Illumina sequencing services. Draft genome SRA data (PRJNA1044235) was submitted to the NCBI GenBank and accession numbers were obtained.

- SAMN38376418 : Sample 11A (TaxID: 333964)
- SAMN38376419 : Sample 11B (TaxID: 333964)
- SAMN38376420 : Sample 20A (TaxID: 333964)
- SAMN38376421 : Sample 20B (TaxID: 333964)
- SAMN38376422 : Sample SFNG (TaxID: 333964)
- SAMN38376423 : Sample SFG (TaxID: 333964)
- SAMN38376424 : Sample AKG (TaxID: 351673)
- SAMN38376425 : Sample AG (TaxID: 351673)
- SAMN38376426 : Sample Menase (TaxID: 3098088)
- SAMN38376427 : Sample Kashmir (TaxID: 3098088)

Fitness attributes of EPN

The biocontrol potential of 40 EPN strains belonging to *H. bacteriophora*, *H. indica*, *Heterorhabditis* sp., *Steinernema abbasi*, *S. carpocapsae*, *S. feltiae*, *Steinernema* sp., and *S. riobrave,* in terms of virulence, environmental tolerance (to heat, desiccation, and cold), host seeking ability etc was studied. Virulence assays were carried out against 12 species of pests belonging to Coleoptera and Lepidoptera. Most isolates infected *G. mellonella* between 16° and 37° C with higher fecundity at 25-30° C. Biocontrol potential was variable among nematode species and among the host species.

Simultaneous detection of gene expression of insects, nematode and bacterial specific genes to monitor the infection

NanoString technology gene expression quantification platform was used to study the expression of toxin genes causing infections from bacteria (*Photorhabdus* and *Xenorhabdus*), nematode (*H. indica, S. carpocapsae, S. riobrave*) specific genes for detection and immune related genes from the infected insects (*S. frugiperda* and *G. mellonella*). The study revealed the expression of different immune related genes from the infected insects (*G. mellonella* and *S. frugiperda*) and helped in understanding the trend of expression of genes in the samples from the healthy condition to the death stage. Variations in gene expression were seen as per the expectation. Accession IDs of *S. frugiperda* for the transcript samples include GSM5929282, GSM5929283, GSM5929284, GSM5929285, GSM5929286 and GSM5929287, while the Accession IDs of *G. mellonella* samples are GSM5929288, 289, GSM5929GSM5929290.

Division of Germplasm Conservation and Utilisation

Incidence of leaf folder on Arabian jasmine

The incidence of leaf folder, *Parotis marginata* (Lepidoptera: Crambidae) on Arabian jasmine was recorded from 26th Standard meteorological weeks (SMW) to 39th SMW at Yelahanka campus of NBAIR. Peak incidence of the pest was recorded during 27th SMW with 7.6 number of folded leafs/branch (Figs 17 & 18). Two braconid parasitoids were recorded on the larvae of *P. marginata*.

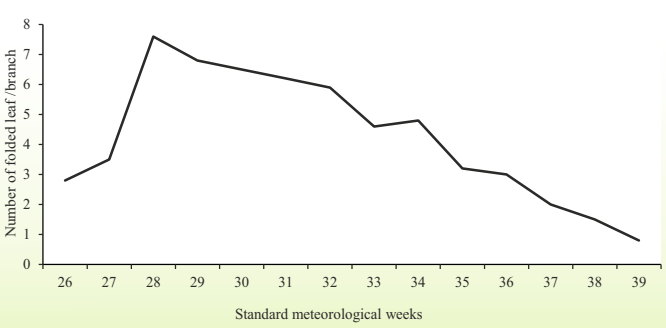


Figure 17. Incidence of leaf folder on Arabian jasmine


Figure 18. Incidence of *Parotis marginata* on Arabian jasmine

Biology of *Sycanus versicolor* on different hosts under laboratory conditions

Sycanus versicolor, a predatory stink bug was collected from the black soldier fly mass production unit of NBAIR. Proper identification was ensured through morphological and molecular analyses. *Sycanus versicolor* biology was studied on three hosts, *Corcyra cephalonica, Hermetia illucens* and *Galleria mellonella. Sycanus versicolor* exhibited a varying degree of host specificity. The life cycle was very short on *G. mellonella* compared to that of *C. cephalonica* and *H. illucens.* On *G. mellonella,* bug completed its incubation period, I II, III, IV nympal instars in 8.30±1.30, 9.30±1.17, 10.15±1.60, 10.40±1.57, 12.55±1.88 days, respectively. The nymphal duration of male and female fifth instar was completed in 12.86±1.95 and 13.92±2.06 days, respectively. Adult male and female have completed its life span in 21.29±2.98 and 27.46±2.40 days, respectively. While it displayed a strong preference for *G. mellonella* species (Fig.19), it also demonstrated the ability to feed on a wide range of hosts. This suggests a potential for ecological versatility in bio- control applications.

Figure 19. Feeding of *Sycanus versicolor* on *Galleria mellonella*

Life table studies of *Sycanus versicolor* on different hosts

Life tables were constructed for *S. versicolor* populations on different hosts, documenting key demographic parameters such as age-specific survival rates (lx), age-specific fecundity (mx), and the age-specific reproductive value (vx). Survivorship curves (Fig. 20) were generated to illustrate the survival patterns of *S. versicolor* populations on different hosts. The effects of host-dependent factors on overall survival were analysed. *Sycanus versicolor* exhibited variations in demographic parameters and survivorship curves across different hosts. Survival rates, fecundity, and reproductive values varied significantly, indicating host-specific influences on population dynamics. Among the host studies, high intrensic rate of increase (r) was on *G. mellonella* (0.333). Survivorship curves indicated that *S. versicolor* populations on *H. illucens* exhibited prolonged longevity (23.69 days) and enhanced survival rates compared to others. This study underscores the importance of host-specific considerations in understanding the life table dynamics of *S. versicolor.*

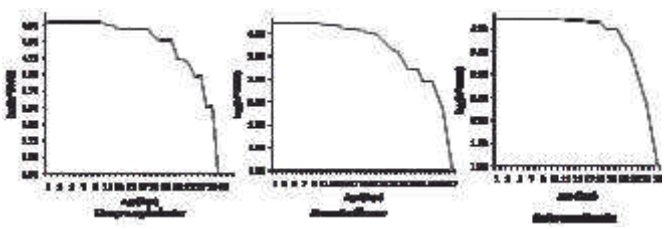


Figure 20. Survivorship curves of *Sycanus versicolor* on different hosts

Feeding potential of *Sycanus versicolor* on different agriculturally important pests

Feeding potential of *S. versicolor* study was carried out on different agriculturally important pests. Adult female of *S. versicolor* exhibited a high feeding potential on okra fruit borer *Earias vitella* (24.12 ±2.12) compared to that of *Orthaga eudrusalis* and *Spodoptera litura*.

Population dynamics and species composition of thrips on marigold

Occurrence of thrips was observed on marigold from 35th to 42nd SMW with peak incidence during 38th SMW (5.33 thrips/tap). Thrips species found on the marigold are *Thrips palmi*, *Thrips parvispinus*, *Thrips florum* , *Neohydatothrips samayunkur* and *Microcephalothrips abdominalis* (Figs 21 & 22).

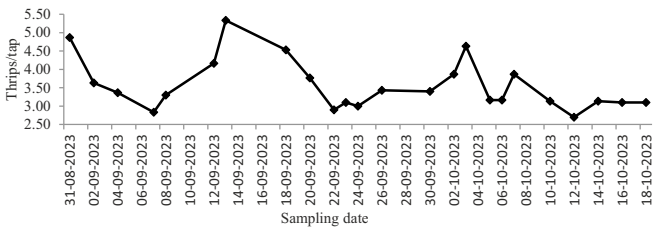


Figure 21. Population dynamics of thrips on marigold

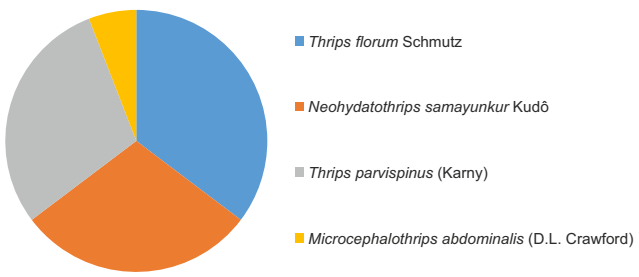


Figure 22. Species composition of thrips on marigold

Evaluation of entomopathogenic fungi against marigold thrips

Field experiment was conducted to evaluate the different entomopathogenic fungi against the marigold thrips. Among the entomopathogenic fungi tested, *Beauveria bassiana* (NBAIR strain) reduced the marigold thrips population up to 54 percent compared the control.

Predators recorded on *Thrips parvispinus* in chilli

The following predators were collected and found feeding on *T. parvispinus*. These are *Dortus primarius, Geocoris ochropterus,* Chrysopids and *Orius* sp. (Fig. 23). When *Blaptostethus pallescens*, *Geocoris ochropterus*, *Dortus primarius* and *Orius* sp. were allowed to feed on *T. parvispinus*, at high prey density (40 thrips) *Orius* sp. consumed all 40 ± 2.12 thrips followed by *G. ochropterus* (32 ± 1.41), *B. pallescens* (29.25± 2.32) and *D. primarius* (22 ± 1.79).

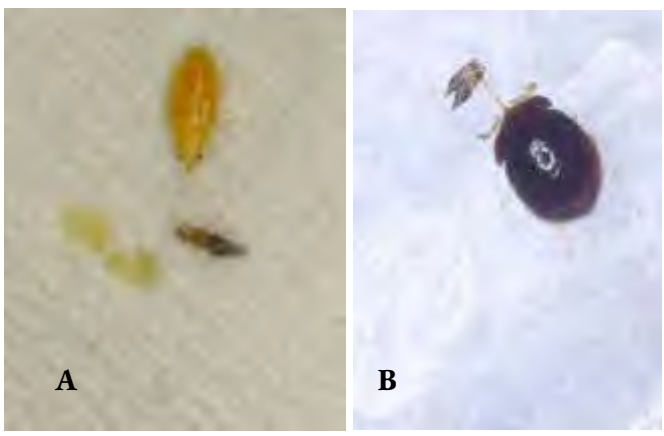


Figure 23. A.*Orius* nymph feeding *Thrips parvispinus*
B. *Geocoris ochropterus* nymph feeding *Thrips parvispinus*

Efficacy of *Blaptostethus pallescens* and *Lecanicillium lecanii* (ICAR–NBAIR Vl-8) on *Frankliniella schultzei* on capsicum plant

Cage study was conducted to explore the potential of *Lecanicillium lecanii* (ICAR–NBAIR Vl-8) and *Blaptostethus pallescens* when used together against *Frankliniella schultzei* in capsicum. Two releases of *B. pallescens* (@10 adults per plant) were made at weekly intervals alternate with two sprays of Vl-8 at 10 days intervals. Results exhibited that when *B. pallescens* and *L. lecanii* (Vl-8) were used alone and together against *F. schultzei* in capsicum, maximum percent reduction in thrips population over control (89.12 %) was

observed in Vl-8 (two sprays at ten days interval) + *B. pallescens* (@10 adults per plant) followed by Vl-8 alone (77.72%) and *B. pallescens* alone (65.42%).

Effect on *Dortus primarius* when fed on *Metarhizium anisopliae* (Ma-4) treated *Tuta absoluta* eggs

Dortus primarius is a mirid predator of *Tuta absoluta* eggs. When this predator was exposed to *Metarhizium anisopliae* (ICAR-NBAIR Ma-4) treated and untreated *T. absoluta* eggs, no significant difference was observed in terms of nymphal duration in both the treatments. However, *D. primarius* consumed more untreated *T. absoluta* eggs (254.06±4.56) than Ma-4 treated eggs (197.31±4.65).

Studies on whiteflies

About eighteen exploratory surveys were conducted in five states, viz. Karnataka, Andhra Pradesh, Telangana, Tamil Nadu and Maharashtra to collect the whiteflies and their natural enemies. Survey revealed the newer geographical distribution and extension of host ranges for whiteflies including invasive to India: palm infesting whitefly, *Aleurotrachelus atratus* in Andhra Pradesh; rugose spiralling whitefly, *Aleurodicus rugioperculatus* in Nagaland, woolly whitefly, *Aleurothrixus floccosus* in Andhra Pradesh and Maharashtra; legume feeding whitefly, *Tetraleurodes acacia* in Maharashtra.

Survey also revealed spread of exotic parasitoid, *Encarsia cubensis* (Hymenoptera: Aphelinidae) on palm infesting whitefly, *A. atratus* as primary parasitoids across the South Indian states.

The maximum overall reduction (75.92%) of rugose spiralling whitefly at 30 days after treatment was observed in bio-intensive integrated pest management (BIPM) modules consisted of standard agronomic practices as per recommendation; intercropping with banana; inundative release of *Apertochrysa astur* @1000 eggs/ha and *E. guadeloupae* @ 600 adults/ha; Foliar application of *Isaria fumosorosea* @ 5g/L, (two sprays at 15 days intervals) which was on par with chemical treatment.

Overall reduction of 63.75% of nesting whitefly and palm infesting whitefly was observed in BIPM module-I which consisted of standard agronomic practices as per recommendation; intercropping with banana; installation of yellow sticky traps (A4 size) @30 traps /ha; inundative release of *A. astur* @1000 eggs /ha and *E. guadeloupae* @600 adults /ha; foliar application of *I. fumosorosea* @5g/L, (two sprays at 15 days intervals). However, pesticides were found to be superior over BIPM modules in reducing these whiteflies.

Among natural enemies, *A. astur* population was recorded maximum (4.25-5.85 grubs/frond) in BIPM treatments as compared to farmer's practice (2.04-2.24 grubs/frond). Interestingly, predator population in BIPM modules were on par with control as well.

Documentation of adaptive defence strategies by stingless bees, *Tetragonula* sp. in newly divided colonies

The nest intruders in the newly divided colonies of stingless, their nature of damage, adaptive defence strategies of the in-hive bees, the sequence of activities after the colony division and task allocation in the colony for nest defence was recorded. Three invaders, viz. solitary resin bees (*Megachile disjuncta*, *M. cephalotes*), ants (*Oecophylla smaragdina* and *Camponotus* sp.) and spiders belonging to the family Salticidae invaded the colonies during the earlier stages of division. Nest entrance closure was observed at 4.37±0.74 days after colony division guard bee activity from 6.13±1.24 days and foraging activity from 10.63±1.06 days after division. Observations on the task allocation framework after colony division indicated that 69% of bees were involved in hive entrance repair, 18% in colony architecture development, and 13% in tending to newly emerged bees from brood cells. The adaptive defence strategies, viz. building complex nest entrance, guarding activity and nest closure behaviour adopted by the bees to protect the nest against intruders was recorded.

Effect of crowding of larvae of *Tenebrio molitor* in the rearing trays on their growth and development

The rearing conditions for the mass multiplication of larvae of *Tenebrio molitor* in trays was standardized. The crowding effect of larvae of *T. molitor* in tray rearing was studied and the effect of overcrowding the trays with live larvae over the food consumption, dry and wet weight of the larvae was studied. Maximum individual weight of live larvae (mg) was recorded in the trays housed with 12 (135.61mg), 24 (129.70mg), 36 (123.62mg) and 48 (115.60mg) larvae per tray. Maximum food consumed was significantly higher in the trays housed with 12 (697.6mg), 24 (493.4mg), 36 (615.8 mg) and 48 (523mg) larvae per tray.

Temporal changes in the cannibalized pupae of *Tenebrio molitor* and *Zophobas morio*

The temporal changes in the number of cannibalized pupae for two species of tenebrionid beetles exposed to different numbers of larvae in the rearing arena was studied. Cent percent cannibalism of the pupae was recorded when mature larvae at the rate of 60-80 were maintained in the rearing trays. There was an increase in the percent cannibalism at 24, 36 and 48 hours after exposure of mature larva towards the pupae in the rearing trays.

Standardization of seeding adults of *Tenebrio molitor* for optimum oviposition and larval growth

The optimum number of adult beetles required for the oviposition trays for the harvest of maximum number of larvae was studied. Maximum larvae per week per tray (190.0 larvae/tray) were harvested by seeding 20 adult female beetles/tray. The adult longevity of *T. molitor* versus its oviposition potential was studied. Adult beetles of age group (40-80 days old) recorded cent percent rate of survival with a percent oviposition of 50-80%.

Documentation of non-bee floral visitors in fennel

The non-bee floral visitors of fennel were documented during the flowering stage. Eight species of vespids, viz. *Vespa affinis continentalis*, *Delta conoideum*, *Polistes* (*Polistella*) *stigma tamulus*, *Eumenes macrops*, *Ropalidia jacobsoni*, *Antepipona sibilans*, *Oreumenoides edwardsi* and *Ropalidia marginata* were recorded. Among the eight species of vespids, *Vespa affinis continentalis* was the most abundant flower visitor carrying pollen grains in its mouth parts and hindleg bristles followed by *R. marginata*. The non-bee insects that visited the umbels of fennel were ants, syrphids, vespids, beetles and Calliphorids.

Development of microbial consortia for the management of crop pests

Fresh rhizophere soil samples were collected from various parts of the country i.e Almora. Pantnagar, Bengaluru, Hosur and Salem. Bacteria were isolated from the rhizosphere soils. The bacterial colonies were characterized based on their colony morphology and Gram reaction. Molecular characterization was done using 16S rDNA analysis. Purified PCR products were sequenced; homology search of the 16S rRNA sequences was done using the BLAST function of NCBI GenBank. The nucleotide sequences of 16S rRNA were deposited in GenBank, NCBI and the accession numbers were obtained for the submitted sequences. Bacterial species identified were *Lysinibacillus xylanilyticus, Lysinibacillus macroides*, *Lysinibacillus fusiformis, Paenibacillus lautus, Peribacillus frigoritolerans, Bacillus safensis, Bacillus altitudinis, Bacillus amyloliquefaciens, Bacillus velezensis Bacillus cereus, Priestia megaterium, Priestia aryabhattai, Cytobacillus firmus.*

Bioefficacy studies to assess the bioefficacy of bacterial strains i.e. *Pseudomonas fluorescens* and *Bacillus albus* against cabbage diamondback moth (*Plutella xylostella*) revealed that both the strains *P. fluorescens* and *B. albus* caused 69 to 75 % larval mortality. LC_{50} value for both the bacterial strains *P. fluorescens* and *B. albus* was 8.85 x 10^3 cfu/ml whereas LC_{50} value for bacterial consortium was 1.6 x 10^8 cfu/ml. *Pseudomonas fluorescens* and *B. albus* were grown in KB broth and NA broth, respectively. Both the bacterial broths having the cell population of 10^8cfu/ml

were mixed individually with talc power and talc based formulation was prepared. The efficacy of individual and consortia of talc formulations were evaluated under field conditions.

Isolation, purification and characterisation of entomopathogenic fungus

NBAIR isolated and characterised promising fungal (*Metarhizium anisopliae* and *Beauveria bassiana*) strains for the management of lepidopteran and sucking pests. Purification of single conidia based entomopathogenic fungus and further PCR based internal transcribed spacer region sequencing confirmed four strains each of *M. anisopliae* and *B. bassiana* (Fig. 24).

Figure 24. Pure culture of entomopathogenic fungus *Metarhizium anisopliae* (left) and *Beauveria bassiana* (right)

Invert emulsion based formulation of entomopathogenic fungus and bacteria against fall armyworm (*Spodoptera frugiperda*)

Different combination of invert emulsion formulations were prepared for entomofungal and entomobacterial pathogens and stored at room temperature. At different time windows these formulations were tested for shelf life and bioefficacy against fall armyworm under *in vitro* conditions. All the tested formulation of entomofungal and bacteria showed cell count of more than 10^8 cfu/ml at eight months from the preparation. The efficacy varied between entomofungal and bacterial formulations which ranged from 60-80 per cent mortality of fall armyworm.

Efficacy of *Metarhizium anisopliae* NBAIR-Ma35 against fall armyworm under field conditions

Metarhizium anisopliae NBAIR-Ma35 was found very effective in management of FAW under field conditions. Minimum number of larvae were recorded in plot treated with *M. anisopliae* NBAIR-35 (11.83, 7.00 and 4.58) and highest post larval count was recorded in control plot (16.33, 15.33 and 16.00) (F value = 29.14; P<0.0001; F =89.51; P<0.0001 and F = 158.89; P<0.0001) on 3rd, 7th and 10th day after spraying, respectively.

Electrophysiological and ovipositional response of pulse beetle, *Callosobruchus maculatus* to essential oils (EOs)

The summated neuronal response of *Callosobruchus maculatus* males in general was lower than females across the essential oils. All the EOs tested showed antennal response in female adults of pulse beetle. EOs of artemesia, rosemary, Japanese mint and cumin oil caused higher antennal response. All the EOs shown dose dependent response. EOs of artemisia, rosemary and Japanese mint caused higher per cent in oviposition reduction (Fig. 25 & 26).

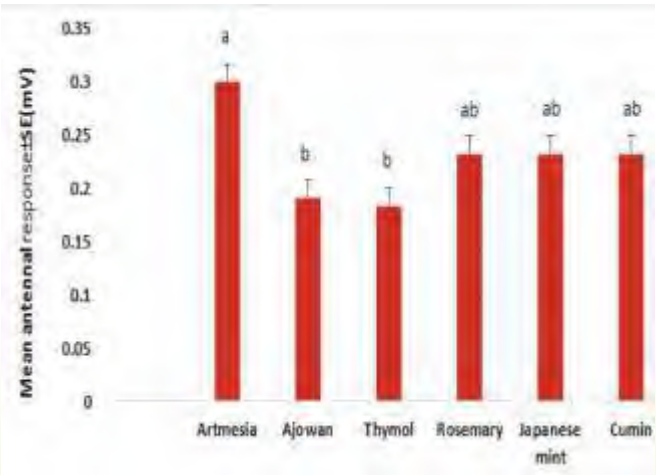


Figure 25. Electrophysiological response of antennal neurons of pulse beetle to essential oils

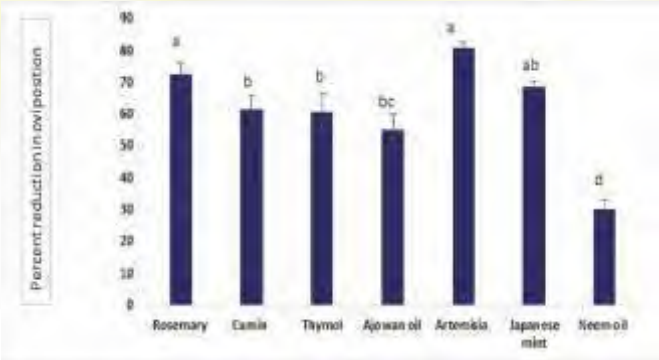


Figure 26. Ovipositional response of female beetles to essential oils

Electrophysiological and behavioural response of female *Corcyra cephalonica* adults to male released pheromone

Farnesal pheromone released from *C. cephalonica* male wing gland was characterized and synthesized. The Female antennae showed neuronal response to male wing gland pheromone in a dose dependent manner. More than 60% of females oriented to farnesal treated arm (Fig. 27).

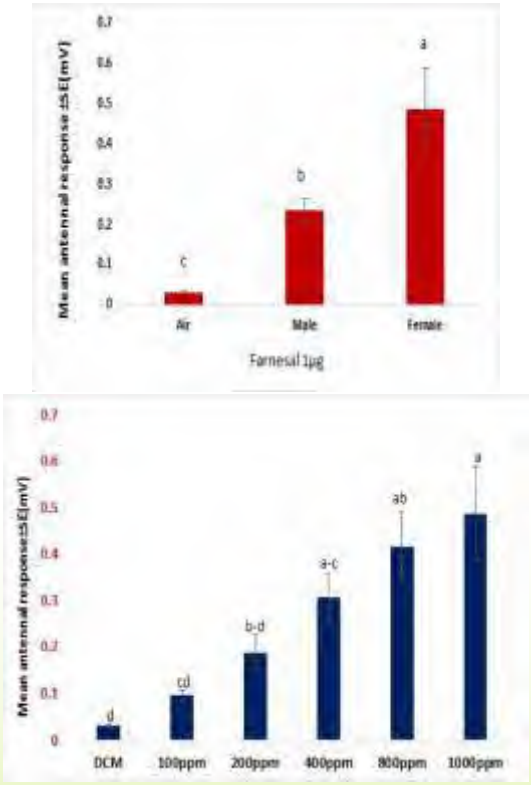


Figure 26. Antennal neuronal responses of *Corcyra cephalonica* adults

Isolation and identification of pheromones /attractants

Revolutionary technology was pioneered to isolate and identify the pheromones/attractants crucial for combatting the litchi fruit and shoot borer - *Conopomorpha sinensis* (Lepidoptera: Gracillariidae). This breakthrough led to the development of slow-release formulations for *Chilo sacchariphagus* (Indicus), *Scirphophaga excerptalis,* and *Spodoptera frugiperda*. A significant achievement was the synthesis and transformation of Octa decanal, (Z, Z)-9,12-Octa decadienal, (Z,Z,Z)-9,12,15-Octadecatrienal, and (Z,Z,Z)-3,6,9-Heneicosatriene into slow-release formulations, effectively managing the red hairy catterpillar, *Amsecta albistriga*. Specialized slow-release attractant formulations were tailored for controlling the pomegranate fruit borer, *Virachola isocrates*, cashew stem borer, *Plocaederus obesus*, potato tuber moth; *Phthorimaea opercullella*, demonstrating significant progress in pest control strategies. Advanced slow-release attractant formulations were innovated for effectively managing pigeonpea pod fly, *Melangromyza obtusa* (Diptera: Agromyzidae) and mango stemborer, *Batocera rufomaculata* (Coleoptera: Cerambycidae) showcasing cutting-edge advancements in pest control methodologies.

Evaluation of chitosan nanopowder on *Trichogramma japonicum*

Chitosan is a naturally occurring linear biopolymer made of partially deacetylated acetyl and N-acetyl glucosamine. Chitosan nanopowder applied to leaves or soil can activate a plant's natural defences against insects and pathogens. The egg parasitoides *Trichogramma japonicum* was used as a low-cost biomarker to determine the potential toxicity of chitosan nanopowder. This study looked into the possibility that the adult stage of the egg parasitoids, *T. japonicum* might be negatively impacted by chitosan nanopowder (80–100 nm). According to the statistical

analysis, (Tables 4, 5 & 6) host eggs exposed to chitosan nanopowder showed noticeably greater parasitization than the control group. As a natural supply of carbohydrate, polymers chitosan nanopowder promotes the parasitization of *T. japonicum.* The data was thoroughly supported through Y dual choice, eight-arm multiple choice, and no-choice olfactometer experiments, as well as images from a stereozoom microscope and a scanning electron microscope (SEM).

Table 4. Effect of chitosan nanopowder on *Trichogramma japonicum* (Y-dual choice olfactometer)

Experiment 1	**Replications**							**Statistical Analysis**		
	R1	R2	R3	R4	R5	R6	Mean	S.D.	S. E.M	N
Treatment (% of parasitised eggs)	40.94	67.07	47.36	47.19	46.55	44.00	48.85	9.25	3.7763	6
Control (% of parasitised eggs)	21.84	17 .70	37.37	37.68	36.66	37.66	31.50	9.14	3.7314	6
	95% confidence interval of difference							t		
	Lower value			Upper value				p-value		
	5.5212			29.1788				3.2681	0.0085	

Note: In this study, mean values were calculated and reported along with their corresponding Standard Deviation (S.D) and Standard Error Mean (S.E.M). Additionally, t value and p value were calculated.

Table 5. Effect of chitosan nanopowder on *Trichogramma japonicum* (Eight arm multiple choice olfactometer)

Experiment 1	**Replications**					**Statistical Analysis**		
	R1	R2	R3	R4	Mean	S.D.	S. E.M	N
Treatment (% of parasitised eggs)	32.20	44.44	47.61	35.24	39.87	7.32	3.66	4
Control (% of parasitised eggs)	26.47	27.61	32.33	29.63	29.01	2.57	1.28	4
	95% confidence interval of difference					t		
	Lower value		Upper value			p-value		
	0.3684		19.351			2.5419	0.0440	

Note: In this study, mean values were calculated and reported along with their corresponding Standard Deviation (S.D) and Standard Error Mean (S.E.M). Additionally, t value and p value were calculated and reported.

Table 6. Effect of chitosan nanopowder on *Trichogramma japonicum* (No-choice olfactometer)

Experiment 1	Replications							Statistical Analysis		
	R1	R2	R3	R4	R5	R6	Mean	S.D.	S. E.M	N
Treatment (% of parasitised eggs)	50.81	68.75	55.55	60.86	63.15	58.57	59.62	6.20	2.56	6
Control (% of parasitised eggs)	46.42	45.16	39.39	31.11	40.84	39.62	40.42	5.42	2.21	6
	95% confidence interval of difference							t		
	Lower value			Upper value					p-value	
	11.6542			26.7458				5.6694	0.0002	

Note: In this study, mean values were calculated and reported along with their corresponding Standard Deviation (S.D) and Standard Error Mean (S.E.M). Additionally, t value and p value were calculated and reported.

Occurrence of invasive insect pest, apple leaf blotch miner (ALBM), *Leucoptera malifoliella*, (Lepidoptera: Lyonetiidae) in Jammu and Kashmir, India

In entire south Kashmir, apple leaf blotch miner (ALBM) caused significant losses to the tune of 13-100% defoliation in apple orchards. The infestation of apple blotch leaf miner was witnessed in almost all the cultivars grown in the Kashmir valley (Fig. 28 a). Severe defoliation of leaves caused by feeding of larvae on the parenchyma tissue of the leaves might affect the apple production.

Biology and damage symptoms of ALBM

The apple leaf blotch miner has four life stages, egg, larvae, pupae and adult. The lifecycle completes in 25-30 days. It is envisaged that attack of the ALBM is severe in summer and autumn months. The oval shaped translucent egg is minute (0.24 mm), usually seen on the abaxial surface of the leaves. The newly hatched larvae start feeding on the leaf mesophyll leading to development of mines/ blotches resulting in development of necrosis that eventually affect the photosynthesis (Fig. 28 b) of plants. It was observed that infestation might also lead to premature leaf loss and affect the yield and bloom in the next season. Severe defoliation by this pest without any remedial measures might result in death of young plants in the nursery as well as in the main field. In the unmanaged orchards, the infestation of this pest led to severe defoliation and burnt appearance of the crop. The larvae have four instars before it goes for pupation. The pupae are brownish yellow with prominent eyes and antennae, measure about 3.0 mm length. After one week period of pupation, the adult emerges and measures mean body length of 2.8-3.0 mm. The male can be distinguished from female based on the prominent fringes of hair in the vertex region of the head. The antennae are very long usually kept in a horizontal position to the body. The size of both male and females are almost same except a wider abdomen in the females (Fig. 28 c). Mating occurs few hours after emergence. The mated female lays its egg singly on the abaxial surface of the leaves. In some cases two eggs were laid side by side by the female.

Figure 28. Damage caused by apple blotch leaf miner: a. damaged apple tree; b. larva inside the blotch and c. Adult male and female moths

Occurrence of invasive soft scale insect, *Fistulococcus pokfulamensis* on Mango and Jamun

The invasive soft scale insect, *Fistulococcus pokfulamensis* (Hemiptera: Coccidae) (Fig. 29) was reported initially on umbrella tree, *Heptapleurum actinophyllum* during 2022 in Bengaluru, but has spread to other host plants like mango, jamun, blueberry and other ornamental plants, causing significant damage to these crops both in Karnataka and Tamil Nadu. During survey, jamun and mango crop were found severely infested by soft scale resulting in the development of sooty mold in the entire tree canopy affecting the photosynthesis of the crop leading to severe defoliation. The occurrence of mango soft scale in *Jatropha integerimma*, *Lagerstroemia lanceolata*, Malayan apple, rose apple, all spice, water apple and *Loranthus* were reported as new host records. In addition to this, earlier reports on mango, jamun, *Vaccinium corymbosum* and *H. actinophyllum* were reconfirmed.

Figure 29. *Fistulococcus pokfulamensis*: females after removal of wax duct

Field efficacy studies of *Anagyrus lopezi* for the management of cassava mealybug

A field efficacy study of *Anagyrus lopezi* was conducted in the farmers' fields (cv. White Thailand) at Alagampatti and Kattampatti, villages under Palacode block of Dharmapuri district, Tamil Nadu during 2022-23. In both the villages, cassava mealybug, *Phenacoccus manihoti* was the predominant mealybug. Before parasitoids release, level of mealybug incidence (70. 0%), per cent crop damage (25%), cassava mealybug abundance (50 no./tip) was recorded. After 20 days of post release, parasitoid recovery studies indicated, *A. lopezi* had established very well in the released sites. Maximum of 50.12 per cent parasitism was observed at six months post release of *A. lopezi* with tuber yield of 25 tonnes/ha. The percent parasitism rate of *A. lopezi* in released fields at different districts of Tamil Nadu ranged between 28.02 and 40.23% (Table.7) resulted effective management of cassava mealybug.

All India Coordinated Research Project on Biological Control of Crop Pests

Biological control of rice pests

The treatment comprising *Pseudomonas fluorescens* NBAIR PFDWD (Seed treatment @10 g/litre +Seedling dip @ 10 gm / litre+ Foliar spray @ 10 gm/litre on standing crop at 10 days interval, i.e. 40, 50, 60 and 70 days after transplanting (DAT) documented the low sheath blight disease intensity of 14-15% as compared to that of 30-35% in untreated control in rice.

Large scale field demonstrations of bio-control practices covering an area of 970 ha were conducted in rice crop in Nainital and U S Nagar (1200 farmers) districts. Ninety five quintals PBAT-3 (*Trichoderma harzianum* Th14 + *Pseudomonas fluorescens* Pf 173) was distributed to the farmers. An average yield of 60.0 q/ha was recorded by the farmers adopting bio-control technologies along with need based organic practices as compared to a yield of 61.0 q/ha by the farmers adopting conventional practices for the management of insect pests and diseases.

Biological control of sugarcane pests

Sugarcane sett treatment at planting and spraying ICAR NBAIR endophytic entomopathogenic strains (*Metarhizium anisopliae* NBAIR Ma35 and *Beauveria bassiana* NBAIR Bb-45), three times at 14 days interval from 25 days after germination proved equally effective as compared to chemical treatment (Cholorantraniliprole).

Biological control of maize pests

IPM module comprising *Trichogramma chilonis*, *Bacillus thuringiensis* (ICAR–NBAIR Bt-25) and *Metarhizium anisopliae* (ICAR–NBAIR Ma-35) recorded the fall armyworm infestation level of 8-10%, whereas the untreated control module recorded 20-25% infestation. The BIPM module has witnessed the 30-35% reduction in chemical pesticide usage.

Table 7. Incidence of cassava mealybug, *Phenacoccus manihoti* and parasitism rate of *Anagyrus lopezi* at released sites in Tamil Nadu during 2022-23

Sl. No.	District	Number of *A. lopezi* released fields	Mealybug abundance (No. per 10 cm tip)	Percent parasitism
1	Salem	20	10.22 ± 2.55	28.02 ± 3.11
2	Namakkal	28	12.99 ± 3.12	32.17 ± 2.99
3	Dharmapuri	30	15.78 ± 4.31	40.23 ± 4.12
4	Erode	22	21.99 ± 8.32	38.27 ± 2.47

Biological control of pulse pests

Use of *Bacillus thuringiensis* NBAIR BtG4 2% @10ml/lit. of water was found effective in reducing the pest population (13.67 larvae/meter row length) and damage (8.5 %) caused by spotted pod borer, *Maruca vitrata* in green gram.

Biological control of oilseed pests

Damage caused by groundnut leaf miner and *Spodoptera litura* was significantly low in *Bacillus thuringiensis* RARS TPTC33 @2 g/L (4.33 and 8.67%) treated plot with higher pod yield (26.5q/ha) followed by treatment with *Metarhizium rileyi* (ANGRAU AKP Nr-1) @5 g/L (4.7% and 9.5%) with pod yield of 25.67q/ha and was on par with emamectin benzoate 5 SD@ 0.4 g/L (25.32q/ha).

Biological control of temperate fruit pests

Occurrence of apple blotch leaf miner, *Leucoptera malifoliella* (Lepidoptera: Lyonetiidae) was recorded in apple in Kashmir. The infestation of Oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) was also observed in apple. Two natural enemies of *L. malifoliella*, viz. brown lacewing, *Hemerobius* sp. (Neuroptera: Hemerobiidae) and *Tetrastichus* sp. were observed from the unmanaged apple orchards (not sprayed with insecticides against *L. malifoliella*) of Kashmir valley. *Metarhizium anisopliae* resulted in 69.02% mortality of apple root borer, *Dorysthenes hugelii* whereas chemical treatment caused 90.30% mortality.

Biological control of plantation crop pests

The entomopathogenic nematode, *Steinernema* sp. (CPCRIS0804) was found effective against the grubs of red palm weevil, *Rhynchophorus ferrugineus*. This isolate has longer shelf life and greater tolerance to pesticides. A novel capsule formulation was developed for the prophylactic application against red palm weevil.

Large scale demonstration of Black headed caterpillar management was done at Allipalli village (GPS coordinates: 17.18670N, 81.00640E), Chintalapudi mandal, Eluru district for the year 2023-24. At 45-day intervals, the parasitoids, *Goniozus nephantidis* and *Bracon hebetor* were released twice, and the larval population was reduced from 10.10 to 2.63 per leaflet, while *B. hebetor* population increased from 0.30 to 2.45 per leaflet and *G. nephantidis* population increased from 0.13 to 3.58 per leaflet.

4. GENBANK / BOLD ACCESSIONS

Sl. No.	ORGANISM	ACCESSION NUMBER
	COLEOPTERA	
1.	*Agriotes ogurae*	OP380046
2.	*Callosobruchus maculatus*	OQ449421, OQ135340
3.	*Cheilomenes sexmaculata*	OM422837
4.	*Coccinella transversalis*	MZ959832
5.	*Coelophora bissellata*	MZ959854
6.	*Lepropus rutilans*	OR838835
7.	*Myllocerus viridanus*	OR826263, OR826217, OR826216, OR826191
8.	*Nematocerus dispar*	OR838834
9.	*Patialus tecomella*	PP054313
10.	Staphylinidae	OQ368737
11.	*Thanasimus lewisi*	ON955906
	DIPTERA	
12.	*Asphondylia* sp.	OQ657351, OQ657352, OQ672322, OQ672321
13.	*Bactrocera* sp.	OQ413247, OQ402417
14.	*Bactrocera rubigina*	OQ413249
15.	*Bactrocera zonata*	OQ413243
16.	*Carpomya vesuviana*	OQ410281
17.	*Dacus feijeni*	OQ413250
18.	*Dacus longicornis*	OQ413246
19.	*Ischiodon scutellaris*	OQ913605
20.	*Leucophenga* sp.	OQ445522, OQ445551
21.	*Zeugodacus cilifer*	OQ353070
22.	*Zeugodacus scutellaris*	OQ413245
23.	*Zeugodacus tau*	OQ413244
24.	*Zeugodacus yoshimotoi*	OQ413248

Sl. No.	ORGANISM	ACCESSION NUMBER
	HEMIPTERA	
25.	*Alcmena spinifex*	OL958633
26.	*Aleurodicus dispersus*	OR244429, OR244470
27.	*Aleurodicus rugioperculatus*	OP020879, OP020723, OM368661
28.	*Aleurothrixus floccosus*	OR245497, OR245369, OR244633
29.	*Ancyrosoma leucogrammes*	OQ282511
30.	*Bemisia tabaci*	OR263435, OR262890, OR244466, OR259129, OR259128, OR253029, OR252865, OR252352, OR252260
31.	*Chaitophorus populeti*	OQ318208
32.	*Codophilla maculicollis*	OR381579, OR381578
33.	*Coridius chinensis*	OQ282510
34.	*Dyroderes umbraculatus*	OQ282514
35.	*Dysmicoccus brevipes*	OQ942254, OQ924104, OQ992639, OQ955830, OR085908
36.	*Dysmicoccus neobrevipes*	OQ942202
37.	*Ferrisia virgata*	OR068143, OR068144, OQ971879, OR068144, OR068143
38.	*Fistulococcus pokfulamensis*	OR515185
39.	*Nezara viridula*	OM108162
40.	*Palomena prasina*	OQ282509
41.	*Paraleyrodes bondari*	OR244536
42.	*Paterculus vittatus*	OQ282513
43.	*Planococcus lilacinus*	OQ909528
44.	*Plautia crossota*	OR294208
45.	*Phenacoccus parvus*	OQ992637
46.	*Phenacoccus solenopsis*	OR105913, OR085908, OQ992640, OQ992638, OQ981243, OQ981242, OQ981242
47.	*Pulvinaria psidii*	OR995348
48.	*Sarju brevirostrata*	OQ282512
49.	*Tessaratoma javanica*	OR832121, OR831994

Sl. No.	ORGANISM	ACCESSION NUMBER
	HYMENOPTERA	
50.	*Apanteles* sp.	OQ657330
51.	*Apanteles sodalis*	MZ960056
52.	*Apis cerana*	OP763644, OP763749, Op782568, OP 763646
53.	*Apis cerana indica*	OP727527
54.	*Apis mellifera*	OP782573, OP782572, OP763642,
55.	*Bombus haemorrhoidalis*	OQ318852, OQ318535
56.	*Bombus tunicatus*	PP107883
57.	*Bruchophagus* sp.	PP111120
58.	*Carinostigmus costatus*	OQ913733
59.	*Cotesia ruficrus*	OQ657334
60.	*Diachasmimorpha longicaudata*	OQ657336
61.	*Glyptapanteles* sp.	OQ657331
62.	*Habrobracon hebetor*	ON428249
63.	*Homalotylus* sp.	ON637052, OR001785
64.	*Macrocentrus* sp.	OQ657333
65.	*Meteorus* sp.	OQ657329
66.	*Pachyneuron aphidis*	ON331743
67.	*Philanthus triangulum*	OQ195786
68.	*Philotrypesis* sp.	PP111121
69.	*Psyttalia fletcheri*	OQ657335, OQ657332
70.	Pteromalidae	OQ996414
71.	*Rhynchium brunneum*	OQ915221
72.	*Sycoscapter* sp.	PP111119
73.	Tetrastichinae	OQ869606, OQ869607, OQ870084, ON637051
74.	*Trichogramma chilonis*	OM283611, OM283618, OM327556, OL958558, OL958541, OL913974, OL913900, OL913800, OM283610, OM283598
75.	*Trypoxylon clavicerum*	OQ913679

Sl. No.	ORGANISM	ACCESSION NUMBER
	LEPIDOPTERA	
76.	*Aplocera plagiata*	OQ195784
77.	*Cadra cautella*	OQ444136, ON377348, OQ862318, OQ862291,
78.	*Chrysodeixis acuta*	PP065768
79.	*Cydia pomonella*	OQ186760, OQ308608, OQ306612, OQ190153
80.	*Hodebertia testalis*	PP065773
81.	*Leucoptera malifoliella*	OR528823, OR528822, OR528821, OR528641, OR528197, OR528194, OR527439, OR527441, OR523413, OR523402, OR514413, OR512081, OR512058, OR512054, OR514414, OR527440, OR527438, OR527435, OR527434, OR527437, OR527436, OR527433, OR523450, OR523455, OR527431, OR523457, OR527430, OR527432, OR523460, OR523458
82.	*Spodoptera frugiperda*	OQ352635
83.	*Thysanoplusia orichalcea*	OQ195747, OQ195725
	NEUROPTERA	
84.	*Apertochrysa flavinotala*	OR122637, PP107879
	PSOCOPTERA	
85.	*Liposcelis bostrychophila*	OQ954774, OQ954765
	THYSANOPTERA	
86.	*Euphysothrips minozzii*	MW914652
87.	*Frankliniella occidentalis*	OR018813
88.	*Hydatothrips longirostris*	OR435268
89.	*Megalurothrips usitatus*	OR536223
90.	*Nandithrips pouzolziae*	OP714094
91.	*Neohydatothrips flavicingulus*	OQ908917
92.	*Pseudodendrothrips darci*	OQ908918
93.	*Sciothrips cardamomi*	OR435269
94.	*Scirtothrips dorsalis*	OR145051
95.	*Thrips coloratus*	OQ877197
96.	*Thrips palmi*	OR483937
97.	*Thrips parvispinus*	ON303614, OR117716, OR116189, OR100707, OR100706, OR084125, OR084119

Sl. No.	ORGANISM	ACCESSION NUMBER
	NEMATODES	
98.	*Heterorhabditis bacteriophora*	MW077301
99.	*Heterorhabditis indica*	OR399557, KX950751, KY524247, OR405077
100.	*Steinernema indicum*	OQ339203, OQ341203, OQ341465
101.	*Steinernema shori*	OR187856, OR194555, OR194554
102.	*Steinernema surkhetense*	OR447669
	BACTERIA	
103.	*Bacillus altitudinis*	PP127894, PP127895
104.	*Bacillus amyloliquefaciens*	PP127896
105.	*Bacillus cereus*	PP127904
106.	*Bacillus safensis*	PP127893
107.	*Bacillus subtilis*	PP127900, PP127901, PP127902, Pp127903
108.	*Bacillus thuringiensis* NBAIR_Bt101 - *Bacillus thuringiensis* NBAIR_Bt150	OQ600806, OQ600807, OQ600808, OQ600809, OQ601532, OQ618222, OQ601564, OQ913927, OQ914359, OQ946977, OQ946981, OQ946983, OQ946986, OQ946988, OQ946991, OQ947027, OQ947031, OQ947029, OQ947038, OQ947040, OQ947044, OQ947066, OQ947092, OQ948172, OQ947100, OQ948333, OQ948423, OQ948476, OQ948477, OQ948479, OQ953984, OQ954064, OQ954067, OQ954099, OR053872, OR053874, OQ954110, OQ954125, OQ590012, OQ589927, OQ589705, OQ589507, OQ589499, OQ589498, OQ589493, OQ589491, OQ588811, OQ581574, OQ588801, OQ588779
109.	*Bacillus thuringiensis* NBAIR_Bt201 - *Bacillus thuringiensis* NBAIR_Bt250	OQ913871, OQ913883, OQ918259, OQ933099, OQ933100, OQ933404, OQ933428, OQ933436, OQ933551, OQ933660, OQ954862, OQ976900, OQ976901, OQ978204, OQ954898, OQ955247, OQ955251, OQ955481, OQ955485, OQ955486, OQ970559, OQ970569, OQ970592, OQ970603, OQ970604, OQ971399, OQ975943, OQ975946, OQ975967, OQ975969, OQ975971, OQ975972, OQ975973, OQ975974, OQ975975, OQ975977, OQ975982, OQ975983, OQ975986, OQ975987, OQ975988, OQ975989, OQ975996, OQ975998, OQ976010, OQ976079, OQ976896, OR016431, OR016430, OR054274

Sl. No.	ORGANISM	ACCESSION NUMBER
110.	*Bacillus thuringiensis* NBAIR_Bt301 – *Bacillus thuringiensis* NBAIR_Bt350	OR058589,OR058649,OR294209,OR058654,OR294210, OR058735,OR064115,OR064116,OR064117,OR073513, OR073526,OR073528,OR073529,OR073531,OR073652, OR294213,OR073530,OR073733,OR073734,OR073735, OR294212,OR294216,OR294215,OR294220,OR073815, OR294223,OR074966,OR074965,OR294224,OR074994, OR074995,OR294230,OR294228,OR294273,OR294299, OR294301,OR294300,OR294302,OR294304,OR294303, OR074132,OR074998,OR074134,OR074176,OR294305, OR074177,OR327094,OR294309,OR294308,OR294311
111.	*Bacillus thuringiensis* NBAIR-BT25	MN327970
112.	*Bacillus thuringiensis* NBAIR-BTG4	MN326511
113.	*Bacillus thuringiensis* NBAIR-BTGa	OP326148
114.	*Bacillus thuringiensis* NBAIR-BTVGa1 – *Bacillus thuringiensis* NBAIR-BTVGa2	OP320505, OP318063
115.	*Bacillus velezensis*	PP127897, PP127898, PP127899
116.	*Cytobacillus firmus*	PP127910
117.	*Lysinibacillus fusiformis*	PP127889
118.	*Lysinibacillus macroides*	PP127888
119.	*Lysinibacillus xylanilyticus*	PP127887, PP127887
120.	*Novosphingobium* sp.	PP127911
121.	*Paenibacillus lautus*	PP127890
122.	*Peribacillus frigoritolerans*	PP127891, PP127892
123.	*Priestia aryabhattai*	PP127905, PP127907, PP127909
124.	*Priestia megaterium*	PP127906, PP127908
	FUNGUS	
125.	*Beauveria bassiana strain* bb1 – *Beauveria bassiana strain* bb3	OR518660, OR519908, OR520131
126.	*Cordyceps javanica strain* NBAIR IJ3 – *Cordyceps javanica strain* NBAIR IJ5	OQ476083, OQ476084, OQ476085
127.	*Fusarium verticillioides*	OR592585

Sl. No.	ORGANISM	ACCESSION NUMBER
	GENOME SEQUENCING	
128.	*Bacillus thuringiensis* NBAIR-BTVGa1	Biosample: SAMN39308120 Bioproject: PRJNA1062621 SRA: SRR27500442
129.	*Bacillus thuringiensis* NBAIR-Bt25	Bioproject ID: PRJNA98999 SRA: PRJNA98999 Biosample Accession: SAMN35742121, SAMN35742122
130.	*Bacillus subtilis* NBAIR-BSWG1	Bioproject ID: PRJNA1001586 SRA: PRJNA1001586 Biosample Accession: SAMN36812655
131.	*Chrysoperla zastrowi sillemi*	Bioproject ID: PRJNA905226 Biosample Accession: SAMN31868369 SRR22425531 (Hi-C assembly), SRR22460645 (Raw reads)
132.	*Polyphagotarsonemus latus*	PRJNA904956 (SRR24115776)
133.	*Xenorhabdus* and *Photorhabdus* sp.	SAMN38376418: Sample 11A (TaxID: 333964) SAMN38376419: Sample 11B (TaxID: 333964) SAMN38376420: Sample 20A (TaxID: 333964) SAMN38376421: Sample 20B (TaxID: 333964) SAMN38376422: Sample SFNG (TaxID: 333964) SAMN38376423: Sample SFG (TaxID: 333964) SAMN38376424: Sample AKG (TaxID: 351673) SAMN38376425: Sample AG (TaxID: 351673) SAMN38376426: Sample Menase (TaxID: 3098088) SAMN38376427: Sample Kashmir (TaxID: 3098088)
	TRANSCRIPTOME SEQUENCING	
134.	*CYP* genes	OR117155 to OR117275
135.	*Galleria mellonella*	GSM5929288, GSM5929289, GSM5929290
136.	*Maconellicoccus hirsutus* (Buprofezin treated)	BioProjectID: PRJNA808162 BioSample IDs SAMN26029374 : MHT1, SAMN26029375 : MHT2, SAMN26029376 : MHT3, SAMN26029377 : MHC1, SAMN26029378 : MHC2, SAMN26029379 : MHC3 SRA IDs SRR18063682, SRR18063681, SRR18063680, SRR18063679, SRR18063678, SRR18063677

Sl. No.	ORGANISM	ACCESSION NUMBER
137.	*Maconellicoccus hirsutus* (GA3 treated)	BioProjectID: PRJNA808162 BioSample IDs SAMN26029374 : MHT1, SAMN26029375 : MHT2, SAMN26029376 : MHT3, SAMN26029377 : MHC1, SAMN26029378 : MHC2, SRA IDs SRR18063682, SRR18063681, SRR18063680, SRR18063679, SRR18063678, SRR18063677
138.	*Polyphagotarsonemus latus*	PRJNA885308, PRJNA900044
139.	*Phenacoccus manihoti*	BioProjectID: PRJNA1013169 BioSample IDs: SAMN37288190, SAMN37288191, SAMN37288190, SAMN37288191 SRA Nos. SRR25920294, SRR25920293, SRR25920292, SRR25920291, SRR25920290, SRR25920289
140.	*Spodoptera frugiperda*	GSM5929282, GSM5929283, GSM5929284, GSM5929285, GSM5929286, GSM5929287
INSECT ASSOCIATED MICROFLORA		
141.	Black soldier fly associated microflora	OR801702
142.	Rhinoceros beetle associated microflora	OR865199 - OR865210
RNAi MACHINERY GENES		
143.	*AGO1*	OQ872387
144.	*AGO2*	OQ872388
145.	*DICER1*	OQ872389
146.	*DICER4*	OQ872390
147.	*DROSHA*	OQ872391
148.	*DROSHA_New*	OQ872392
149.	*DICER2*	OQ872393
150.	*RISC*	OQ872394

5. IDENTIFICATION SERVICES

Dr Sunil Joshi

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Melanaphis sacchari*	Aphididae	Indian Institute of Millets Research, Centre on Rabi Sorghum, Solapur
2.	*Aphis craccivora* (2), *A. gossypii* (6), *A. spiraecola* (3), *Hyadaphis coriandri* (2), *Phorodon cannabis, Rhodobium porosum, Schizaphis rotundiventris*	Aphididae	CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow
	Drepanococcuscajani (2), *Pulvinaria polygonata*	Coccidae	
	Aspidiotus destructor	Diaspididae	
	Icerya pilosa, I. purchasi (2)	Monophlebidae	
	Ferrisia virgata, Dysmicoccus carens (3)	Pseudococcidae	
3.	*Pseudaulacaspis pentagona* (2)	Diaspididae	Directorate of Plant Protection, Quarantine & Storage, Regional Plant Quarantine Station, Mumbai (Imported from Iran)
4.	*Aiceona pallida, Aphis fabae, A. gossypii* (4), *Brevicoryne brassicae* (2), *Hyadaphis corinadri, Melanaphis sacchari, Myzus persicae* (3), *Pentalonia caladii, Rhopalosiphum maidis* (2), *R. padi*	Aphididae	Himachal Pradesh University, Summer Hill, Shimla
5.	*Aphis gossypii, Erioso malanigerum*	Aphididae	Directorate of Plant Protection, Quarantine & Storage, Regional Plant Quarantine Station, Chennai (Imported from Moldova & Netherlands).

6.	*Mangalorea hopeae*	Beesoniidae	University of Calicut, Kerala
7.	*Aphis(Toxoptera) aurantii, A. craccivora, A. odinae, Aphis* sp., *Brachycaudus helichrysi, Ceratovacuna lanigera, Eriosoma lanigerum, Rhopalosiphum maidis*	Aphididae	ICAR-National Bureau of Agricultural Insect Resources, Bengaluru
	Antecerococcus indicus, Ceroplastes cirripdeiformis , Ceroplastes sp.*, Coccus hesperidum* (2)*, C. longulus, C. viridis* (2), *Marsipococcus marsupials, Parasaissetia nigra* (2), *Pulvinaria polygonata* (3), *Pulvinaria* sp.*, Saissetia coffeae, Trijuba oculata* (2)	Coccidae	
	Aonidiella orientalis, Aulacaspis tubercularis, Comstockaspis pernicosa, Pinnaspis strachani (2), *Pseudaulacaspis cockerelli, P. pentagona, P. rubra*	Diaspididae	
	Icerya aegyptiaca, Labioproctus poleii	Monophlebiade	
	Coccidohystrix insolita, Dysmicoccus brevipes (5), *Dysmicoccus neobrevipes* (2), *Ferrisia virgata* (3), *Kiritshenkella* sp.*, Maconellicoccus hirsutus* (5), *Nipaecoccus viridis* (16), *Paracoccus marginatus* (6), *Planococcus citri*, *Planococcus* sp., *Phenacoccus solenopsis* (44), *Phenacoccussolani, Planococcus lilacinus* (3), *Planococcus sp.*(5), *Pseudococcus jackbeardsleyi, Pseudococcus* sp.*, Rastrococcus iceryoides* (5), *Saccharicoccus sacchari Coccidohystrixinsolita* (3)	Pseudococcidae	
8.	*Aphis craccivora* (2), *A. gossypii, Brevicoryne brassicae*	Aphididae	University of Agriculture Sciences, Raichur
	Drosicha sp.*, Icerya aegyptiaca, Labioproctus poleii*	Monophlebidae	
	Ferrisia virgata, Nipaecoccus viridis (2), *Planococcus citri, P. lilacinus, Rastrococcus iceryoides* (4)	Pseudococcidae	
9.	*Planococcus bendovi*	Pseudococcidae	Institute of Forest Genetics and Tree Breeding, Coimbatore.
10.	*Rhopalosiphum rufiabdominale*	Aphididae	ICAR–Directorate of Groundnut Research, Junagadh

11.	*Aphis fabae, A. gossypii* (3), *A. spiraecola*	Aphididae	Avian Trust, Bengaluru
	Coccus longulus, Fistulococcus pokfulamensis, Saissetia coffeae (2), *Pulvinaria polygonata, P. psidii*	Coccidae	
	Hemiberlesia lataniae, Pseudaulacaspis rubra	Diaspididae	
	Coccidohystrix insolita (2), *Maconellicoccus hirsutus, Nipaecoccus viridis, Paracoccus marginatus, Planococcus citri* (3), *Pseudococcus jackbeardsleyi*	Pseudococcidae	
12.	*Ceroplastes cirripediformis, C. destructor, C. floridensis, Coccus hesperidum, Discochiton expansum, Saissetia coffeae*	Coccidae	College of Agriculture, Vellayani
	Conchaspis angraeci	Conchaspididae	
	Aspidiotus sp.	Diaspididae	
	Icerya sp.	Monophlebidae	
	Crisicoccus hirsutus (2), *Formicococcus polysperes, Phenacoccus solenopsis* (2), *Planococcus citri* (2), *P. lilacinus* (2)	Pseudococcidae	
13.	*Lipaphis pseudobrassicae, Schoutedenia emblica*	Aphididae	Anand Agricultural University, Anand
14.	*Pseudococcus cryptus*	Pseudococcidae	Vanavarayar Institute of Agriculture, Manakkadaru
15.	*Aonidiella aurantii*	Diaspididae	Central Silk Board, Hosur
	Paracoccus marginatus, Pseudococcus jackbeardsleyi, Rastrococcus iceryoides	Pseudococcidae	
16.	*Ceroplastes ceriferus, C. cirripediformis* (3), *C. floridensis, C. rubens* (6), *Ceroplastes* sp. (2), *Coccus longulus, C. viridis* (3), *Milviscutulus mangiferae* (2), *Parasaissetia nigra, Prococcus acutissimus, Pulvinaria ixorae, P. psidii, Saissetia coffeae*	Coccidae	College of Agriculture, Vellanikkara
	Abgrallaspis cyanophylli, Aonidiella aurantii, A. orientalis, Aspidiotus destructor, Aulacaspis madiunensis (2), *Chrysomphalus aonidum* (2), *Hemiberlesia lataniae* (2), *Lindinga spisrossi, Pinnaspis buxi, Pseudaulacspis cockerelli*	Diaspididae	

	Icerya aegyptiaca (3), *Icerya seychellarum* (2), *Icerys* sp.	Monophlebidae	
	Insignorthezia insignis (6)	Ortheziidae	
	Ferrisia virgata (8), *Paracoccus marginatus, Planococcus citri, P. lilacinus, Phenacoccus solenopsis* (7), *Pseudococcus jackbeardsleyi* (4), *Pseudococcus* sp.	Pseudococcidae	
17.	*Myzus persicae* (17)	Aphididae	ICAR–Central Potato Research Institute, Shimla
18.	*Aphis gossypii* (6), *Myzus persicae* (4), *Rhopalosiphum maidis*	Aphididae	ICAR–Central Potato Research Institute, Modipuram
19.	*Aphis craccivora, A. gossypii* (2), *A. spiraecola, Macrosiphoniella sanborni, Myzus persicae*	Aphididae	Agriculture Research Station, College of Agriculture, Dharwad
	Coccus longulus, Parasaissetia nigra	Coccidae	
20.	*Uroleucon compositae*	Aphididae	ICAR-Directorate of Floricultural Research, Pune
	Ceroplastes rubens, Pulvinaria psidii	Coccidae	
	Aulacaspis rosae, Chrysompha aonidumlus	Diaspididae	
21.	*Myzus persicae, Rhopalosiphum padi*	Aphididae	Corteva Agriscience India Pvt. Ltd., Hyderabad
22.	*Aphis gossypii*	Aphididae	Onion and Garlic Research Station, Rahuri
	Pulvinaria polygonata	Coccidae	
23.	*Planococcus citri*	Pseudococcidae	University of Agricultural Sciences, Bengaluru
24.	*Aphis craccivora, A. gossypii, Melanaphis sacchari* (3), *Rhopalosiphum maidis* (2), *Schizaphis graminum*	Aphididae	College of Agriculture,Vijayapura
25.	*Lipaphis erysimi*	Aphididae	ICAR-National Centre for Integrated Pest Management, Pusa Campus

26.	*Myzus persicae, Sitobion miscanthi*	Aphididae	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidalaya, Palampur
27.	*Aphis* sp.(2)	Aphididae	Punjab Agricultural University, Ludhiana
28.	*Aphis gossypii, Lipaphis erysimi, Myzus persicae* (2), *Rhopalsoiphum maidis*	Aphididae	Uttar Banga Krishi Viswavidyalaya, Pundibari
29.	*Aphis* (*Toxoptera*) *odinae*	Aphididae	S. G. College of Agriculture and Research Station, Jagdalpur
30.	*Antecerococcus indicus* (2)	Coccidae	ICAR-National Institute of Secondary Agriculture, Ranchi
	Icerya purchasi	Monophlebidae	
	Paracoccus marginatus	Pseudococcidae	
31.	*Icerya pilosa*	Monophlebidae	ICAR–Indian Institute of Sugarcane Research Biological Control Centre, Pravaranagar
32.	*Aphis craccivora* (3), *A. gossypii* (2), *Macrosiphoniella sanborni*	Aphididae	Dr. Rajendra Prasad Central Agricultural University, PUSA, Samastipur, Bihar
	Saissetia oleae, Pulvinaria sp.	Coccidae	
	Aonidiella aurantii (2), *Fiorinia theae* (2), *Parlatoria ziziphi*	Diaspididae	
	Icerya aegyptiaca	Monophlebidae	
	Ferrisia virgata, Nipaecoccus viridis (3), *Paracoccus marginatus* (2), *Phenacoccus solenopsis* (2), *Rastrococcus iceryoides, R. invadens*	Pseudococcidae	

33.	*Aphis gossypii* (2)	Aphididae	H. M. Clause India Pvt. Ltd., Nelamangala
34.	*Hayhurstia artiplicis*	Aphididae	College of Agriculture, Hisar
35.	*Phenacoccus manihoti*	Pseudococcidae	ICAR–Central Plantation Crops Research Institute, Kayamkulam
36.	*Brevicoryne brassicae, Lipaphis erysimi*	Aphididae	ICAR–Central Agricultural Research Institute, Wellington
37.	*Aphis gossypii*	Aphididae	Corteva Agriscience, Coimbatore
38.	*Aphis gossypii* (2), *Brevicoryne brassicae, Greenideniae* sp., *Myzus persicae, Pentalonia* sp.	Aphididae	College of Horticulture and Forestry, Pasighat
	*Planococcus*sp.	Pseudococcidae	
39.	*Cerataphis brasiliensis*	Aphididae	Cardamom Research Station, Pampadumpara
	Coccus viridis	Coccidae	
40.	*Rastrococcus iceryoides*	Pseudococcidae	ICAR–Central Plantation Crops Research Institute, Kasaragod
41.	*Phenacoccusso lenopsis, Planococcus lialacinus* (2)	Pseudococcidae	ICFRE–Arid Forest Research Institute, Jodhpur
42.	*Lopholeucaspis japonica* (5)	Diaspididae	ICAR–National Research Centrefor Grapes, Solapur
43.	*Fistulococcus pokfulamensis*	Coccidae	ICAR–Indian Institute of Horticulture Research, Bengaluru

44.	*Kiritshenkella sacchari, Phenacoccus saccharifolii* (2)	Pseudococcidae	ICAR–Indian Institute of Sugarcane Research, Lucknow
45.	*Aonidiella aurantii*	Diaspididae	ICAR–Central Citrus Research Institute, Nagpur
46.	*Maconellicoccus hirsutus, Paraputo* sp., *Planococcus lilacinus, Planococcus* sp. (2), *Pseudococcus* sp.	Pseudococcidae	Directorate of Plant Protection, Quarantine & Storage, Regional Plant Quarantine Station, Bengaluru (Imported from Thailand)
47.	*Ferrisia virgata, Paracoccus marginatus* (3), *Phenacoccus solenopsis, Planococcus lilacinus, Planococcus* sp. (2), *Rastrococcus iceryoides, Kiritshenkella sacchari*	Pseudococcidae	G. B. Pant University of Agriculture and Technology, Pantnagar
48.	*Aphis gossypii* (5)	Aphididae	ICAR–Directorate of Medicinal and Aromatic Plants Research, Anand
	Paracoccus marginatus (2), *Phenacoccus solenopsis* (2), *Nipaecoccus viridis*	Pseudococcidae	
49.	*Hysteroneura setariae*	Aphididae	Assam Agricultural University, Jorhat
50.	*Paracoccus marginatus, Pseudococcus jackbeardsleyi*	Pseudococcidae	Dr. Y.S.R. Horticulture Research Station, Ambajipeta
51.	*Saccharicoccus sacchari*	Pseudococcidae	Kerala Agricultural University- Agriculture Research Station, Thiruvalla

Dr K. Sreedevi

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Cerambycid larva* (20)	Cerambycidae	Regional Plant Quarantine Station, Kandla
	Cyrtogenius luteus (4), *Hylurgus ligniperda* (4), *Orthotomicus erosus* (10), *Orthotomicus* sp. (4), *Platypus* sp. (4), *Xyleborus* sp. (4)	Curculionidae	
	Corticeus pini? (5), *Corticeus* sp. (4)	Tenebrionidae	

2.	Elaterid larva	Elateridae	Plant Quarantine Station, Hyderabad
	Ant (4)	Hymenoptera	
	Brachypeplus sp. (8)	Nitidulidae	
	Oryzaephilus sp. (4)	Silvanidae	
3.	*Cantharid beetle* (3)	Cantharidae	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
	Ophionea indica (3)	Carabidae	
	Altica sp. (3), *Dicladispa* sp. (2), *Hispa atra* (2), *Bruchidius angustifrons* (10)	Chrysomelidae	
	Elaterid beetle (4)	Elateridae	
	Mylabris pustulata (2)	Meloidae	
	Amadotrogus sp. (4), *Anomala dimidiata* (3), *Anomala dorsalis* (4), *Anomala polita* (7), *Anomala xanthoptera* (3), *Anomala* sp1. (4), *Anomala* sp2. (4), Cetoniine beetle (4), *Holotrichia longipennis* (3), *Holotrichia problematica* (9), *Holotrichia sikkimensis* (3), *Holotrichia sp. nr. reynaudi* (3), *Schizonycha ruficollis* (4), *Popillia cupricollis* (2)	Scarabaeidae	
	Paederus fuscipes (4)	Staphylinidae	
4.	*Hypothenemus hampei* (5)	Curculionidae	St. Joseph's University, Bengaluru
	Elaterid larva	Elateridae	
5.	*Holotrichia serrata* (3)	Scarabaeidae	Sugarcane Research Station, Vuyyuru
	Anomala bengalensis		
	Oryctes rhinoceros		
6.	*Bruchidius albopubens* (20)	Chrysomelidae	Central Integrated Pest Management Centre, Jaipur
7.	*Rhizopertha dominica* (3)	Bostrichidae	College of Agriculture, Vijayapur
	Callosobruchus chinensis (4), *C. maculates* (2)	Chrysomelidae	

	Coptosoma sp. (3)	Plataspidae	
	Cryptolestis sp. (4), *Oryzaephilus surinamensis* (4)	Silvanidae	
	Tribolium castaneum (3)	Tenebrionidae	
8.	*Cheilomenes sexmaculata* (4), *Scymnus* sp. (3)	Coccinellidae	Central Silk Board, Koppal
9.	Cryptorrhynchinae (4), *Gastrocercus* sp. (4), *Ips sexdentatus* (5), *Pissodes* sp. (5)	Curculionidae	Plant Quarantine Station, Mundra
	Carpophilus sp. (4)	Nitidulidae	
10.	*Anomala dussumieri* (2), *Holotrichia farinose* (3), *Holotrichia* sp. (2)	Scarabaeidae	Cardamom Research Station, Pampadumpara
11.	*Cerambycid larva*	Cerambycidae	Plant Quarantine Station, Mundra
	Hylurgus ligniperda (4), *Ips sexdentatus* (4), *Scolytus* sp. (4), *Tomicus piniperda* (5)	Curculinoidae	
	Ahasverus advena (9)	Silvanidae	
12.	Paussinae beetle (5)	Carabidae	Plant Quarantine Station, Mangaluru
	Platypus sp. (4)	Curculionidae	
	Typhaea stercorea? (6)	Mycetophagidae	
	Brachypeplus sp. (4), *Carpophilus* sp. (6)	Nitidulidae	
	Oryzaephilus surinamensis (4), *Silvanus* sp. (6)	Silvanidae	
	Tribolium castaneum (4)	Tenebrionidae	
	Bitoma quadricollis (6)	Zopheridae	
13.	*Apogonia rauca* (26)	Scarabaeidae	College of Agriculture, Vellayani
14.	*Carpophilus* sp. (5)	Nitidulidae	Navsari Agricultural University, Navsari
15.	*Pheropsophus* sp. (11)	Carabidae	Central Institute for Cotton Research, Coimbatore

16.	*Anomala* sp., *Dynastine* sp. (7), *Schizonycha* sp.	Scarabaeidae	Agricultural College, Bapatla
17.	Bostrichid beetle	Bostrichidae	Central Agricultural University, Pasighat
	Cerambycid beetle 1, Cerambycid beetle 2 (3)	Cerambycidae	
	Hyosorus sp. (7)	Hybosoridae	
	Lucanid beetle 1 (15), Lucanid beetle 2 (2)	Lucanidae	
	Blister beetle (63)	Meloidae	
	Passalid beetle	Passalidae	
	Dung beetle, Dung roller, Melolonthid beetle, Scarab beetle (3), *Anomala* sp. 1, *Anomala* sp. 2, *Anomala* sp. 3 (3), *Anomala* sp. 4 (2), *Anomala* sp. 5 (3), *Anomala* sp. 6 (6), *Anomala* sp. 7 (3), *Anomala* sp. 8 (2), *Anomala* sp. 9 (2), *Anomala* sp. 10 (2), *Anomala* sp. 11 (33), *Cyphochilus* sp. 1 (3), *Cyphochilus* sp. 2 (6), *Cyphochilus* sp. 3 (2), *Heteronychus* sp. (11), *Holotrichia* sp. 1 (2), *Holotrichia* sp. 2 (4), *Holotrichia* sp. 3, *Holotrichia* sp. 4, *Holotrichia* sp. 5, *Macrodactylini* ? (4), *Maladera* sp., *Mimela* sp. 1, *Mimela* sp. 2, *Mimela* sp. 3, *Pentadon* sp. (10), *Polyphylla* sp. (4), *Popillia* sp. 1 (22), *Popillia* sp. 2 (18), *Sophrops* sp. 1 (6), *Sophrops* sp. 2 (15), *Sophrops* sp. 3 (2), *Sophrops* sp. 4, *Sophrops* sp. 5, *Xylotrupes* sp. (7)	Scarabaeidae	
	Tenebrionid beetle (2)	Tenebrionidae	
18.	*Adoretus versutus* (3), *Amadotrogus* sp. (2), *Anomala bilobata* (2), *Anomala* nr. *bilunata* (4), *Anomala* sp. (4), *Catharsius* sp. (4), *Heteronychus* sp. (2), *Lepidiota* nr. *bimaculata* (4), *Onitis* sp. (3), *Popillia* sp. (5), *Sophrops* sp. (3)	Scarabaeidae	Assam Agricultural University, Assam
19.	*Stromatium barbatum* (3)	Cerambycidae	Dr. Y .S.R. Horticultural University, Tirupati
20.	May flies (exuviae) (10)	Ephemeroptera	Living Aquatic Systems Pvt. Ltd., Hebbal
21.	*Adoretus duvauceli, Adoretus* sp. (5), *Anomala bengalensis, Holotrichia rufoflava* (18), *Holotrichia* sp. (3), *Maladera rufocuprea* (31), *Maladera* sp. (21), *Schizonycha fuscesens, Schizonycha* sp. (20)	Scarabaeidae	Regional Agricultural Research Station, Anakapalle, A.P.
22.	Cerambycid beetle	Cerambycidae	Punjab Agricultural University, Ludhiana

23.	*Xylothrips flavipes* (2)	Bostrichidae	Central Horticultural Experiment Station, Chettalli
	Flea beetles (4)	Chrysomelidae	
	Euplatypus parallelus (8), *Xyleborus affinis* ? (5), *Xylosandrus crassiusculus* (5), *Xylosandrus* sp.1 (2), *Xylosandrus* sp. 2 (4)	Curculionidae	
24.	Nitidulid beetles (4)	Nitidulidae	ICAR-Indian Institute of Horticultural Research, Bangalore
25.	*Holotrichia akolana ?* (8)	Scarabaeidae	ICAR–Indian Institute of Sugarcane Research, Biological Control Centre, Prawaranagar
26.	Aphodine beetle (12), *Rhinyptia* sp. (3)	Scarabaeidae	College of Agriculture (Agri. University), Jodhpur
27.	*Popillia* sp. (3)	Scarabaeidae	ICAR- Directorate of Floricultural Research, Pune
28.	Tenebrionid beetle (37)	Tenebrionidae	ICAR–Central Agroforestry Research Institute, Jhansi

Dr G. Mahendiran

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Elaeidobius kamerunicus*	Derelominae	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishva-vidyalaya, Palampur
2.	*Hypera postica*	Hyperinae	Rani Lakshmi Bai Central Agricultural University, Jhansi

3.	*Cryptolestes* sp.	Laemophloeidae	ICAR-Indian Agricultural Research Institute, New Delhi
	Europs sp.	Monotomidae	
	Cryphalus mangiferae, Hypothenomus sp.	Scolytinae	
4.	*Sitophlus oryzae*	Dryophthorinae	College of Agriculture, Vijayapura
5.	*Hypomeces squamosus*	Entiminae	ICAR Research Complex for NEH Region, Manipur
6.	*Pempherulus affinis*	Conoderinae	Tamil Nadu Agricultural University, Coimbatore
7.	*Gasterocerus* sp.	Crytorhychinae	Plant Quarantine Station, Directorate of Plant Protection, Quarantine and Storage, Mundra
	Pissodes sp.	Molytinae	
8.	*Ochyromera artocarpi*	Curculioninae	University of Agriculture Sciences, Dharwad
9.	*Apion* sp.	Apioninae	University of Agriculture Sciences, Dharwad
10.	*Diuncusha berkorni*	Scolytinae	Agricultural college and Research Institute, Madurai
11.	*Myllocerus undecipustulatus*, *Phytoscapus chloroticus*, *Tanymecus sciurus*, *Xanthochelus faunus*	Curculionidae	Dr Rajendra Prasad Central Agricultural University, Samastipur
12.	*Platymycterus himalayanus*	Entiminae	Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar

13.	*Lepropus lateralis*	Entiminae	ICAR–National Research Centre on Litchi, Muzaffarpur
14.	*Derodus denticollis*, *Myllocerus viridanus*	Entiminae	University of Agriculture Sciences, Raichur
15.	*Rhyzopertha dominica*	Bostrichidae	Chaudhary Charan Singh Haryana Agricultural University, Hisar
	Bruchidius sp., *Callosobruchus chinensis*	Bruchidae	
16.	*Cyrtozemia dispar*, *Myllocerus dorsatus*, *M. viridanus*, *Lepropus lateralis*	Entiminae	ICAR–Directorate of Medicinal & Aromatic Plants Research, Anand
17.	*Indozacladus theresiae*	Ceutorhynchinae	ICAR–Indian Institute of Seed Science, Regional station, Bengaluru
	Sitophilus linearis, S. oryzae	Dryophthorinae	
18.	*Sitophilus oryzae*	Dryophthorinae	University of Agriculture Sciences, Dharwad
19.	*Pempherulus affinis*	Conoderinae	ICAR–Central Institute of Cotton Research, Regional Station, Coimbatore

Dr Ankita Gupta

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Cotesia flavipes*	Braconidae	Acharya N. G. Ranga Agricultural University, Tirupati
2.	*Ormyrus orientalis*	Ormyridae	ICAR–Directorate of Cashew Research, Puttur

3.	*Apanteles* sp.	Braconidae	B.A. College of Agriculture, Anand
	Eurytoma sp.	Eurytomidae	
	Ormyrus sp.	Ormyridae	
	Anisopteromalus sp.	Pteromalidae	
4.	*Meteorus* sp.	Braconidae	University of Agricultural Sciences, Dharwad
5.	*Spinaria* sp.	Braconidae	Nagaland Central University
	Brachymeriaeu ploeae	Chalcididae	
	Anastatus sp.	Eupelmidae	
6.	*Brachymeria nephantidis*	Chalcididae	Dr. Y .S.R. Horticulture Research Station, Ambajipeta
7.	*Phanerotoma* sp.	Braconidae	Indira Gandhi Krishi Vishwavidyalaya, Raipur
8.	*Dolichogenidea* sp.	Braconidae	ICAR–National Bureau of Agricultural Insect Resources, Bengaluru
	Ooencyrus sp.	Encyrtidae	
	Pnigalio sp., *Tetrastichus* sp.	Eulophidae	
9.	*Pteromalus puparum*	Pteromalidae	Maharana Pratap University of Agriculture and Technology, Udaipur
	Podagriono pisthacanthum	Torymidae	
10.	*Aleiodes* sp., *Diolcogaster* sp., *Dolichogenidea* sp., *Glyptapanteles* sp.	Braconidae	Uttar Banga Krishi Vishwavidyalaya, West Bengal

11.	*Cotesia ruficrus, Glyptapanteles obliquae*, *Meteorus* sp.	Braconidae	CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow
	Copidosoma floridanum	Encyrtidae	
	Campoletis chlorideae, Charops sp.	Ichneumonidae	
12.	*Cotesia ruficrus*	Braconidae	Virginia Tech, Nepal
	Campoletis chlorideae	Ichneumonidae	
13.	*Chelonus formosanus*	Braconidae	Philippine Rice Research Institute, Philippines

Dr K.J. David

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Bactrocera correcta*, *B. dorsalis*, *B. zonata*, *Zeugodacus cucurbitae*, *Z. gavisus*	Tephritidae	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
2.	*Bactrocera correcta*, *B. dorsalis*, *B. zonata*, *Zeugodacus cucurbitae*	Tephritidae	Anand Agricultural University, Gujarat
3.	*Acrotaeniostola spiralis, Bactrocera dorsalis, B. divenderi, B. gombokensis, B. latifrons, B. lombokensis, B. thailandica, Dacus longicornis, Erectovena sp., Paraxarnuta sp., Phorelliosoma sp., Themara yunnana*	Tephritidae	College of Post-Graduate Studies, Umiam
4.	*Bactrocera divenderi*, *Zeugodacus cucurbitae*, *Z. diversus*	Tephritidae	Banda University of Agriculture & Technology, Banda
5.	*Bactrocera divenderi*, *B. dorsalis*, *B. zonata* , *Dacus persicus*, *Zeugodacus cucurbitae*, *Z. diversus*	Tephritidae	Haryana Agricultural University, Hisar
6.	*B. caryeae*, *B. syzygii*, *Z. tau*	Tephritidae	ICAR–Central Plantation Crops Research Institute, Kayamkulam
7.	*Bactrocera correcta, B. dorsalis, B. versicolor, B. zonata, Zeugodacus brevipunctatus, Z. caudatus, Z. cucurbitae, Z. duplicates, Z. zahadi*	Tephritidae	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

8.	*Bactrocera dorsalis*, *B. correcta*, *B. zonata*, *Zeugodacus cucurbitae*	Tephritidae	Sardarkrushinagar Dantiwada Agricultural University, Banaskantha
9.	*Mycodiplosis* sp.	Cecidomyiidae	ICAR-Indian Institute of Horticulture Research, Bengaluru
10.	*Ophiomyia* sp.	Agromyzidae	University of Agricultural Sciences, Raichur

Dr Salini S.

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Menida versicolor*	Pentatomidae	Anbil Dharmalingam Agricultural College & Research Institute, Tiruchirappalli
2.	*Dunnius bellus*	Pentatomidae	Modern College, Pune
3.	*Nysius* sp.	Lygaeidae	ICAR–Indian Institute of Pulses Research, Kanpur
4.	*Placosternum* sp.	Pentatomidae	Researcher, Nashik
5.	*Homoeocerus* sp.	Coreidae	University of Agricultural Sciences, Raichur
	Cyclopelta siccifolia	Dinidoridae	
	Catacanthus incarnates, Eocanthecona furcellata, Erthesina sp., *Eupaleopada concinna, Eysarcoris guttiger, Halys serrigera, Menida labecula, Meridindia* sp., *Piezodorus hybneri*	Pentatomidae	
	Brachyplatys subaeneus, Coptosoma sp.	Plataspidae	
	Chrysocoris stockerus	Scutelleridae	

6.	*Sycanus versicolor*	Reduviidae	ICAR–National Bureau of Agricultural Insect Resources, Bengaluru
7.	*Scotinophara bispinosa*	Pentatomidae	Government Medical College, Kottayam
8.	*Physopelta gutta gutta, Physopelta quadriguttata*	Largidae	Central Agricultural University, Pasighat
	Carbula crassiventris, Hoplistodera recurva , Nezara viridula var. *smaragdula, Placosternum* sp., *Priassus exemptus*	Pentatomidae	
	Brachyplatys subaeneus	Plataspidae	
	Melamphaus faber	Pyrrhocoridae	
	Epidaus sp., *Oncocephalus* sp.	Reduviidae	
	Lamproceps indicus	Rhyparochromidae	
	Cantao ocellatus	Scutelleridae	
	Eusthenes eurytus	Tessaratomidae	
9.	*Halyomorpha picus*, *Plautia crossota*	Pentatomidae	ICAR-National Research Centre on Litchi, Muzaffarpur
	Tessaratoma javanica	Tessaratomidae	
10.	*Gampsocoris pulchellus*	Berytidae	Sri Karan Narendra Agriculture University, Jobner
	Nesidiocoris tenuis	Miridae	

Dr Rachana R.R.

Sl. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Thrips parvispinus* (2), *T. florum*	Thripidae	Avian Trust, Bengaluru
2.	*Ayyaria chaetophora,* *Scirtothrips dorsalis* (2), *Thrips palmi*	Thripidae	Junagadh Agricultural University, Junagadh

3.	*Thrips palmi* (2), *T. parvispinus*	Thripidae	Kerala Agricultural University, Vellayani
4.	*Thrips florum, T. hawaiiensis*, *T. parvispinus*	Thripidae	Zoological Survey of India, Kolkata
5.	*Scirtothrips dorsalis*, *Thrips palmi*	Thripidae	University of Agricultural Sciences, Dharwad
6.	*Stenchaetothrips biformis* (2), *Thrips parvispinus* (3)	Thripidae	Sri Konda Laxman Telangana State Horticultural University, Rajendranagar
7.	*Thrips tabaci*	Thripidae	Chaudhary Charan Singh Haryana Agricultural University, Hisar
8.	*Frankliniella occidentalis*, *F. schultzei*	Thripidae	Kerala Agricultural University, Vellayani
9.	*Frankliniella schultzei*, *Megalurothrips distalis* (2), *M. typicus* (3), *M. usitatus* (12)	Thripidae	Pulses Research Station, Gujarat
10.	*Frankliniella occidentalis* (6), *Thrips parvispinus*	Thripidae	Regional Plant Quarantine Station, Chennai
11.	*Scirtothrips dorsalis, Thrips parvispinus*	Thripidae	ICAR-Indian Institute of Horticultural Research, Bengaluru
12.	*Megalurothrips usitatus*, *Thrips florum*, *T. hawaiiensis*, *T. parvispinus*	Thripidae	ICAR-National Bureau of Agricultural Insect Resources, Bengaluru
13.	*Frankliniella occidentalis*, *F. schultzei*, *Scirtothrips dorsalis*	Thripidae	Centre for Integrated Pest Management, Bengaluru
14.	*Frankliniella schultzei*, *Thrips palmi* (2)	Thripidae	ICAR-Directorate of Floricultural Research, Pune
	Haplothrips (*Haplothrips*) *ganglbaueri*, *H. gowdeyi*	Phlaeothripidae	
15.	*Megalurothrips distalis*, *M. usitatus*, *Thrips florum*, *T. hawaiiensis* (2), *T. parvispinus*	Thripidae	Indira Gandhi Krishi Vishwavidyalaya, Raipur
16.	*Lefroyothrips varatharajani* (6), *Thrips hawaiiensis*	Thripidae	ICAR-Indian Institute of Horticultural Research, Bengaluru

17.	*Pseudodendrothrips darci*	Thripidae	Central Silk Board, Bengaluru
18.	*Scirtothrips dorsalis*	Thripidae	Mahatma Phule Krishi Vidyapeeth, Rahuri
19.	*Ayyaria chaetophora*	Thripidae	ICAR–Indian Institute of Pulses Research, Dharwad
20.	*Thrips hawaiiensis* (2), *T. parvispinus* (5)	Thripidae	University of Horticultural Sciences, Bengaluru
21.	*Frankliniella schultzei*, *Thrips palmi* (2), *T. parvispinus*, *T. subnudula* (7)	Thripidae	Kerala Agricultural University, Vellayani

Dr Omprakash Navik

S. No.	Taxon/taxa identified	Group/Family	Service provided to
1.	*Trichogramma chilonis* (5)	Trichogrammatidae	Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
2.	*Trichogramma achaeae* (2), *T. chilonis* (3), *T. chilotrae* (2)	Trichogrammatidae	CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, Uttar Pradesh.

Dr M. Sampath Kumar

Sl. No.	Taxon/taxa identified	Group /family	Service provided to
1.	*Argiope pulchella*, *Neoscona theisi* (2)	Araneidae	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
	Oxyopes ?kamalae (2), *Oxyopes* sp.	Oxyopidae	
	Bianor angulosus	Salticidae	
2.	*Lycosa* sp.	Lycosidae	University of Agricultural Sciences, Dharwad
	Oxyopes sp. (2)	Oxyopidae	
	Bianor sp.	Salticidae	
	Runcinia sitadongri, *R. tropica*, *Runcinia* sp., *Thomisus granulifrons, Thomisus* sp.	Thomisidae	

3.	*Neoscona* sp.	Araneidae	University of Agricultural Sciences, Raichur
	Oxyopes sp., *Peucetia* sp.	Oxyopidae	
	Thomisus sp. (3)	Thomisidae	
4.	*Oxyopes hindostanicus*	Oxyopidae	University of Agricultural Sciences, Dharwad
	Carrhotus viduus	Salticidae	
	Tetragnatha ?nitens, *Tetragnatha* sp. (5)	Tetragnathidae	
5.	*Argiope pulchella* (9)	Araneidae	University of Horticultural Sciences, Bagalkot
	Leucauge decorate, *Tetragnatha mandibulata*	Tetragnathidae	
6.	*Pardosa pseudoannulata*	Lycosidae	Acharya N G Ranga Agricultural University, Maruteru
	Menemerus bivittatus, *Plexippus paykulli*, *Plexippus* sp.	Salticidae	
7.	*Argiope* sp., *?Neoscona* sp. (2), *?Cyrtarachne* sp., *? Cyrtophora* sp.	Araneidae	University of Agricultural Sciences, Dharwad
	Cheiracanthium sp.	Cheiracanthiidae	
	Clubiona sp.	Clubionidae	
	Lycosa sp.	Lycosidae	
	Oxyopes ?hindostanicus, *Oxyopes* sp. (2)	Oxyopidae	
	Phintella sp., *Thyene* sp.	Salticidae	
	Leucauge decorata	Tetragnathidae	
	?Chikunia sp. (2), *?Chrysso* sp. (4), *Rhomphaea* sp.	Theridiidae	
	Mastira menoka, *Misumena* sp., *Thomisus granulifrons*	Thomisidae	
8.	*Neoscona theisi*	Araneidae	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
	Nephila pilipes	Nephilidae	
	Leucaug Sp.	Tetragnathidae	
9.	*Neoscona theisi* (2)	Araneidae	

	Pardosa sp. (2)	Lycosidae	Lovely Professional University, Punjab
	Oxyopes kusumae, *Oxyopes* sp.	Oxyopidae	
	Bianor angulosus, *Bianor* sp., *Thyene imperialis*	Salticidae	
10.	*Zelotes shantae*	Gnaphosidae	University of Agricultural Sciences, Dharwad
	Pardosa sp1. (3), *Pardosa* sp2.	Lycosidae	
	Oxyopes ?hindostanicus, *Oxyopes* sp.	Oxyopidae	
	Tetragnatha sp.	Tetragnathidae	
	Coleosoma blandum	Theridiidae	
11.	*Neoscona* sp. (3)	Araneidae	University of Agricultural Sciences Raichur
	Peucetia sp.	Oxyopidae	
12.	*Argiope anasuja* (5), *Gasteracantha geminata* (3), *Gasteracantha* sp., *Neoscona vigilans*	Araneidae	ICAR-National Research Centre for Banana, Trichy
	Afraflacilla sp., *Carrhotus viduus* (2), *Plexippus paykulli*	Salticidae	
13.	*Neoscona theisi*	Araneidae	Dr Rajendra Prasad Central Agricultural University, Pusa
	Cheiracanthium inornatum	Cheiracanthiidae	
	Lycosa mackenziei, *Pardosa pseudoannulata*, *Pardosa* sp.	Lycosidae	
	Oxyopes sp.	Oxyopidae	
	Thomisus sp.	Thomisidae	
14.	*Neoscona* sp.	Araneidae	College of Agriculture, Vijayapura
	Oxyopes sp.	Oxyopidae	

Dr Jagadeesh Patil

S. No.	Taxon/taxa identified	Group/Family	Service provided to
1. .	*Heterorhabditis indica*	Heterorhabditidae	Indira Gandhi Krishi Vishwavidyalaya, Raipur
	Steinernema surkhetense	Steinernematidae	
2.	*Heterorhabditis indica*	Heterorhabditidae	ICAR–Indian Vegetable Research Institute, Varanasi

6. EXTENSION ACTIVITIES

NBAIR demonstrated biocontrol technologies for the management of invasive rugose spiralling whitefly in coconut plantations

NBAIR conducted farmers' Training-cum-Demonstrations on biological management of invasive whiteflies in collaboration with Department of Agriculture at Ragihosalli and Hosadurga villages of Shimoga and Chitradurga districts of Karnataka on 20 January and 21 February 2023, respectively to educate the different stakeholders about the diagnosis and management strategies of invasive whiteflies. Dr K. Selvaraj, Senior Scientist (Entomology) briefed about the origin of whiteflies, their invasion, distribution, different host plants, life cycle, nature of damage and management strategies to farmers. Further, a field demonstration on the method of conservation, re-distribution, production and use of potential parasitoids, *Encarsia guadeloupae* (for rugose spiralling whitefly) and *Encarsia cubensis* (for palm infesting whitefly) and preparation and foliar application of *Isaria fumosorosea* were conducted for the farmers. Training kits including biocontrol agents, viz. *E. guadeloupae*, *E. cubensis* and *I. fumosorosea* formulations (oil and talc) and extension folders on invasive whiteflies and their bio-control strategies were distributed to the farmers. About 250 farmers participated in the training programmes. The training-cum-demonstration was organised under the research project on "Development and validation of bio-intensive integrated pest management strategies for coconut invasive whiteflies in Karnataka" sponsored by Coconut Development Board, Kochi.

Two more farmers' Training-cum-Demonstrations on biocontrol strategies for management of invasive whiteflies in coconut were organised on 6 February 2023 at Nangavaram in Karur district, Tamil Nadu in collaboration with Krishi Vigyan Kendra, Karur, and on 6 June 2023 at Madanapalle, Annamayya district of Andhra Pradesh in collaboration with ICAR–KVK, Kalikiri. Dr K. Selvaraj, Senior Scientist (Entomology) at NBAIR addressed the farmers on importance of biocontrol for tackling invasive whiteflies in coconut, their diagnostic characteristics, host range, augmentation and conservation strategies of their natural enemies. During the meetings, parasitoids and *I. fumosorosea* formulations were distributed to farmers. About 150 farmers and KVK officials participated in the programmes.

NBAIR assessed crop damage due to unseasonal rain and hailstorm in Karnataka

Unseasonal rain as well as severe hailstorm was reported in Bengaluru Rural, Bengaluru Urban, Chikkaballapur and Kolar districts in Karnataka on 16 March 2023. In these districts, crops like beans, cabbage, capsicum, grape, jackfruit, maize, mango, mulberry, papaya, tamarind and tomato were affected. As per the direction of ICAR, NBAIR constituted a team consisting of Drs K. Selvaraj and B. Gundappa to assess the crop losses in the hailstorm affected districts in Karnataka. Team members visited the affected districts on 21 March 2023 and assessed the impacts of hailstorm on different crop plants.

NBAIR celebrated International Year of Millets–2023

NBAIR organised a farmers' meeting on 18 March 2023 during the "International Year of Millets–2023". Arrangements were made for the farmers to virtually witness the inauguration of "Global Millets (Shree Anna) Conference" at Subramaniam Hall, NASC Complex, New Delhi by Honourable Prime Minister, Mr Narendra Modi.

NBAIR staff and other stakeholders including millet farmers and agripreneurs participated in the programme. The Director of NBAIR, Dr S.N. Sushil addressed the farmers and staff and farmers also shared their views on the importance of millets in their culture. Participation certificates and mementoes were distributed to the millet farmers.

NBAIR conducted SCSP and TSP programs in Dharmapuri, Tamil Nadu

NBAIR organised SCSP program at Parvathanahalli village, Pennagaram Taluk, Dharmapuri District and TSP program at Bothakkadu village, Pappireddipatti Taluk, Dharmapuri District in Tamil Nadu in collaboration with Krishi Vigyan Kendra (KVK), TNAU, Papparapatti, Dharmapuri District on 23 March 2023. During the program, NBAIR Director, Dr S.N. Sushil distributed solar light traps, battery operated sprayers, honey bee boxes, mango and coconut seedlings, vermicompost, biopesticides like *Bacillus* spp., *Beauveria bassiana* and *Metarhizium anisopliae* to SC farmers and tribal farmers. Farmers were also provided with vegetable seeds for the establishment of Nutrigarden in their villages.

NBAIR organised awareness programmes for farmers under the Tribal Sub-Plan (TSP) Programme in Andhra Pradesh tribal areas

NBAIR through Acharya N.G. Ranga Agricultural University conducted awareness programmes on crop management practices, integrated farming systems, importance of millet growing and crop diversification in four locations, viz. Killoguda village, Dumbriguda Mandal, Alluri Sitharama Raju District; Tennuboddavara village, Srungavarapukota Mandal, Vizianagaram District; Chittelaba village, Pachipenta Mandal, Vizianagaram District; and Donubai village, Seethampeta Mandal, Srikakulam District in Andhra Pradesh during 12–13 April 2023. Inputs compising seeds of the locally grown crops (ginger, groundnut, niger, ragi, rajmah and turmeric), coconut seedlings, pheromone traps, sticky traps, biopesticides and biofertilizers were distributed to the tribal farmers. Baby goats of Black Bengal goat breed, duplex poultry units, poultry chicks and vermibeds were also distributed to tribal beneficiaries to promote integrated farming system (IFS) in supporting the livelihoods of tribal farmers. All these activites were carried out through Regional Agricultural Research Station (RARS), Anakapalle and District Agricultural Advisory and Transfer of Technology Centre (DAATTC), Vizianagaram, ANGRAU, Andhra Pradesh. Around 500-550 tribal farmers got benefited in total of these four districts of Andhra Pradesh. Dr S.N. Sushil, Director, NBAIR; Dr A. Vishnuvardhan Reddy, Honourable Vice Chancellor, ANGRAU; Dr G. Rama Rao, Registrar, ANGRAU; QRT team of AICRP–BC; Dr P.V.K. Jagannadha Rao, Associate Director of Research, RARS, Anakapalle; Dr. Suresh, Associate Director of Research, Chintapalle; and scientists from NBAIR, RARS, Anakapalle and DAATTC, Viazainagaram participated in the programme and motivated the tribal farmers to adopt newer and safer technologies and integrated farming systems towards enhancement of crop production and productivity to expand the horizon of their livelihood.

NBAIR organised release of exotic parasitoid, *Anagyrus lopezi* in Kerala for classical biological control of cassava mealybug

The occurrence of cassava mealybug in India was first detected at Thrissur during 2020 by NBAIR. Consequently, in order to save the crop from mealybug infestation, NBAIR imported a highly host-specific parasitoid, *Anagyrus lopezi* from IITA, Republic of Benin, West Africa as per Government of India guidelines during August 2021. After undertaking the mandatory quarantine studies ensuring its non-target impacts on other organisms, several field release programmes were organized by the Bureau for one year across all districts of Tamil Nadu where cassava is being grown as the predominant crop. Looking at the impact of the parasitoid in cassava mealybug management in Tamil Nadu and considering, the current level of cassava mealybug

problem in Kerala, NBAIR in collaboration with ICAR–CTCRI, Thiruvananthapuram, AICRP–BC, KAU, Thrissur centre jointly organised the field release programme of *A. lopezi* in Madakkathara Panchayat, Thrissur, Kerala on 26 April 2023. More than 100 tapioca growing farmers of the region participated in this programme. Madakkathara Grama Panchayat president, Kerala Agricultural University officers, State Agricultural Department officials of Kerala, CIPMC and PQS officials of Kochi graced the event.

NBAIR organised a training-cum-input distribution programme for ensuring sustainable livelihood security for SC farming community under the Scheduled Caste Sub-Plan (SCSP) programme

NBAIR hosted a Training-cum-Input Distribution Programme aimed at ensuring sustainable livelihood security in agriculture for the SC farming community of Chinnakanal Panchayat, Idukki, Kerala on 25 May 2023. This event was organized under the Scheduled Caste Sub Plan (SCSP) Programme in collaboration with ICAR–KVK, Idukki, and ICAR–ATARI, Bengaluru. Dr Ramya, R.S., Scientist at NBAIR delivered a talk on the benefits and application of *Pseudomonas fluorescens*, as well as the utilization of black soldier fly for waste degradation and compost production. During the ceremony, 12 farmers were felicitated, and approximately 100 farmers attended the programme. Around 50 tribal farmers received inputs such as honey bee boxes, black soldier fly rearing and composting units, knapsack sprayers, and *P. flourescens* formulation.

NBAIR conducted Regional Millet Mela–2023 under the Tribal Sub Plan Program

NBAIR in collaboration with ICAR–KVK, Tamil Nadu Agricultural University (TNAU), Dharmapuri conducted Regional Millet Mela–2023 during 28–29 May 2023 at ICAR–KVK, Dharmapuri, Tamil Nadu as part of the celebrations to commemorate International Year of Millets. Mr M.R.K. Paneerselvam, Minister for Agriculture and Farmers' Welfare, Government of Tamil Nadu; Dr V. Geethalakshmi, Vice Chancellor, TNAU; Dr P.P. Murugan, Director of Extension Education, TNAU; Dr Shaik N. Meera, Director of ICAR–ATARI, Hyderabad; Mrs K. Shanthi, District Collector, Dharmapuri, Tamil Nadu, District MPs and MLAs participated in the programme. More than 4000 farmers participated in the Regional Millets Mela–2023. Tribal farmers were provided with agricultural inputs like millet seeds, vegetable seeds, bio-pesticides, farm implements like cono weeders and coconut climbers for the improvement of their livelihood.

NBAIR organised release of exotic parasitoid, *Anagyrus lopezi* in Puducherry for classical biological control of cassava mealybug

In order to manage the spread of the invasive pest, cassava mealybug (CMB), *Phenacoccus manihoti* in Puducherry union territory, NBAIR in collaboration with Department of Agriculture and Farmers Welfare (ATMA), Perunthalaivar Kamaraj Krishi Vigyan Kendra, Puducherry organised field release of parasitoid, *Anagyrus lopezi* at Santhai Pudukuppam village in Puducherry union territory on 8 July 2023. Mr C. Djeacoumar, Honourable Minister of Agriculture, Government of Puducherry took part in the programme and released the parasitoids in the cassava mealybug infested fields. More than 150 tapioca growing farmers of the region participated in this programme. Several thousands of parasitiods mass produced at NBAIR were distributed to the farmers for cassava mealybug control in their fields.

NBAIR organised input distribution and capacity development programme under the Schedules Caste Sub-Plan (SCSP) Program

NBAIR in collaboration with Krishi Vighan Kendra, V.C. Farm, Mandya and Department of Horticulture, Mandya organized Training-cum-Input Distribution programme under SCSP on 10 July 2023. Dr T.M. Shivalingaswamy,

Principal Scientist, NBAIR delivered a speech on livelihood development of scheduled caste coconut growers, and also on management of coconut black headed caterpillar, rugose spiralling white fly and red palm weevil. A farmer-scientist interaction was co-ordinated by scientists at NBIAR, Drs A.N. Shylesha, K. Selvaraj and B. Gundappa. Critical inputs, viz. coconut seedlings, sprayer, neem soap, legume seeds, *Trichoderma* formulation, plant protection chemicals, and seedlings/grafts/cuttings of horticulture crops were distributed to 60 SC farmers.

NBAIR and FAO–India jointly organized "Scientists–Farmers Interface Meeting for the management of fall armyworm through biological control"

A Scientists-Farmers Interface meeting for the management of fall armyworm, *Spodoptera frugiperda* was organized on 4 October 2023 in Yelahanka campus of NBAIR for the benefit of maize growing farmers. The beneficiaries primarily comprised of small and marginal farmers from Kolar district, Karnataka. Dr S.N. Sushil, Director, NBAIR distributed talc formulation of *Metarhizium anisopliae* NBAIR-Ma35, *Pseudomonas fluorescens* strain NBAIR-PFDWD and liquid formulation of *Bacillus thuringiensis* NBAIR-Bt25 which showed promising results against *S. frugiperda* to all the farmers for management of FAW and also for enrichment of farm yard manure in their fields.

NBAIR organised The Biocontrol Expo 2023

NBAIR organised the Biocontrol Expo-2023 on 19 October 2023 as part of the celebration of the 31st Foundation Day which showcased a total of thirty-six stalls, featuring products and technologies from various industries and Krishi Vigyan Kendras (KVKs).

The Expo and Foundation Day were inaugurated by the Ms Shobha Karandlaje, the Union Minister of State for Agriculture & Farmers' Welfare, Government of India. Dr S.N. Sushil, Director, NBAIR hosted the program with the presence of various distinguished figures including Dr S.C. Dubey, Assistant Director General (PP & BS); Dr P.K. Singh, Agriculture Commissioner, Government of India; Dr J.P. Singh, Plant Protection Advisor, Government of India; Dr S.V. Suresha, Honourable Vice Chancellor of the University of Agricultural Sciences, Bengaluru; and Dr Dnyaneshwar Wagchoure from the Agricultural Microorganisms Manufacturers and Farmers Association. During the event, the Honourable Minister emphasized the necessity of training both Central and State Government agricultural and horticultural officers in the multiplication of beneficial insects, with the goal of imparting these skills to farmers. She also stressed the significance of biological control agents in natural and organic farming, which can contribute to the production of pesticide-free food.

The Minister also presented awards to progressive farmers and distributed agricultural inputs to two hundred farmers under SCSP programme.

The Expo drew visitors from four districts in Karnataka: Chikkaballapur, Chintamani, Hadonahalli and Mandya. An "Open Day" was organised for school students as part of the programme. The students were exposed to the various activities carried out in the Bureau and they also participated in fun-filled competitions. A total of 263 students from DPS North Bangalore (127 students) and Trio World School (136 students) participated in the event. The footfall recorded for the event was around 800.

NBAIR organised an "Open Day" for school students

NBAIR planned and organised an "Open Day" and educational visit at the NBAIR Hebbal and Yelahanka campuses on 29 November 2023 for the students of Grade XI (180 students) of Kendriya Vidyalaya, MEG & Centre under PM Schools for Rising India (PM SHRI).

NBAIR celebrated World Soil Day

World Soil Day programme was organised by NBAIR in Thovinakere village, Koratagere Taluk, Tumkur District on 5 December 2023. The significance of soil health and water conservation was highlighted followed by a scientists-farmers interaction. Around 100 farmers participated in the programme.

NBAIR observed Swachhta Pakhwada

A campaign on "Waste to Wealth" was organised for the farmers and other households in Attur, Yelahanka, Bengaluru. Scientists from NBAIR demonstrated about kitchen waste management by using black soldier fly to farmers on 19 December 2023. Further, an awareness program about the importance of cleanliness in day to day life of farmers was conducted in Chikkaganni village, Channarayapatna Taluk, Hassan District on 21 December 2023 and around 35 farmers participated in the event.

NBAIR celebrated Kisan Diwas

Kisan Diwas was celebrated on 23 December 2023 at NBAIR Yelahanka campus. Around 200 farmers from Chikkaballapur and Kolar Districts participated in the programme. Mr S. Muniswamy, Member of Parliament, addressed the farmers virtually. Farmers were supplied with kits including battery operated sprayer, Tricho cards, formulations of *Bacillus thuringiensis*, *Beauveria bassiana*, *Isaria fumosorosea*, *Metarhizium anisopliae* and pheromone kits.

7. AWARDS AND RECOGNITIONS

Dr S. N. Sushil

Bestowed with the "Global Biopesticides Excellency Award" at the Global Biopesticides Summit–2023, held in Bishkek, Kyrgyzstan, 27 August 2023.

Conferred with Special Recognition Award at International Conference on Plant Health Management (ICPHM)–2023 organised by the Plant Protection Association of India at PGTSAU, Hyderabad during 15–18 November 2023.

Delivered a lead talk on "Organizing and Incentivizing National Research and Development on Biocontrol in Global Forum" in the "Training Workshop on Biological Control" jointly organised by International Centre of Insect Physiology and Ecology and FAO at Nairobi, Kenya, 27 June 2023.

Dr T.M. Shivalingaswamy

Served as Expert Member, Fourteenth SAC Meeting at Krishi Vigyan Kendra, Hadonahalli, 23 January 2023.

Served as Expert Member, Screening Committee for selection of scientists for RMP, Agricultural Scientists Recruitment Board, New Delhi, 17–18 January 2023.

Served as Expert Member, Screening Committee for selection of scientists for RMP, Agricultural Scientists Recruitment Board, New Delhi, 27–28 January 2023.

Served as Expert Member, Selection Committee for Promotion of Teachers under Career Advancement Scheme, University of Agricultural Sciences, Bengaluru, 10 March 2023.

Served as Expert Member, Selection Committee for Promotion of Scientists under Career Advancement Scheme, Agricultural Scientists Recruitment Board, New Delhi, 17 March 2023.

Dr M. Nagesh

Indian Potato Association Medal for the Best Paper Award–2023 for the paper entitled "Species composition and distribution of the vector aphids of PVY and PLRV in India".

Dr T. Venkatesan

Recognised as Fellow of National Academy of Biological Sciences, (FNABS), Chennai.

Recognised as Vice-President, Society for Biocontrol Advancement, Bengaluru.

External Expert for the evaluation of research project at Seri-Biotech Research Laboratory, Central Silk Board, Ministry of Textiles, Govt. of India, Kodathi, Bengaluru.

Chairman for the theme on "Empowering farmers by integrating host plant resistance and protection of plant varieties for crop health management" during the DST–SERB sponsored "National Symposium on Crop Health Management: Safeguarding Crop through Diagnostics and Innovations" held at ICAR–VPKAS, Almora, 29–30 September 2023.

Co-Chairman for the theme on "Novel Approaches for Crop Health Management" during the DST–SERB sponsored "National Symposium on Crop Health Management: Safeguarding Crop through Diagnostics and Innovations" held at ICAR–VPKAS, Almora, 29–30 September 2023.

Recognised as reviewer of the journals, BMC Microbiology, Indian Journal of Entomology, Pest Management Science, BioControl and International Journal of Pest Management.

External Examiner for the Ph.D Entomology student, Mr Shranabasavappa, Department of Agricultural Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur.

External Examiner for evaluation of thesis of PG student, Ms Gopu Sushma in the Department of Agricultural Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur.

Served as Co-convener in "Cross Disciplinary National Dialogue on Growing Concern over Insect Pest Invasiveness" in India held at ICAR–NBAIR, Bengaluru, 20 October 2023.

External Examiner for PhD Entomology student, Ms Karshanal J., Division of Entomology, ICAR–IARI, New Delhi.

Conducted comprehensive viva voce examination for 2021 batch students, TNAU Coimbatore, as External Examiner, 25 July 2023 to 28 July 2023.

Recognised as Associate Editor, Indian Journal of Entomology, IARI, New Delhi.

Dr Sunil Joshi

Selected as a Head of Division, Germplasm Collection and Characterisation, ICAR–National Bureau of Agricultural Insect Resources through ASRB, New Delhi.

Dr K. Subaharan

Awarded a certificate by ICAR for developing a technique for "Rearing of parasitoid *Nesolynx thymus* and their use in housefly, *Musca domestica* management".

Invited by SIIC IIT, Kanpur to review the progress of Pherobank Technologies Limited, a grantee of DBT–BIRAC BIG grant.

Served as an expert in the Staff Research Council (SRC) meeting to review the progress made in the research projects handled at the Central Coffee Research Institute, Chikkamagaluru, 29–31 May 2023.

Chaired a session on Agriculture held at Shanghai Cooperation Organization–Young Scientist Conclave at JNCASR, Bengaluru, 6–10 February 2023.

Nodal officer for Government of Mizoram for setting up the State Biocontrol Laboratory at Aizwal.

Recognised as adjunct faculty at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore for the period 2023–2024.

Served as ICAR DG's nominee in the Assessment Committee for considering the promotion of scientists in the discipline of Agricultural Entomology.

Awarded certificate for development of technology, "SpobNPV (ICAR–NBAIR1) for the management of Bihar hairy caterpillar *Spilosoma obliqua*" on 95th ICAR Foundation and Technology Day as Associate developer, 16 July 2023.

Served in the expert panel for the Session on Crop Protection during the XXXII Annual Group Meeting of ICAR–All India Coordinated Research Project on Palms, ICAR–CPCRI, Kasaragod, Kerala held at Kahikuchi, 13–15 September 2023.

Co-chaired a session on Transfer of Technology during the XXXII Annual Group Meeting of ICAR–All India Coordinated Research Project on Palms, ICAR–CPCRI, Kasaragod, Kerala held at Kahikuchi, 13–15 September 2023.

Served as a screening committee member for the proposals from CSIR laboratories for the third round of "CSIR–Fundamental & Innovative Research in Science of Tomorrow (CSIR–FIRST)".

Dr G. Sivakumar

Delivered a lead lecture on "Baculoviruses in Biological Control of Crop Pests" in the "National Symposium on Crop Health Management: Safeguarding Crop through Diagnostics and Innovations" at VPKAS, Almora, 29–30 September 2023.

Served as a Chairman of the technical session on "Emerging trends and challenges for crop health amid climate change" in the "National Symposium on Crop Health Management: Safeguarding Crop through Diagnostics and Innovations" at VPKAS, Almora, 29–30 September 2023.

Served as an Expert and evaluated the project proposals of Seri Biotech Research Institute, Central Silk Board, Bengaluru.

Recognized as a member in the Collaborative Platform for Data Generation for Biopesticide Registration.

Served as an external examiner for thesis evaluation of M.Sc & Ph.D students of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Awarded certificate for development of technology, "SpobNPV (ICAR–NBAIR1) for the management of Bihar hairy caterpillar, *Spilosoma obliqua*" on 95th ICAR Foundation and Technology Day as Lead Developer, 16 July 2023.

Awarded certificate for development of technology, "Aqueous formulation of *Spodoptera frugiperda* nucleopolyhedrovirus (SpfrNPV ICAR–NBAIR1) for the management of maize fall armyworm on 95th ICAR Foundation and Technology Day as Lead Developer, 16 July 2023.

Dr M. Mohan

Received ICAR–NBAIR Best Worker Award–Scientific Category, 2023.

Served as Organising Secretary for the "National Dialogue Meeting on Threats of Invasive Insect Pests in India-Challenges and the Way Forward" held at ICAR–NBAIR, Bengaluru, 20 October 2023.

Dr A. Kandan

Awarded certificate for development of technology, "A novel *Bacillus albus* strain NBAIR-BATP with excellent insecticidal, antagonistic and growth promotion properties for the management of pests and diseases" on 95th ICAR Foundation and Technology Day as Lead Developer, 16 July 2023.

Dr K. Sreedevi

Received "Senior Agricultural Entomologist Award" from B.V. David Foundation, Chennai during the "National Conference on Recent Advances in Agricultural and Industrial Entomology, Environmental Science and their Impact on Environment and Food Security" held at Loyola College, Chennai, 29–30 September 2023.

Dr Mahesh Yandigeri

Awarded certificate for development of technology, "SpobNPV (ICAR–NBAIR1) for the management of Bihar hairy caterpillar, *Spilosoma obliqua*" on 95th ICAR Foundation and Technology Day as Associate Developer, 16 July 2023.

Awarded certificate for development of technology, "Aqueous formulation of *Spodoptera frugiperda* nucleopolyhedrovirus (SpfrNPV ICAR–NBAIR1) for the management of maize fall armyworm on 95th ICAR Foundation and Technology Day as Associate Developer, 16 July 2023.

Awarded certificate for development of technology, "BSF based floating fish feed: Product" on 95th ICAR Foundation and Technology Day as Associate Developer, 16 July 2023.

Dr K. Selvaraj

Awarded certificate for development of technology, "Mass production technology for parasitoid, *Encarsia guadeloupae* for the suppression of rugose spiralling whitefly" on 95th ICAR Foundation and Technology Day as Lead Developer, 16 July 2023.

Awarded certificate for development of technology, "Potential entomopathogenic fungus, *Isaria fumosorosea* (strain ICAR–NBAIR Pfu-5) for management of rugose spiralling whitefly *Aleurodicus rugioperculatus* in coconut and oil palm." on 95th ICAR Foundation and Technology Day as Lead Developer, 16 July 2023.

Received "Best Scientist (Senior) Award" in the field of Entomology by Plant Protection Association of India (PPAI) Golden Jubilee Awards Committee for the year 2023.

Received Smt. Kavuri Sarada Memorial Award for "The Best Research Paper" published in the Indian Journal of Plant Protection for the year 2021 (Vol. 49, No. 4, Page No. 227–232) by Plant Protection Association of India (PPAI) for the research paper entitled "Increasing distribution, biology and population dynamics of invasive woolly whitefly, *Aleurothrixus floccosus* on guava".

Dr R.G. Gracy

Recognised as Subject Editor of Advances in Modern Agriculture.

Dr B. S. Gotyal

Received the "Fellow Award" from the society of "Plant Protection Association of India (PPAI)" during the International Conference on Plant Health Management ICPHM 2023–Innovation and Sustainability, Hyderabad, 15–18 November 2023.

Dr Ankita Gupta

Received Fellow of the Royal Entomological Society, London.

Received Science and Engineering Research Board International Travel Support Scheme (ITS) Travel Award (File No: ITS/2023/002031) to present a research paper in the 10th Congress of International Society of Hymenopterists, Iasi, Romania.

Received Science and Engineering Research Board Core Research Grants project on "Community structure and dynamics of parasitoid wasps and their butterfly hosts in a complex ecological system" as Co-PI.

Nominated as a judge for screening Student Travel Award for the upcoming XXVII International Congress of Entomology to be held at Kyoto, Japan.

Nominated as a judge for Australasian session for screening students' competition in Hymathon 2023, 30 November 2023.

Received certificate for development of technology, "A technique for the rearing of the parasitoid *Nesolynx thymus* (Girault) and their use in the housefly *Musca domestica* management" on 95th ICAR Foundation and Technology Day as Associate Developer, 16 July 2023. .

Dr S. Salini

Invited as an external expert by the Australian Government to join an international team of stink bug taxonomists on a venture on the systematics of the Brown Marmorated Stink Bug (*Halyomorpha halys*), a major pest of food crops in many parts of the world.

Visited and studied the insect specimens deposited at The National Museum of Czechia (NMC), Prague, Czech Republic and The Natural History Museum (NHM), London, United Kingdom, 4 April–31 May 2023.

Awarded with Plant Protection Award–2023 by the Avian Trust and Insect Environment, 16 December 2023.

Dr K. J. David

Awarded with Plant Protection Award–2023 by the Avian Trust and Insect Environment, 16 December 2023.

Dr U. Amala

Delivered a lead lecture on "Apitherapy and value-added bee products in agri-preunership" in the "National Symposium on Crop Health Management", ICAR–Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, 29–30 October 2023.

Received Department of Science & Technology Science and Engineering Research Board (DST–SERB) International Travel Grant to present an oral paper titled, "Trap nesting: an easy way to conserve leaf cutter bees for enhanced pollination in pigeon pea" in the Twelfth International Symposium on Pollination, Cape Town, South Africa, 16–20 October 2023.

Dr B. Gundappa

Served as external expert and reviewed two proposals under BIG SIIC BIRAC of DBT, 1 April 2023.

Recognized as PG Faculty and Guide for IARI Bengaluru hub.

Received appreciation letter from Indian Entomologist for serving as Associate Editor.

Awarded with Plant Protection Award–2023 by the Avian Trust and Insect Environment, 16 December 2023.

Dr Richa Varshney

Served as consultant for setting up the Biocontrol unit at APSSRDI, Hindupur.

Dr C. Manjunatha

Recognized as Course instructor for "Plant Pathogenic Prokaryotes" PL PATH 503 for ICAR–IARI Bengaluru hub-AY 2023–24 - M.Sc. Plant Pathology.

Nominated as external examiner for evaluation of Master's degree thesis entitled "Virulence profiling and identification of TAL and non-TAL effectors repository in *Xanthomonas oryzae* population of Karnataka", from University of Agricultural Sciences, Raichur.

Dr R. R. Rachana

Selected as Life Fellow of Entomological Society of India.

Recognised as Post Graduate Teacher in IARI Bengaluru hub.

Invited by CABI, UK to author a datasheet on *Retithrips syriacus.*

Dr R. S. Ramya

Recognized as Post-Graduate faculty in Indian Agricultural Research Institute, IARI, New Delhi.

Recognized as Post-Graduate teacher in University of Agricultural Sciences, Raichur, Karnataka; University of Agricultural Sciences, Bengaluru, Karnataka; University of Agricultural Sciences, Dharwad, Karnataka.

Recognised as Reviewer for the journal, *PLOS One*, which has a NAAS rating of 9.75.

Recognised as Life member, Association for Advancement of Pest Management in Horticultural Ecosystems (AAPMHE), ICAR–IIHR, Bengaluru.

Recognised as Course instructor for "Insect Anatomy and Physiology" ENT502 for ICAR–IARI Bengaluru hub-AY 2023–24 (I semester)- M.Sc. Entomology.

8. AICRP COORDINATION UNIT AND CENTRES

Sl.No	Centres	
	Regular Centres	
1.	AAU, Anand	Anand Agricultural University, Anand
2.	AAU, Jorhat	Assam Agricultural University, Jorhat
3.	ANGRAU, Anakapalle	Acharya N.G. Ranga Agricultural University, Anakapalle
4.	GBPUA T, Pantnagar	Govind Ballabh Pant University of Agriculture and Technology, Pantnagar
5.	KAU, Thrissur	Kerala Agricultural University, Thrissur
6.	MPKV , Pune	Mahatma Phule Krishi Vidyapeeth, Pune
7.	PAU, Ludhiana	Punjab Agricultural University, Ludhiana
8.	PJTSAU, Hyderabad	Pandit Jayashankar Telangana State Agricultural University, Hyderabad
9.	SKUAST, Srinagar	Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar
10.	TNAU, Coimbatore	Tamil Nadu Agricultural University, Coimbatore
11.	YSPUHF, Solan	Y.S. Parmar University of Horticulture and Forestry, Solan
	Voluntary Centres	
12.	CAU, Pasighat	Central Agricultural University, Pasighat
13.	MPUA T, Udaipur	Maharana Pratap University of Agriculture & Technology, Udaipur
14.	OUAT , Bhubaneswar	Orissa University of Agriculture & Technology, Bhubaneswar
15.	UAS, Raichur	University of Agricultural Sciences, Raichur
16.	ICAR–CISH, Lucknow	Central Institute of Subtropical Horticulture, Lucknow
17.	ICAR–CPCRI, Kayamkulam	Central Plantation Crops Research Institute, Kayamkulam
18.	ICAR–IIHR, Bangalore	Indian Institute of Horticultural Research, Bangalore
19.	ICAR– IIMR, Hyderabad	Indian Institute of Millet Research, Hyderabad
20.	ICAR–IIRR, Hyderabad	Indian Institute of Rice Research, Hyderabad
21.	ICAR–IIVR, Varanasi	Indian Institute of Vegetable Research, Varanasi
22.	ICAR–NCIPM, New Delhi	National Centre for Integrated Pest Management, New Delhi
23.	DRYSRUH, Ambajapeta	Dr. Y S R Horticultural University, Ambajipeta
24.	IGKV , Raipur	Indira Gandhi Krishi Viswavidhyalaya, Raipur
25.	KAU, Kumarakom	Regional Agricultural Research Station (KAU), Kumarakom
26.	KAU, V ellayani	Regional Agricultural Research Station (KAU), Vellayani

Sl.No	Centres	
27.	UBKV , Pundibari	Uttar Banga Krishi Viswavidyalaya, Pundibari
28.	PDKV, Akola	Panjabrao Deshmukh Krishi Vidyapeeth, Akola
29.	SKUAST - Jammu	Sher-e-Kashmir University of Agricultural Science & Technology, Jammu
30.	UHAS, Shivamogga	University of Agricultural and Horticultural Sciences, Shivamogga
31.	DRYSRHU, Tirupati	Citrus Research Station, Dr. Y.S.R. Horticultural University, Tirupati
32.	ICAR–SBI, Coimbatore	Sugarcane Breeding Institute, Coimbatore
33.	WNC-ICAR–IIMR, Hyderabad	Indian Institute of Millet Research, Hyderabad
34.	NIPHM, Hyderabad	National Institute of Plant Health Management, Hyderabad
35.	CoA, Agartala	College of Agriculture (CAU), Lembucherra, Agartala
36.	ICAR–NRRI, Cuttack	National Rice Research Institute, Cuttack
37.	ICAR–DFR, Pune	Directorate of Floriculture Research, Pune
38.	ICAR–NRCL, Muzafarpur	National Research Centre on Litchi, Muzafarpur
39.	ICAR–CTRI, Rajahmundry	ICAR-Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh
40.	CSKHPKV, Palampur	CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur
41.	TCRS, Yethapur, Salem	Tapioca and Castor Research Station, (TNAU), Yethapur, Salem

9. ONGOING RESEARCH PROJECTS

A. List of Institute projects

DIVISION OF GERMPLASM COLLECTION AND CHARACTERISATION

I. Biosystematics of agriculturally important insects and associated fauna

1. Taxonomic studies on Coccoidea (Hemiptera) with special reference to Pseudococcidae, Coccidae, Diapsididae, Monophlebidae and Rhizoecidae (01.08.2022 to 31.03.2027) – Dr Sunil Joshi
2. Biosystematics studies on Scarabaeidae and Cerambycidae of Coleoptera (22.06.2017 to 31.03.2023) – Dr K. Sreedevi
3. Taxonomic studies on Indian Curculionids (Coleoptera) with emphasis on Dryophthorinae (01.08.2022 to 31.03.2027) – Dr G. Mahendiran
4. Digitization of type specimens and cataloguing of voucher specimens in ICAR-NBAIR reference collections (01.04.2018 to 31.03.2023) – Dr Ankita Gupta
5. Taxonomic studies on Braconidae with special reference to Cheloninae, Microgastrinae and Braconinae with emphasis on host-parasitoid association in India (01.04.2021 to 31.03.2026) – Dr Ankita Gupta
6. Taxonomy and biocontrol potential of entomopathogenic nematodes in Deccan Plateau of India (01.04.2017 to 31.03.2023) – Dr Jagadeesh Patil
7. Biodiversity and systematic studies on entomopathogenic nematodes with a special reference to Western Ghats of India (16.05.2023 to 16.04.2028) – Dr Jagadeesh Patil
8. Taxonomic studies on Tephritoidea (Diptera) of India with special reference to Tephritidae, Platystomatidae, Ulidiidae and Pyrgotidae (01.04.2020 to 31.03.2025) – Dr K.J. David
9. Taxonomy of Pentatomoidea (Hemiptera: Heteroptera) of India with special reference to Pentatomidae and Tessaratomidae (01.04.2020 - 31.03.2025) – Dr S. Salini
10. Taxonomy of Indian jumping spiders (Salticidae: Araneae) with reference to crop agroecosystem (01.04.2016 to 31.03.2026) – Dr M. Sampath Kumar
11. Taxonomy and diversity of Indian Thysanoptera with special reference to Terebrantia (01.10.2015 to 31.03.2024) – Dr R.R. Rachana
12. Taxonomy of Indian Trichogrammatidae (Chalcidoidea: Hymenoptera) and evaluation of potential species (01.09.2016 to 31.03.2023) – Dr Navik Omprakash Samodhi
13. Faunal composition and diversity of Trichogrammatidae (Chalcidoidea: Hymenoptera) in cultivated and natural habitats.(16.05.2023 to 16.04.2028) – Dr Navik Omprakash Samodhi

DIVISION OF GENOMIC RESOURCES

II. Molecular characterisation, genomics and bioinformatics of agriculturally important insects, entomopathogenic nematodes and associated microorganisms

1. Biological characterization of agriculturally important insects through DNA barcodes (01.04.2020 to 31.03.2025) – Dr T. Venkatesan
2. Studies on the molecular and functional diversity of EPN-EPB-insect tritrophism and their utilization against soil pests (08.07.2016 to 30.03.2024) – Dr M. Nagesh
3. *Bacillus thuringiensis* – Fermentation and formulation strategies for enhanced toxicity against insect pests (01.04.2017 to 31.04.2023) – Dr R. Rangeshwaran
4. Population genetic diversity in selected insect borer of economic importance (01.04.2018 to 31.03.2023) – Dr M. Mohan
5. Genome analysis and gene knockout studies using genomic tools in selected insect species (16.05.2023 to 16.04.2027)-Dr M. Mohan

6. Development of interactive Mobile Apps for Non-chemical methods in insect pest management (01.04.2017 to 31.03.2023) – Dr M. Pratheepa
7. Geo Mapping of predominant insect pests and their natural enemies including invasive species in India (01.08.2022 to 31.03.2026) – Dr M. Pratheepa
8. Studies on black soldier fly and associated microorganisms for their utilization (01.04.2020 to 31.03.2025) – Dr Mahesh Yandigeri
9. Gene characterization, identification and validation of gene silencing approach against *Maconellicoccus hirsutus* and *Phenacoccus manihoti* (01.08.2022 to 31.03.2026) – Dr R. Gandhi Gracy
10. Molecular diversity of economically important mealybugs and their associated natural enemies in different ecosystems (01.08.2022 to 31.3.2026) – Dr B.S. Gotyal
11. Identification and molecular characterization of Indian Tachinids (01.04.2020 to 31.03.2023) – Dr. R.S. Ramya
12. Development and molecular studies of improved strains of selected natural enemies for insecticide resistance (01.08.2022 to 31.03.2026) – Dr. R.S. Ramya
13. Molecular studies on the virulence of *Bacillus thuringiensis* against fall armyworm and root grubs (01.04.2021-31.03.2026) – Dr . C. Manjunatha
14. Molecular characterization of economically important plant bugs and their diversity (01.04.2020 to 31.03.2024) – Mr K. T. Shivakumara

DIVISION OF GERMPLASM CONSERVATION AND UTILISATION

III. Biodiversity conservation, behavioural studies and maintenance and utilization of arthropod germplasm

1. Exploiting the olfactory cues for management of key stored product pests (01.04.2019 to 31.03. 2023) – Dr K. Subaharan
2. Microbial volatilome for management of *Plutella xylostella* and *Phthroimaea* (*Tuta*) *absoluta* (01.04.2023 – 01.04.2028)) – Dr K. Subaharan
3. Ecological studies on the establishment and management of invasive insects fall armyworm, *Spodoptera frugiperda* and cassava mealybug, *Phenacoccus manihoti* in India (01.10.2020 to 31.03.2024) – Dr A.N. Shylesha
4. Non bee insect pollinators of important crops (01.04.2021 to 31.03.2026) – Dr T.M. Shivalingaswamy
5. Tailoring strategies to introduce acaropathogens and predatory mites for biological control in protected and open-field crops (01.08.2022 to 31.03.2027) – Dr P. Sreerama Kumar
6. Characterisation of viruses with special reference to Lepidoptera & Coleoptera (24.11.2015 to 31.03.2023) – Dr G. Sivakumar
7. Developing formulations of consortia of microbial biocontrol agents for the management of pests of crops of protected cultivation. (17.05.2023 to 17.04.2028) – Dr G. Sivakumar
8. Developing controlled release formulations for major pests (03.10.2018 to 02.10.2023) – Dr Deepa Bhagat
9. Nanomaterials and their effects on natural pest-control agents including parasitoids, predators, and beneficial insects (17.05.2023 to 17.04.2028) – Dr Deepa Bhagat
10. Controlled Release Pheromone formulations for management of the Plassey borer, *Chilo tumidicostalis* Hampson. and the Gurdaspur borer, *Acigona steniellus* Hampson. (17.05.2023 to 17.04.2028) – Dr Deepa Bhagat
11. Development of suitable formulation for entomopathogenic fungi and under exploited entomogeneous bacteria for the management of major lepidopteran and coleopteran pests (01.10.2020 to 31.03.2025) – Dr A. Kandan

12. Climate change effect on the diversity and bioecology of some important sucking pests (01.04.2014 to 31.03.2023) – Dr K. Selvaraj
13. Studies on whiteflies and associated natural enemies for their management (19.09.2016 to 31.03.2023) – Dr K. Selvaraj
14. Standardization of crop-specific standard operating procedures for application biopesticides and natural enemies in plantation crops using drones. (1 April, 2023 to 31st March, 2026) – Dr K. Selvaraj
15. Mass culturing and utilisation of stingless bee *Tetragonula iridipennis* Smith (Hymenoptera: Apidae) for pollination of selected crops (01.10.2020 to 31.03.2024) – Dr U. Amala
16. Development of mass production protocols of selected insects of industrial importance (01.10.2020 to 31.03.2024) – Dr U. Amala
17. Diagnosis, ecology and management of thrips in horticultural crops. (1.10.2022 to 31.3.2027)- Dr. Gundappa
18. Ecological studies on emerging lepidopteran insect pests of horticultural crops. (1.4. 2023 to 31.3.2028))- Dr. Gundappa
19. Investigation on interactions between the entomopathogenic fungi and natural enemies (01.10.2020 to 31.03.2024) – Dr Richa Varshney

B. List of external funded projects

DIVISION OF GERMPLASM COLLECTION AND CHARACTERISATION

1. ICAR- National Fellow: Biogeography and biosystematics of whitegrub fauna (coleopteran: Scarabaeidae) of various agroclimatic zones of India (28.10.2022 to 28.10.2027) – Dr K. Sreedevi
2. DST-SERB: Biodiversity and systematic studies on weevils (Curculionidae: Coleoptera) with special reference to Eastern Ghats of India (10.02.2022 to 09.02.2025) – Dr G. Mahendiran
3. DST-SERB: Taxonomic studies on species complexes in selected parasitoids (Braconidae: Hymenoptera (10.02.2022 to 09.02.2025) – Dr Ankita Gupta
4. DST: Community structure and dynamics of parasitoid wasps and their butterfly hosts in a complex ecological system (14.8.2023 to 13.8.2026) – Dr Ankita Gupta
5. DST-SERB: Systematics studies on shoot flies of atherigoninae (muscidae: Diptera) from India (30.12.2020 to 29.12.2023) – Dr K.J. David
6. Godrej Agrovet: To study the efficacy of fruit fly trap in attracting peach fruit fly, *Bacterocera zonata* (01.4.2023 to 31.03.2024) – Dr K.J. David
7. DST: Faunistic studies on bamboo-shoot fruit flies (Dipetera: Tephritidae) of western Ghats and Northeast India (14.8.2023 to 13.8.2026) – Dr K.J. David
8. Rashvee International: Evaluation of non insecticidal fruit fly liquid traps for its efficiency in attracting fruit flies (04.5.2023 to 04.6.2023)
9. DST-SERB: Systematic studies on Pentatominae (Hemiptera: Heteroptera: Pentatomidae) from North East India (03.01.2020 to 03.01.2023) – Dr S. Salini
10. DST-SERB: Taxonomy and diversity of Terebrantian thrips (Thysanoptera: Terebrantia) from south India with special reference to Western Ghats (10.02.2022 to 09.02.2025) – Dr R.R. Rachana

DIVISION OF GENOMIC RESOURCES

11. DST-INSPIRE: Baculovirus mediated modulation of small RNA's and its implications in pathogenicity of lepidopteran hosts (01.05.2018 to 31.04.2023) – Dr Nishtha Nayyar
12. CABin Network: Genome manipulation for the management of important agricultural insect pests (01.04.2020 to 31.03 2025) – Dr T. Venkatesan

13. NASF: Identification and validation of newer approaches for the management of whitefly *Bemisia tabaci* (Hemiptera: Aleyrodidae) (01.08.2020 to 31.07.2023) – Dr T. Venkatesan
14. National Bee Board-DAC: Exploration of gut microbiome & quality bee products for sustainable bee keeping in India (2021 to 2023) – Dr T. Venkatesan
15. Arthro Biotech: Evaluating the bio efficacy of Entomopathogenic Nematodes (EPN) produced using various insect larvae (4.10.2023 to 04.4.2024) – Dr M. Nagesh
16. ICAR under CRP Genomics: Insect Genomics (01.04.2020 to 31.03.2026) – Dr M. Mohan
17. ICAR: Enhancing climate resilience and ensuring food security with genome editing tools (01.04.2023 to 31.03.2026) – Dr M. Mohan
18. Bioseeds Research India:Generation of baseline susceptibility data for *Bacillus thuringiensis* toxin against field collected populations of cotton pink bollworm, *Pectinophora gossypiella* (20.9.2023 to 20.8.2024) – Dr M. Mohan
19. AMAAS: Exploitation of endosymbionts of insect pests for pest management (01.04.2017 to 31.03.2024) – Dr Mahesh S. Yandigeri
20. Draslowka Services India: Laboratory bio-assay of newer fumigant molecular against storage insects (12.9.2023 to 31.3.2024) – Dr R. S. Ramya

DIVISION OF GERMPLASM CONSERVATION AND UTILISATION

21. DBT: Controlled release of olfactory cues for management of lesser grain weevil, *Sitophilus oryzae* a stored product pest of rice (26.12.2023 to 26.12.2026) – Dr K. Subaharan
22. NASF: Development of sustainable management tools for the invasive pest fall armyworm, *Spodoptera frugiperda* (J.E. Smith) in maize (01.11.2019 to 31.10.2023) – Dr K. Subaharan
23. ICAR under NAIF Component -1: Strengthening of the institutional mechanism to protect/manage innovations/intellectual properties (IPs) generated at ICAR-NBAIR (1.4.2020 to 31.03.2025) – Dr K. Subaharan
24. CSB: Profiling of lipid, protein and carbohydrate of mulberry mealybug *Maconellicoccus hirsutus* (Green) for its control (21.10.2023 to 31.03.2025) – Dr K. Subaharan
25. CABI: Emergency response to address Fall Armyworm, (*Spodoptera frugiperda*) in India through deployment of proven IPM technologies for its management (01.01.2019 to 31.12.2023) – Dr A. N. Shylesha
26. CSB-CSRTI: Development of an integrated management packages for the broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) in mulberry (03.11.2022 to 03.10.2024) – Dr P. Sreerama Kumar
27. Corteva Agriscience India: To evaluate the bio-efficacy of Picoxystrobin 7.05% +Propiconazole11.71% w/w SC (Galileo way) against foliar diseases (Cercospora leaf spot, Alternaria leaf spot and Grey mildew) in Cotton and phytotoxicity and natural enemies (01.10.2021 to 30.12. 2023) – Dr G. Sivakumar
28. Agrinos India: Studies on Agrinos HYT products for Nematode Management (01.8.2021 to 31.3.2023) – Dr G. Sivakumar
29. AMAAS: Development of formulations of *Beauveria bassiana*, *Metarhizium anisopliae* and *Lecanicillium* spp. for the management of sucking pests in vegetable crops (01.04.2017 to 31.03.2024) – Dr A. Kandan
30. Validation of microbial biocontrol agents for the management of Fall armyworm (03.04.2023 to 03.10.2023) – Dr A. Kandan

31. CDB: Development and validation of biointensive integrated pest management strategies for coconut invasive whiteflies in Karnataka (17.12.2020 to 17.04.2023) – Dr K. Selvaraj

32. CDB: Generation of toxicological data for registration of *Isaria fumosorosea* in CIBRC and demonstration of biocontrol agents for management of Invasive Whiteflies in Coconut (01.12.2023 to 30.11.2024) – Dr K. Selvaraj

33. DST: Enhancing the pollination in fennel (*Foeniculum vulgare* Mill.) by syrphid fly, *Ishchiodon scutellaris* Fabricius (10.02.2022 to 09.02.2025) – Dr U. Amala

34. DBT under Establishment of Biotech-KISAN Hub: Establishment of Biotech-KISAN Hub: Establishment of Organic Hub for supporting organic and alike farming through promotion of bio-inputs technologies in farmers' field of North East India (16.3.2022 to 16.02.2024) – Dr Richa Varshney

10. PUBLICATIONS

Peer-reviewed articles

Amala U, Chandramanu KGR, Joshi S, Shivalingaswamy TM. 2023. Studies to identify an alternative aphid host for culturing the predatory syrphid, *Ischiodon scutellaris* (Fabricius) (Diptera: Syrphidae). *Egypt J Biol Pest Control*. 33: 39–45.

Amala U, Chandramanu KGR, Joshi S, Shivalingaswamy, T. M. 2023. Fennel, *Foeniculum vulgare* as banker crop for syrphids to promote aphidophagy and myophily. *Curr Sci.* 124(12): 1469–1472.

Amala U, Raghavendra A, Subaharan K, Shivalingaswamy TM. 2023. Foraging specificity of *Tetralonia* (*Thygatina*) *macroceps* (Hymenoptera: Apidae: Anthophorinae) on *Argyreia cuneata* (Convolvulaceae). *Sociobiology*, 70(2): e8262.

Amala U, Venu HS, Chandramanu KGR, Shivalingaswamy TM, Shylesha AN, Subaharan K, Sushil SN. 2023. A sustainable technique for colony multiplication by eduction of wild nests of the stingless bee *Tetragonula iridipennis* Smith. *Sociobiology*. 70(3): e9148–e9148.

Amala, U., Chandramanu, KGR, Shivalingaswamy TM. 2023. A preliminary study of pupation behavior of common banded awl, *Hasora chromus* (Hesperiidae: Lepidoptera) in an urban farm landscape. *Int J Trop Insect Sci*. 43: 689–702.

Amutha M, Rachana RR. 2023. Species diversity of thrips on cotton. *Indian J Entomol.* 85(1): 78–82.

Ankitha KS, Radha TK, Ruqiya S, Kukreti A, Aarthi N, Nanditha S, Rangeshwaran R, Kandan A, Sivakumar G, Shylesha AN, Girisha HC, Nagaraju K, Venkatesan T, Sushil SN, Manjunatha C. 2023. Exploring the impact of cyclic lipopeptides from *Bacillus subtilis* NBAIR-BSWG1 through *in vitro* and *in planta*, studies against *Sclerotium rolfsii*. *J Biol Control*. 37(3): 145–149.

Aravinda H, Shivakumara KT, Chandrashekara K, Rani AT, Casini R, Sayed SR, Elansary HO, El-Sabrout AM. 2023. Isolation of antimicrobial peptides from seed harvester ant, *Trichomyrmex scabriceps* (Mayr) (Hymenoptera: Formicidae) and their antimicrobial assay. *Arab J Chem.* 16(10): 105162.

Arya PS, Chander S, Rajna S, Tenguri P, Yele Y. 2023. Population dynamics of the rice leaf folder *Cnaphalocrocis medinalis* Guenee: a lifetable study. *Indian J Entomol*. DOI: 10.55446/IJE.2023.1335.

Augustine N, Selvapandian U, Venkatesan T, Srinivasa N, Saraswathy BP, Mohan M. 2023. Evaluation of reference genes for expression studies in the broad mite, *Polyphagotarsonemus latus* (Acari: Tarsonemidae). *Appl Entomol Zool*. 59: 31–40.

Augustine N, Upasna S, Chethan BR, Suresh J, Venkatesan T, Mohan M. 2023. Resistance to fenazaquin in broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae): realized heritability, risk assessment and cross-resistance. *J Appl Entomol*. DOI: 10.1111/jen.13187.

Augustine N, Venkatesan T, Upasna S, Mohan M. 2023. Acaricide resistance among broad mite (*Polyphagotarsonemus latus* (Banks)) populations in Karnataka, India. *Curr Sci*, 124(12): 1462–1468.

Babu N, Tripathi R, Sampathkumar M, Caleb JTD, Prasad G, Mohanasundaram M, Mahendiran G, Sudhikumar AV. 2023. Two new species of *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae: Chrysillini) from India. *Arthropoda Sel*. 32(4): 459–465.

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Basak S, Shakyawar DB, Samanta KK, Kumar N, Bhowmick M, Debnath S, Ghosh RK, Manjunatha BS, Ghosh S, Mustafa I, Kadam V. 2023. Cellulose-protein blended sustainable biodegradable flexible composite: a step towards a leather alternative. *Cellul.* 30: 11087–11112.

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Bhagyasree SN, Baradevanal G, Hussain Z, Suroshe SS. 2023. Population dynamics and development of weather-based prediction model for the incidence of whitefly, *Bemisia tabaci* Gennadius and its predator, *Nesidiocoris tenuis* (Reuter) in tomato. *Pest Manage Hortic Ecsyst.* 29(1): 62–65.

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Calcetas OA, Joshi RC, Gupta A, Ranjith AP, Madrid MA, Fameronag J. 2023. New record of the egg-larval parasitoid, *Chelonus formosanus* Sonan of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) in the Philippines. *Jurnal Proteksi Tanaman*. 7(2): 103–114.

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Chiru TDS, Johnson T, Rachana RR, Varatharajan R. 2023. An updated checklist of thrips (Insecta: Thysanoptera) of Sikkim. *Rec Zool Surv India*. 123(i2S): 671–678.

Correya JC, Sreedevi K. 2023. Species diversity of phytophagous scarab fauna (Coleoptera: Scarabaeidae) in Western Ghats of Kerala, India. *Rec Zool Surv India*. 123: 305–314.

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David KJ, Abhishek V, Kennedy N, Ajaykumara KM, Gracy RG, Hissay CB. 2024. Four new species of *Zeugodacus Hendel* (Diptera, Tephritidae, Dacinae, Dacini) and new records of dacines from India. *ZooKeys*. (Accepted for Publication).

Deeksha MG, Nebapure SM, Kalia VK, Sagar D, Bhattacharya R, Dahuja A, Subramanian S. 2023. Comparison of phenotypic and genotypic frequency of phosphine resistance in select field populations of *Tribolium castaneum* from India. *Mol Biol Rep*. 50(8): 6569–6578.

Dhanyakumar O, Ram Kumar P, Ashwitha G, Venkatesan T, Mohan M, Nishtha N, Sivakumar G. 2023. Sub-lethal effects of indigenous isolate of *Spodoptera frugiperda* nucleopolyhedrovirus on fall armyworm growth and reproduction in India. *Egypt J Biol Pest Control*. 33: 10.

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Gotyal BS, Korada RR, Satpathy S, Shivakumar KV. 2023. Profiling of volatile organic compounds in jute causing non-preference to hairy caterpillar, *Spilosoma obliqua* Walker (Lepidoptera: Noctuidae). *J Environ Biol*. 44(3): 396–400.

Gupta A, Van Achterberg C, Pattar R, Hemanth Kumar HM. 2023. First report of two braconid genera *Syntretus Foerster* and *Xynobius Foerster* from India with description of one new species. *Zootaxa.* 5319(4): 582–588.

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Jadhav MM, Shashank PR, Rani AT, Mohanasundaram A, Rajgopal NN, Naik S, Patil R, Prakash NR. 2023. DNA barcoding, morphological description and field diagnostics of *Eublemma amabilis* (Lepidoptera: Erebidae). *Indian J Entomol.* 85: 96–100.

Jambagi SR, Mohan M, Venkatesan T, Rao AM, Mohan KM, Nagesha N. 2023. Relative response of pink bollworm, *Pectinophora gossypiella* (Saunders) population towards Bollgard-II® Bt cotton expressing Cry1Ac+Cry2Ab toxins. *Mysore J Agric Sci.* 57: 364–371.

Jamuna B, Timmanna H, Basavaraj YB, Baradevanal G, Bhimanna M, Srinivas AG. 2023. Influence of weather on thrips population and tospovirus disease incidence in tomato crop. *AMA Agric Mech Asia.* 54(10): 15851–15860.

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Kedar SC, Gupta A, Shashank PR, Navik O, Patil J. 2023. The lepidopteran pest complex infesting menthol mint in India: distribution during the crop development, species composition and associated parasitoids. *Crop Prot.* 173: 106382.

Keerthi MC, Suroshe SS, Doddachowdappa S, Shivakumara KT, Mahesha HS, Rana VS, Gupta A, Murukesan A, Casini R, Elansary HO, Shakil NA. 2023. Bio-intensive tactics for the management of invasive fall armyworm for organic maize production. *Plants.* 12(3): 685.

Kiran Kumar GN, Suroshe SS, Gupta A, Keerthi MC, Srinivas K, Anil. 2024. Morphological and molecular diagnosis of platygastrid parasitoid, *Allotropa* sp. near *phenacocca* (Hymenoptera) from India and its performance on cotton mealybug, *Phenacoccus solenopsis. Phytoparasitica*. 52: 1.

Kukreti A, Chethana B, Prasannakumar M, Manjunatha C, Reddy NK, Puneeth M, Gulati P. 2023. In vitro assessment of bacterial endophytes for antagonistic activity against *Magnaporthe oryzae* and *Cochliobolus miyabeanus* in rice. *J Biol Control.* 37(2): 73–79.

Kumar P, Chandel M, Kataria S, Swami K, Kaur K, Sahu BK, Dadhich A, Urkude RR, Subaharan K, Koratkar N, Shanmugam, V. 2023. Hand-held crop pest sensor using binary catalyst-loaded Nano-SnO2 particles for oxidative signal amplification. *ACS Sens.* DOI: 10.1021/acssensors.3c01669.

Kumar T, Gurudayalram G, Sreedevi K. 2022. Redescription of seven genera of tribe Mecysolobini (Coleoptera: Curculionidae: Molytinae) from India. *Indian J. Entomol.* 85(1): 52–67.

Lalitha Y, Omprakash N, Varshney R, Patel VN, Ballal CR. 2023. Field efficacy of *Trichogramma chilonis* reared on different factitious hosts for the management of sugarcane stem borers. *Bull Insectology.* 76(1): 1–7.

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Manjunath K, Thippaiah M, Srinivasa YB, Rachana RR. 2023. Investigation on the temporal and spatial distribution of flower thrips population in *Nyctanthes arbor-tristis* Linn. *Biol Forum.* 15(1): 383–387.

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11. TECHNOLOGY, PRODUCTS AND PATENTS

Technologies developed

1. Multiple insecticide tolerant strain egg parasitoid, *Trichogramma chilonis*

2. Multiple insecticide tolerant strain of egg parasitoid, *Trichogramma chilonis* for the management of fall armyworm *Spodoptera frugiperda* (MITS-FAW)

3. High temperature tolerant strain of egg parasitoid, *Trichogramma chilonis*

4. Pesticide tolerant strain of aphid lion, *Chrysoperla zastrowi sillemi*, an important predator of sucking pests

5. Novel insecticidal WP formulations of *Heterorhabditis indica* (NBAII Hi101) and *Heterorhabditis bacteriophora* (NBAII Hb105) for the biological control of white grubs and other soil insect pests

6.Novel Device for field release of parasitoids

7. Mass production technology for parasitoid *Encarsia guadeloupae* for the suppression of rugose spiraling whitefly

8. Production and use of the predatory mite *Typhlodromus (Anthoseius) transvaalensis* to control mites and thrips in mulberry

9. Wettable powder formulation of *Heterorhabditis indica* strain NBAIIH38 for management of white grubs and fall armyworm

10. Liquid formulation of indigenous *Bacillus thuringiensis* strain against lepidopteran pests.

11. Powder based formulation of *Pseudomonas fluorescens* (NBAIR-PFDWD), an antimicrobial 2,4-diacetylphloroglucinol (DAPG) producing biotic and abiotic stress tolerant strain for diseases and Thrips species management.

12. Bio formulation of salinity tolerant *Trichoderma harzianum* with biocontrol potential

13. Bioformulation of carbendazim tolerant *Trichoderma harzianum* with biocontrol potential

14. Powder based formulation of *Bacillus megaterium* as growth promoter

15. Wettable Powder based formulation of *Bacillus megaterium* for the growth promoting ability in brinjal and tomato

16. *Metarhizium anisopliae* ICAR–NBAIR Ma4 for management of white grubs in sugarcane

17. *Metarhizium anisopliae* ICAR–NBAIR Ma35 for management of fall armyworm *Spodoptera frugiperda* in Maize

18. *Bacillus thuringiensis* ICAR–NBAIR-BT25 for management of fall armyworm *Spodoptera frugiperda* in Maize

19. Aqueous formulation of *Spodoptera frugiperda* nucleopolyhedrovirus (SpfrNPV) NBAIR strain for the management of FAW

20. Bioformulation of *Bacillus subtilis* strain NBAIR BS1 for growth promotion

21. Potential entomopathogenic fungus *Isaria fumosorosea* (ICAR–NBAIR Pfu-5) for management of rugose spiralling whitefly *Aleurodicus rugioperculatus*

22. A Novel *Bacillus albus* strain NBAIR–BATP with excellent insecticidal, antagonistic and growth promotion properties for the management of pests and diseases

23. Aqueous formulation of *Spilosoma obliqua* nucleopolyhedrovirus (SpobNPV ICAR–NBAIR1) for the management of Bihar hairy caterpillar *Spilosoma obliqua*

24. Aqueous formulation of *Helicoverpa armigera* nucleopolyhedrovirus HearNPV

25. Aqueous formulation of *Spodoptera litura* nucleopolyhedrovirus (SpliNPV ICAR–NBAIR1) for the management of *Spodoptera litura*

26. *Beauveria bassiana* NBAIR– Bb5a – A potential biopesticide for management of chewing and sucking pests of cabbage

27. A novel *Lecanicllium fusisporum* NBAIR–VL8 strain with impressive Insecticidal activity for the management of major sucking pests of cotton and okra.

28. A novel *Pseudomonas entomophila* NBAIR–PEOWN strain with excellent insecticidal activity for management of shoot and fruit borer of brinjal

29. *Trichoderma asperellum* (NBAIR–TATP) – A potential antagonist for root rot and wilt pathogens

30. A dispenser for the monitoring of eucalyptus gall wasp, *Leptocybe invasa*

31. A plant volatile-based attractant for enhanced attraction of fruit fly.

32. Protocol for designing lure for impregnating parapheromone 4[4-acetoxy) phenbutanone to attract male flies of *Bactrocera* spp attacking cucurbit crops for mass trapping and monitoring its population thereof

33. Control release dispensers for semiochemicals

34. A herbal based repellant for termites on woody trees-REPTER

35. Herbal swabber for the management of white stem borer *Xylotrechus quadripes* in coffee (organic and non-pesticidal) and booster for boosting plant health in coffee (not for certified organic coffee)

36. Adsorption and delivery of molecules using nanoporous materials.

37. A bisexual attractant for *Bactrocera dorsalis* in delta trap.

38. Dorsa-Delta , an efficient trap for mango fruit fly

39. A volatile attractant for trapping uzi fly, *Exorista bombycis*, parasitiod pest on mulberry silkworm *Bombyx mori* based on pheromonal compounds

40. Insect repellent formulation and methods thereof

41. A technique for rearing of housefly parasitoid *Spalangia cameronensis*

42. A technique for rearing of housefly parasitoid *Nasonia vitripennis* (Pteromalidae)

43. A simple technique of rearing brinjal shoot and fruit borer, *Leucinodes orbonalis*

44. Waste to wealth: Technology on black soldier fly mediated bioconversion of farm and kitchen wastes

45. A technique for rearing of parasitiod *Nesolynx thymus (*Girault) and their use in house fly, *Musca domestica* management

46. Development and maintenance of isofemale and inbred lines of susceptible insect pests

47. Black soldier fly floating fish feed

Technologies commercialised

1. Controlled release dispenser for delivery of semiochemicals

2. Novel insecticidal WP formulations of *Heterorhabditis indica* (NBAIIHi101) *Heterorhabditis bacteriophora* (NBAII Hb105) for the biological control of white grubs and other soil insect pests

Technologies Certified by ICAR

1. Multiple insecticide tolerant strain of egg parasitoid *Trichogramma chilonis* for the management of fall armyworm *Spodoptera frugiperda* (MITS-FAW)

2 Shatapada-Wettable powder formulation of *Heterorhabditis indica* strain NBAIIH38 for management of white grubs and fall armyworm

3. Mass production technology for parasitoid *Encarsia guadeloupae* for the suppression of rugose spiralling whitefly

4. Aqueous formulation of *Spodoptera frugiperda* nucleopolyhedrovirus (SpfrNPV) NBAIR strain for the management of FAW

5. Bioformulation of *Bacillus subtilis* strain NBAIR BS1 for growth promotion

6. Potential entomopathogenic fungus *Isaria fumosorosea* (ICAR–NBAIR Pfu-5) for management of rugose spiralling whitefly *Aleurodicus rugioperculatus*

7. A novel *Bacillus albus* strain NBAIR–BATP with excellent insecticidal, antagonistic and growth promotion properties for the management of pests and diseases

8. Aqueous formulation of *Spilosoma obliqua* nucleopolyhedrovirus Spob NPV ICAR–NBAIR1 strain for the management of crop pest *Helicoverpa armigera*.

9. A volatile attractant for trapping uzi fly, *Exorista bombycis*, parasitoid pest on mulberry silkworm *Bombyx mori* based on pheromonal compounds

10. A technique for rearing of parasitoid *Nesolynx thymus* (Girault) and their use in house fly, *Musca domestica* management

Revenue generated during 2023

The total revenue generated was **Rs. 39,49,589/-** through following activities

Details of Revenue generated (₹)	Amount (₹)
Commercialization of technologies	**87,500.00**
Sale of Macrobials	**5,94,400.00**
Sale of Microbials	**16,18,080.00**
HRD activities	**12,40,859.00**
PG Cell activities	**2,71,400.00**
Contract research	**1,37,350.00**
Total	**Rs. 39,49,589.00**

Transfer of know-how license agreement on Controlled release dispenser for delivery of semiochemicals jointly developed ICAR–NBAIR and JNCASR to M/s Farm root Agritech Pvt. Ltd, Bengaluru

Novel insecticidal WP formulation of *Heterorhabditis indica* for the biological control of white grubs & other soil insect pests. MOU signed and technology transferred to Indo US biotech, Ahmedabad–380 061, Gujarat

Waste to wealth: Technology on Black Soldier Fly mediated bioconversion of farm and kitchen wastes MOU signed and technology transferred to M/s Amala Eco Clean Pvt. Ltd., Cherthala, Alappuzha, Kerala.

Release of the book, "Technologies Ready for Agribusiness" during ICAR–NBAIR foundation day.

12. CONFERENCE PAPERS

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13. MEETINGS AND DECISIONS

XXVII Research Advisory Committee Meeting:

The Director General, ICAR has reconstituted the Research Advisory Committee of ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, vide letter No. F.NO.CS15/5/2007-IA.III (e 17141), dated 24th January 2023, as per the provisions contained under 71 A (a) of the Rules and Bye-laws of the ICAR.

Dr B. V. Patil (Chairman, RAC)	-	Former Vice Chancellor, UAS, Raichur
Dr. S.C. Dubey (Member, RAC)	-	Assistant Director General (PP&B), ICAR, New Delhi
Dr V. V. Ramamurthy (Member, RAC)	-	Former Principal Scientist, Division of Entomology, ICAR–IARI, New Delhi
Dr B. Sarath Babu (Member, RAC)	-	Former Head, ICAR–NBPGR, RS, Hyderabad
Dr P. N. Sharma (Member, RAC)	-	Former Head, CSK HPKV, Palampur, Himachal Pradesh
Dr S. Desai (Member, RAC)	-	Former Principal Scientist & Head, ICAR–CRIDA; Dean, School of Agricultural sciences and Technology, NMIMS, Shirpur
Dr A. Sundaresan (Member, RAC)	-	Prof & Chair, Chemistry and Physics of Material Unit, JNCSAR, Jakkur, Bengaluru
Dr S. N. Sushil	-	Director, ICAR–NBAIR, Bengaluru
Dr M. Mohan (Member Secretary, RAC)	-	Principal Scientist & Officer in-charge PME Cell, ICAR–NBAIR, Bengaluru

The XXVII meeting of the Research Advisory Committee (RAC) of the National Bureau of Agricultural Insect Resources was held on 28th April 2024

The following specific issues, emerging from the presentations and follow up discussions, were deliberated at length.

I. The Chairman and the members emphasized the importance of taxonomic work, unfortunately a dwindling science, should be given top priority. ICAR–NBAIR should take the lead at national level by co-ordinating with all the taxonomists working under different Organisations /Institutes/Universities forming "Taxonomists Hub" which helps students and scientists for further research.

II. In this context Dr. S.C. Dubey insisted that, all the taxonomist working on insect group can be put under one umbrella and a mega project proposal can be sent via concerned SMD to the Council or any other funding agencies which should be considered on top priority.

III. Chairman and members suggested because of shortage of taxonomists, the existing vacant posts in ICAR–NBAIR can be converted into taxonomist posts or some posts of scientists can be shifted from other Institutes to ICAR–NBAIR for strengthening of this important field.

IV. All the scientists have the responsibility to provide the

necessary information of RAC and ATR reports, so that it can be compiled effectively and sent to all the members at least two weeks in advance to get effective suggestions for fine tuning the research programme.

The following suggestions were made by the RAC:

I. Division of Germplasm Collection and Characterisation

1. Taxonomist should make the lists of insect groups which are of the national importance and research should be focused on those groups, which have not been attended so far.
2. Molecular markers should be linked with all the new taxa which are being described.
3. Research work on Veterinary pests to be initiated for the benefit of the farmers.
4. As alternative to NPIB projects, an ad-hoc research proposal can be made with the collaboration of all the insect taxonomists in India.
5. All the taxonomic keys needs to be digitized and be accessible for the user.
6. Taxonomic work on Scarabaeidae to be included with immature stage taxonomy and DNA barcodes.
7. Damage potential of the pests should be correlated with reduction in crop yield due to the pest.
8. Collection of insects to be linked with geotagging and the same data can be further used to study the climatic factor changes at periodical interval.
9. Survey and collection of insects including intercepted ones may also be looked for entomopathogens occurrence.
10. Insect identification to be charged on the number of specimens rather than per samples with free service to students.

II. Division of Genomic Resources

1. Molecular taxonomy to be given importance and DNA barcodes for all the new taxa described to be included along with the taxonomical report rather than independently.
2. The lists of agriculturally important insects may be prepared and complete genomic studies to be carried out for the insects of national importance.
3. The insecticide resistance studies should also include the resistance level, if the stress has been withdrawn in order to know the reversal of insecticide resistance in the absence of insecticide and the same to be made as an Adhoc recommendation for implementation.
4. Molecular interaction of EPN and bacteria with hosts can be studied under different ecological niche.
5. The work done report to be presented relevant to the mandate of the Division only, and the other work should be presented in the relevant Divisions.
6. The information on DNA barcodes generated by ICAR–NBAIR has to be updated in the website and periodical updation of the information is required.
7. Studies on the multiple role of single target genes to be taken into consideration, while designing dsRNA experiments.

III. Division of Germplasm Conservation and Utilisation

1. Research on ecological entomology need to be given more emphasis followed by periodical survey and monitoring as Govt of India is giving more emphasis on

natural farming in which role of bio agents preferably by conservation remains top priority.

2. The effective delivery mechanism has to be worked out for the use of essential oils for the management of pulse beetles.
3. In addition to nutritional aspects, the effect of temperature and relative humidity also to be standardized for the mass production of the insects.
4. The research on conservation studies may be relooked and a meticulous planning has to be carried out in an ecosystem. Araku valley could be one of the place where such studies can be carried out.
5. The Government of Meghalaya can be contacted for the need based stingless bee studies.

Consolidated recommendations:

1. The taxonomists working on insects' groups across the country can be put under one umbrella and prepare a mega project proposal umbrella with ICAR-NBAIR as a lead centre forming a national "Taxonomists Hub" for taxonomic services confirming both by morphological and molecular basis. The proposal should be submitted to National fund via concerned SMD to the Council or any other funding agencies by the Institute.
2. Shared resources should be created for accessing the collections housed at National Insect Museum at ICAR-NBAIR and National Pusa Collection (NPC) at IARI, New Delhi.
3. The experimental results on stingless bees need to be carried out in multilocation field trials in collaboration with AICRP on Honeybees and Pollinators and other government organization especially in the NEH region
4. Prioritizing the insect genera/species of national importance for detailed research including genomics will help to enhance visibility of the institute
5. There is a need to identify potential bioagents and formulation strategies for the management of insect pests and diseases in protected cultivation on priority basis.
6. Research on effective Entomopathogens'consortium to be initiated under different ecological niche.
7. Explore the use of biocontrol or biocontrol compatible technologies for the management of insect pests in storage.
8. Infrastructure deficiency (Lab space) encountered by the scientists at the institute must be resolved, to create better facilities to work on larger projects.

XLVII Institute Research Council Meeting:

The XLVII Institute Research Council Meeting of the ICAR-NBAIR, Bengaluru, was held on 15th – 17th May 2023 under the Chairmanship of Dr. S.N. Sushil, Director, ICAR-NBAIR.

General comments to the Divisions

- The term "Species diversity" is preferred instead of "biodiversity" or "Taxonomic identification" in project titles and objectives
- The phylogenetic analysis should be specifically used to ascertain whether a particular group is monophyletic, paraphyletic or polyphyletic.
- An adhoc project can be prepared and submitted for external funding involving the relevant taxonomists of India in consultation with Dr V.V. Ramamurthy
- All the taxonomists should be exposed to molecular taxonomic work
- Common species of all the groups should be made as a hand book for school children
- Add more number of molecular markers
- Database on quarantine pests for strategic planning on tackling new invasive species to be made.

Quinquennial Review Team (2017-2022):

The Director General, Indian Council of Agricultural Research (ICAR) constituted the VIIIth Quinquennial Review Team (QRT) with the following experts to review the progress of research and impact and other relevant activities undertaken by the ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru and the AICRP on Biological Control of Crop Pests (AICRP BC), during the five year period from 2017-18 to 2021-22 vide Council's order F. No. CS. 15/3/2017-IA-III (e-19592) dated 14th October 2022.

Committee comprising of

Dr H. C. Sharma (Chairman, QRT)	-	Former Vice Chancellor, Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh
Dr Basant K. Agarwala (Member, QRT)	-	Ex-Professor, Tripura University ,Ex-Chairman, Tripura State Pollution Control Board, Tripura
Dr V.V. Belavadi (Member, QRT)	-	Former Emeritus Scientist, Department of Entomology University of Agricultural Sciences, GKVK, Bangalore
Dr R. Swaminathan (Member, QRT)	-	Dean (Retired) & Former Emeritus Scientist, Maharana Pratap University of Agricluture & Technology (MPUAT), Udaipur (Rajasthan)
Dr S. C. Dhawan (Member, QRT)	-	Principal Scientist (Retd), IARI, New Delhi
Dr H. S. Tripathi (Member, QRT)	-	Professor (Retd), GBPUAT, Pantnagar
Dr M. Mohan (Member Secretary, QRT)	-	Principal Scientist & Officer in-charge PME Cell, ICAR-NBAIR, Bengaluru

The QRT has made the following recommendations to further improve the research output of the Bureau

1. Collaboration with National and International museums should be strengthened further and a virtual database for the "Type" species should be developed.
2. Studies on genome editing need to be initiated for developing futuristic strategy for the eco-friendly pest management.
3. Species of *Apis* prevailing in India should be characterized molecularly and traits of economic importance should be identified.
4. Impact assessment of technologies developed need to be undertaken on priority basis.
5. The inoculative release of parasitoids should also focus on intraguild competition among the natural enemies.
6. Integrative taxonomical and molecular methods need to be strengthened for identification of insect pests and their natural enemies.

Administration

1. Considering the mandate and amount of work at hand, ICAR-NBAIR is lacking adequate manpower of scientific, technical and supporting staff. To meet the

strength of ICAR- NBAIR should be doubled in the next 5 years. There is an urgent need of scientific positions in the field of Economics, Extension, and Biotechnology.

2. Considering the mandate of the Bureau and extensive research activities, there is an urgent need of additional infrastructure in terms of laboratory facility, sitting chambers for staff and residential complex for smooth functioning.

Policy

3. Considering the strength and expertise of ICAR-NBAIR in insect importation, the Bureau needs to be empowered to issue import permit, for the import of beneficial insects in accordance with the provisions of clause 7(1) of the Plant Quarantine Order, 2003.

Review of ICAR–NBAIR and AICRP BC centres by QRT team

A National Dialogue on "Threats of invasive insect pests in India challenges and the way forward"

A National dialogue on "Threats of invasive insect pests in India challenges and the way forward was held on 20 Oct 2023, at ICAR-NBAIR, Bengaluru under the chairmanship of Dr P.K. Singh, Agriculture Commissioner, Government of India. The meeting was attended by various Government department authorities. The aim of the dialogue was to discuss the ways and means by preventing alien invasive insect, pest entry by stringent enforcement of National policies, strengthening of domestic quarantine to prevent further spread of invasives, ease of procedures in exchange of insect natural enemies and to heighten regional cooperation and collaboration between countries.

The following dignitaries participated in the discussion:

Dr P.K. Singh	-	Agriculture Commissioner, GoI
Dr S.N. Sushil	-	Director of ICAR–NBAIR Bengaluru
Mr Kunal Satyarthi	-	Joint Secretary (Policy and Planning), National Disaster Management Authority, Government of India
Dr S C Dubey	-	ADG (PP&B) ICAR, New Delhi
Mr P.V. Bhyrappa	-	Deputy Director from National Academy of Customs, Indirect Taxes & Narcotics (NACIN) Bengaluru
Dr J P Singh	-	Plant Protection Advisor, GOI
Dr D. K. Nagaraju	-	Joint Director (Entomology), RPQS, BengaluruOnline
Dr B. Balaji	-	Secretary, National Biodiversity Authority, Chennai
Dr Alok K. Srivastava	-	Director, ICAR–NBAIM, Mau, Uttar Pradesh
Dr Subhash Chander	-	Director, ICAR–NCIPM, New Delhi
Dr R. K. Murali Baskaran	-	Principal Scientist (Agricultural Entomology) from ICAR–National Institute of Biotic Stress Management (NIBSM)

The Institute Review Meeting

The Institute Review Meeting chaired by Dr. Himanshu Pathak, Director General, ICAR & Secretary, DARE was conducted online on 27.12.2023.

Based on the discussions during the meeting following points have emerged:

1. Develop digital databases of new insect species, which can be made available in the Institute website for public use.
2. The Director, ICAR–NBAIR may be invited in all the crop based AICRPs for presentation of technologies available with the Bureau.
3. A collaborative project with NRC on Grapes, Pune may be initiated for field evaluation of newly developed attractant compound against pink mealy bug.
4. NPV of NBAIR strain against *Spodoptera litura* is performing well in tobacco ecosystem. Hence, ICAR–NBAIR may commercialize the product, as there is huge demand from farmers.
5. Biological control technologies developed by ICAR–NBAIR may be promoted in collaboration with ATARIs through KVKs.

International Year of Millets-2023

ICAR–NBAIR organised online meeting dated 18, March, 2023 at ICAR–NBAIR, Hebbal Campus during the "International Year of Millets-2023" Global International Conference on "Enhancing Productivity and Value Addition in Millets" on 18 th and 19 th March, 2023. Under the celebrations of International Year of Millet, Honble Prime Minister Shri Narendra Modi inaugurated a two-day International Conference on 'Shree Anna' in New Delhi to create awareness on nutri-cereals (Shree anna). ICAR–NBAIR staff and other stakeholders including millet farmers participated in the inaugural session (virtual). After the Inaugural session, Director Dr S. N. Sushil, ICAR-NBAIR, Bangalore addressed the stakeholders/ farmers and staff of ICAR–NBAIR, Bengaluru. Farmers and millet stakeholders also shared their views on the importance of millet and their nutritive values. Director ICAR– NBAIR, Bangalore, gave the participation certificate and momento to the millet farmers and stakeholders.

Online meeting to commemorate International Year of Millets 2023

Group photo with farmers at the event to celebrate International Year of Millets 2023

14. PARTICIPATION OF SCIENTISTS IN MEETINGS

Abroad

Dr S.N. Sushil	Participated and delivered a lead talk on organizing and incentivizing national research and development on biocontrol in "Global Forum on Biological Control and Training Workshop on Biological Control" jointly organized by International Centre of Insect Physiology and Ecology and FAO at Nairobi, Kenya, 27 June 2023. Attended and participated in Global Biopesticide Summit 2023 and chaired a session on Explore the opportunities in agriculture *vis-a-vis* biopesticides: Roles of industries, institutions and regulators at Bishkek, Kyrgystan, 27 August 2023.
Dr Ankita Gupta	Attended 10th International Congress (physically) organized by the International Society of Hymenopterists and Alexandru Ioan Cuza University, Iaşi, Romania, 24 - 29 July 2023. Attended international workshop (physically) "An introduction to computable phenotype descriptions of Hymenoptera". The workshop was organized by Diego S. Porto, Katja C. Seltmann, and István Mikó. It was held at the Alexandru Ioan Cuza University, Iasi, Romania, 26 July 2023. Attended Hymathon 2023 (online) and delivered talk on "An account of sub tribe Spinariina van Achterberg (Braconidae) from India with first report of its member from the Great Nicobar Island, India". #Hymathon2023, 30 November to 1 December 2023.
Dr U. Amala	Attended 12 th International Symposium on Pollination, Cape Town, South Africa, October 16–20, 2023

India

Dr S.N. Sushil	Participated and delivered a talk on Systems Approach for Pest Risk Management in International Trade in the Workshop on Systems Approach for Management of Fruits Flies on Mango jointly being organized by Directorate of Plant Protection and Quarantine, DA&FW, Ministry of Agriculture & Farmers Welfare and Asia pacific Plant Protection Commission (APPPC-FAO) at Mumbai, 19-23 June 2023 . Attended the ICAR-ATARI interface meeting between scientist, KVK and SAUS at UAS, Bengaluru, 21 June 2023. Participated in the XXIV Annual Group meeting of AINP on Soil Arthropod Pests organised by SKN Agricultural University, Jaipur, Rajasthan, 13 July 2023. Participated in Industry Interface meet organised by ICAR-IIHR, Bengaluru, 31 October 2023.

Dr S.N. Sushil	Participated and delivered lead talk on "Invasive Insect Pests threats to Indian Agriculture: Present status, Challenges and way forward" at "International Conference on Plant Health Management, ICPHM-2023" organized by the Plant Protection Association of India, ICAR-NBPGR, Regional station, Hyderabad, 15-18 November 2023.
Dr T. Venkatesan	Attended and presented the work done under the Network project on "Agricultural Bioinformatics and Computational Biology" during the Technical Review Committee (TRC) meeting for the Crop Science Domain chaired by Honourable DDG (Crop Science) ICAR, New Delhi, 15 November 2023 (virtual). Attended "Brainstorming session on Implementation of Green Credits Programme, NAAS, New Delhi, 24 August 2023 (online). Attended and Presented work done report of NASF project "Identification and validation of newer approaches for the management of whitefly *Bemisia tabaci* (Hemiptera: Alyrodidae) for the Expert review meeting on Strategic area "Biotechnology, Genomics and Allele mining in plants, animals and fisheries", 8 March 2023. Attended and Presented to the Empowering Committee, NASF regarding work done report of NASF project "Identification and validation of newer approaches for the management of whitefly *Bemisia tabaci* (Hemiptera: Alyrodidae) on Strategic area "Biotechnology, Genomics and Allele mining in plants, animals and fisheries", 6 July 2023. Attended 30th Annual General Body Meeting of NAAS, New Delhi, 04-05 June 2023.
Dr K. Subaharan	Attended the review meeting of the projects operated under the Bangalore Science Cluster funded by Office of the Principal Scientific Advisor to the Government of India, 10 July 2023. Attended the Industry Institute interaction meeting of Crop and Horticultural Sciences Divisions held under the Chairmanship of Dr. T.R. Sharma, Deputy Director General (Crop and Horticultural Sciences), ICAR at Bharat Ratna C. Subramanian Auditorium, NASC Complex, New Delhi, 16 July, 2023. Attended and Co-chaired a session on Research on biological Control at ICAR –NBAIR, Biodiversity of natural enemies and Crop Pest Outbreak report during XXXII Annual Review Meeting of AICRP on Biological Control of Crop Pests held at Pune, 20 – 21 July 2023. Invited to attend the SAGE network summit organized by the echo network which is a social innovation partnership initiated by O/o Principal Scientific Advisor to Govt. of India to be held at TIGS Bangalore, 10 – 12 August 2023. Attended the Industry -Academia meeting at Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, 22 September 2023.

Dr K. Subaharan	Attended a workshop on "Non spinning in silkworm: Possible reasons and probable remedies" and delivered a talk on non- target effect of insecticides on cropping ecosystem, 27 September 2023. Attended a meeting to address the impact of toxicology issues on non spinning of silk in silkworms at CSTRI, Mysore, 11 October 2023.
Dr G. Sivakumar	Attended and participated as a committee member of Institute Management Committee and attended meeting of ICAR-National Institute of Biotic Stress Management, Raipur, 11 August 2023. Attended farmers interaction meeting held at Nainital district, Uttarakhand state, 28 September 2023.
Dr Deepa Bhagat	Attended and participated as speaker and Panel member i-STEM Tech Management Conclave (ITMC) Discussion-Theme: Linking Researchers and Resources held at Biological Sciences Auditorium, IISc, Bengaluru, 21-22 February 2023.
Dr K. Sreedevi	Attended Biodiversity SSD 20 Technial Committee Meeting at Manak Bhawan, BIS, New Delhi, 23 June 2023. Attended as an Expert Member for State Level Technical Programme (SLTP) of Entomology discipline at Dr. YSR Horticultural University (Dr. YSRHU), Venkataramannagudem, Andhra Pradesh, 12 – 14 June 2023. Attended CAS assessment (8000 – 9000 grade pay) as Subject expert in Agricultural Entomology discipline at Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, 21–22 November 2023. Attended 24th Annual Review workshop of All India Network Project on Soil Arthropod Pests (AINP on SAP) at RARI, Durgapura, Jaipur, Rajasthan, 13–14 July 2023.
Dr M. Mohan	Attended 7th Annual Review Workshop ICAR–Consortium Research Platform on Genomics at ICAR–National Bureau of Fish Genetic Resources, Lucknow, 26–27 May 2023. Attended and served as an RAC committee member, attended 32ndRAC meeting of SBRL, Silk Board Bangalore on 21 September 2023.
Dr Mahesh Yandigeri	Attended and Participated in "Expert Consultation on Microbiome Engineering to Restore the Holobiont Functionality for improving the Climate and Disease Resilience" at ICAR–NBAIM, Mau, 15 March 2023.

Dr S.N. Sushil **Dr B.S. Gotyal** **Dr G. Mahendiran** **Dr K. Selvaraj**	Attended "International Conference on Plant Health Management ICPHM 2023–Innovation and Sustainability organized by Plant Protection Association of India, at PJTSAU, Hyderabad, 15–18 November 2023.
Dr M. Nagesh **Dr M. Pratheepa** **Dr M. Mohan** **Dr B.S. Gotyal** **Dr Gundappa** **Dr Richa Varshney** **Dr C. Manjunatha** **Dr Navik Omprakash**	Attended and participated in honourable prime minister's programme "Making India a Global Hub for Shree Anna" at ICAR–NBAIR, Bengaluru, 24 February 2023 (Virtual).
Dr Gundappa **Dr Navik Omprakash**	Attended and participated in G-20 technical workshop on "One Health-Opportunuties and challenges' at ICAR–NIANP, Bengaluru, 30 August 2023.
Dr S.N. Sushil **Dr T. Venkatesan** **Dr G. Sivakumar** **Dr U. Amala**	Attended National Symposium on Crop Health Management: Safeguarding crop through Diagnostics and Innovations at VPKAS, Almora, 29– 30 September, 2023.
Dr B. S. Gotyal **Dr K Selvaraj** **Dr R.S. Ramya,** **Dr Navik Omprakash**	Attended and Participated in the Industry Interface Meet in XVI Agricultural Science Congress organized by National Academy of Agricultural Sciences (NAAS) and hosted by ICAR–CMFRI during at Kochi, 10–13 October 2023.
Dr M. Nagesh **Dr T.M. Shivalingaswamy** **Dr T. Venkatesan** **Dr K. Subaharan** **Dr G. Sivakumar** **Dr M. Mohan** **Dr Deepa Bhagat** **Dr K. Sreedevi** **Dr A. Kandan** **Dr Jagadeesh Patil** **Dr M. Sampath Kumar** **Dr K. Selvaraj** **Dr U. Amala** **Dr Richa Varshney** **Dr Navik Ompraksh** **Dr C. Manjunatha**	Attended XXXII Annual Review meeting of All India co-ordinated Research project on Biological control of crop pests at College of Agriculture, MPKV, Pune, Maharashtra, 20–21 July 2023.
Dr S.N. Sushil **Dr K. Subaharan** **Dr Deepa Bhagat** **Dr U. Amala**	Attended National workshop on Innovations in Chemoecological Methods for Pest Management: A Path Forward for India, jointly organized by ICAR–National Bureau of Agricultural Insect Resources (ICAR–NBAIR), Bengaluru, the Indian Academy of Sciences, Bengaluru and the Entomology Society of India, New Delhi, 23 Nov. 2023.

All the Scientists	Attended workshop on "IPR issues in Agricultural Research" at ICAR–NBAIR, Bengaluru, 9 February 2023. Attended institute 8th QRT meeting at ICAR–NBAIR, Bengaluru, 16–17 February 2023. Attended lecture delivered by Dr. Sudha Mysore, Former CEO Agri Innovate and Principal Scientist (Retd), ICAR – IIHR, Bengaluru on "Women and IP: Accelerating Innovation and Creativity" on the eve of World Intellectual Property day at ICAR–NBAIR, Bengaluru, 26 April 2023. Attended 27th Research Advisory Committee (RAC) Meeting of ICAR–NBAIR, Bengaluru, 28 April 2023. Attended 47th IRC meet at ICAR–NBAIR, Bengaluru, 15–17 May 2023. Attended World Environment Day at ICAR–NBAIR, Bengaluru, 5 June 2023. Attended Hindi Diwas meeting at ICAR–NBAIR, Bengaluru, 13 June 2023. Attended i-STEM training meeting at ICAR–NBAIR Bengaluru , 14 June 2023. Attended "Biocontrol Expo 2023 and 31st Foundation Day" at ICAR–NBAIR Yelahanka campus, 19 October 2023. Attended national dialogue meeting on "Threats of invasive insect pests in India challenges and the way forward" held at ICAR–NBAIR, Bengaluru, 20 October 2023. Attended Meeting on "Vigilance Awareness Week" at ICAR–NBAIR Bengaluru, 14 June 2023. Attended Kisan Diwas celebrations at ICAR–NBAIR Yelahanka, 23 December 2023.

15. TRAININGS CONDUCTED

A) Capacity building programme undertaken

INTERNATIONAL TRAINING PROGRAMME ORGANISED

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation If any (in ₹)
1.	Participants from Nepal and Bangladesh	USAID funded international training programme on "Production protocol of biocontrol agents for the management of fall armyworm".	22 - 26 May 2023	Dr. K. Subaharan Dr. M. Sampath Kumar Dr. Amala Udayakumar Dr. Richa Varshney Dr. S. N. Sushil Dr. Ankita Gupta Dr. Omprakash Navik Dr. G. Sivakumar Dr. T. Venkatesan Dr. T. M. Shivalingaswamy Dr. A. N. Shylesha Dr. A. Raghavendra Dr. C. Manjunatha Dr. M. Mohan Dr. Jagadeesh Patil Dr. G. Mahendiran	7	10,60,166

INSTITUTE CAPACITY BUILDING PROGRAMME ORGANISED

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation If any (in ₹)
1.	Horticultural officials and other stake holders	Training cum demonstration on Biocontrol strategies for management of whiteflies in Coconut	20 January 2023	Dr. K. Selvaraj Dr. A. Kandan Dr. B. S. Gotyal Dr. C. Manjunatha	50	
2.	Extension Officials, Scientist of SAUs and KVKs	CDB funded training on Mass production of biocontrol agents for suppression of invasive whiteflies (Batch –II)	23 - 25 January 2023	Dr. K. Selvaraj Dr. A. Kandan Dr. Gundappa Dr. C. Manjunatha	10	-
3.	Scientists from Indian Council of Forestry Research and Education, (ICFRE), Dehradun	Training programme on Insect taxonomy	3 - 7 July 2023	Dr. K. Sreedevi Dr. M. Sampath Kumar	5	96,875
4.	Agriculture Department officials, Govt. of Mizoram	In-house training programme on "Scaling up of production of macrobials & microbials for the management of fall armyworm"	7 - 11 August 2023	Dr. Kesavan Subaharan Dr. M. Sampath Kumar Dr. Richa Varshney	3	

INSTITUTE IN HOUSE TRAINING PROGRAMME ORGANISED

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation If any (in ₹)
1.	Dr. Rabeesh, UPASI Tea Research Foundation,Valparai	In-house training on Anthocorid mass production	18 January 2023	Dr. Richa Varshney	1	3540
2.	M/s Unifly Insect Technology, New Delhi and M/s Eeki Automation Private limited, Rajasthan	In-house entrepreneur training on scientific mass production technique of major macrobials	31 January 2023 to 2 February 2023	Dr. Richa Varshney Dr. Omprakash Navik Mr. P. Raveendran	2	21240
3.	Mr. Rahul B Rathod, STA-B, Department of Marine Biotechnology, Naval Materials Research Laboratory, DRDO, Ministry of Defence, Ambarnath, Maharashtra	In-house training on "Mass rearing of *Galleria mellonella*"	8 - 10 March 2023	Dr. Jagadeesh Patil	1	10620
4.	Ms. Priyanka Dupatne Field Trial Operations Executive, M/s Bayer Crop Science Ltd. Benguluru	In-house training on "Scientific mass rearing techniques of *Cryptolaemus montrouzieri*"	5 January 2023	Dr. Richa Varshney	1	3540
5.	Dr. Suman Singh Digital Entomologist, M/s Materra India Pvt. Ltd. Ahmedabad	Scientific mass production techniques of Chrysopids	30 August 2023	Dr. Richa Varshney	1	3540
6.	Mrs. K. Kasthuri, FTCE, APSSRDI, Hindupur Mrs. K. Madhavi, Research scholar, APSSRDI, Hindupur, A.P.	In-house training on "Scientific mass production of Macrobials''	15 - 17 November 2023	Dr. Richa Varshney	2	12390
7.	Dr. Yogesh E. Thorat Scientist (Nematology), ICAR–Indian Institute of Sugarcane Research, Lucknow	Inhouse training programme on "Studies on Nematode Taxonomy"	18 - 30 December 2023	Dr. Jagadeesh Patil	1	1000

ARS PROBATIONERS' PROFESSIONAL ATTACHMENT TRAINING

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation if any (in ₹)
1.	Dr. Ipsita Samal, Scientist (Entomology), ICAR–NRCL, Muzaffarpur	Professional Attachment Training	22 August 2023 - 21 November 2023	Dr. K. Subaharan	1	–
2.	Dr. Mogili Ramaiah, Scientist, (Entomology), ICAR–DWR, Jabalpur, Madhya Pradesh	Professional Attachment Training	1 September 2023 - 30 November 2023	Dr. A. N. Shylesha	1	–
3.	Dr. S. D. Divija, Scientist (Entomology), ICAR–DMAPR, Anand, Gujarat	Professional Attachment Training	1 September 2023 - 30 November 2023	Dr. T. Venkatesan	1	–
4.	Dr. Kishore Chandra Sahoo, Scientist (Entomology), ICAR–IARI, Assam	Professional Attachment Training	30 October 2023 - 29 January 2024	Dr. Kolla Sreedevi	1	–
5.	Dr. M.G. Deeksha, Scientist (Entomology), ICAR–DWR, Maharajpur, Jabalpur Madhya Pradesh	Professional Attachment Training	4 December 2023 - 4 March 2023	Dr. Richa Varshney	1	–

STUDENT TRAINING PROGRAMME

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation if any (in ₹)
1.	Mr. Emil M. Saji M.Sc. Microbiology, St. Joseph University, Bengaluru	Student Internship Programme	16 January 2023 - 17 April 2023	Dr. G. Sivakumar	1	23600
2.	B. Tech students, College of Agriculture, Hassan	Student Training Programme	23 January 2023 - 30 April 2023	Dr. R. Rangeshwaran Dr. M. Mohan Dr. R. Gandhi Gracy	3	–
3.	Final year B.Sc. Hons (Agri.) students, SKUAST– Jammu	Student Training Programme	1 February 2023 - 31 May 2023	Dr. Deepa Bhagat	11	–
4.	Ms. Tejaswini Chandra, M.Sc., Government College of Pharmacy, Bengaluru	Student in-house training programme on "Mass rearing techniques of host insects"	5 April 2023	Dr. Richa Varshney	1	590

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation if any (in ₹)
5.	Ms. Ipshita Ghosh Ph.D. scholar, Agrl. Entomology, BCKV, West Bengal	Student in house training programme on "Collection, preservation, preliminary sorting & general overview of parasitoids of Hymenoptera"	10 - 14 April 2023	Dr. Ankita Gupta	1	–
6.	Ms. Archana B.R. Ms. T.P. Chandana, M.Sc. (Agrl. Entomology), College of Agriculture, UAS, Raichur	Student in house training programme on "Electro-physiological and behaviour methods for insect olfaction"	18 - 20 April 2023	Dr. K. Subaharan	2	–
7.	Mr. Amal Poulose, II M.Sc. Department of Agricultural Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala	Student in-house training on techniques in thrips taxonomy	26 June 2023 - 3 July 2023	Dr. R. R. Rachana	1	–
8.	Mr. Salunkhe Manoj Bhaurao, II M.Sc., Dept. of Entomology, CSK, HPKV, Palampur	Student in-house training on techniques in thrips taxonomy	10 - 15 July 2023	Dr. M. Sampath Kumar	1	–
9.	Mr. Balram, M. Sc. Entomology, CoA, CCSHAU, Hisar, Haryana	Student in-house training on "Collection and identification of spiders"	7 - 11 July 2023	Dr. K. J. David	1	–
10.	Mr. Vishwajeet, Ph. D. Scholar, Department of Entomology, Dr. RPCAU, Pusa, Bihar	Student in-house training programme on pheromone/attractant isolation for Plassey borer	07 - 29 August 2023	Dr. Deepa Bhagat	1	–
11.	M. Sc. Microbiology students from MHES College of Science and technology, Vadakara, Kerala	Student Internship Programme	1November 2023 - 31 January2024	Dr. G. Sivakumar Dr. C. Manjunatha	4	94,400
12.	Ms. Bhavitha, B. Sc. Biotechnology, Jain University, Bengaluru	Student Internship Programme	1December 2023 - 29 February2024	Dr. R. S. Ramya	1	11,800
13.	M. Tech Biotechnology students of Karunya Institute of Technology and Sciences, Coimbatore	Student Internship Programme	6 December 2023 - 19 April 2024	Dr. T. Venkatesan Dr. M. Mohan Dr. R. Gandhi Gracy	3	1,06,200
14.	Mr. Jasti Sri Vishnu Murthy, (Ph. D.), Dept. of Entomology College of Horticulture, Kerala Agricultural University, Thrissur	Student training programme on mass production of host-specific parasitoid, *Anagyrus lopezi*	15 December 2023	Dr. M. Sampath Kumar	1	–
15.	Ms. Aradhana Panda, Ph. D., Div. of Entomology, Faculty of Agriculture, Wadura, Sopore SKUAST- Kashmir	In-house training on DNA barcoding	26 December 2023 - 9 February 2024	Dr. T. Venkatesan	1	–
16.	Final year B. Tech students, Tamil Nadu Agricultural University, Coimbatore	Student Internship Programme	8 December 2022 - 24 February 2023	Dr. T. Venkatesan Dr. B. Gandhi Gracy Dr. B. S. Gotyal Dr. R. S. Ramya Dr. C. Manjunatha	5	–

FARMERS VISIT CUM TRAINING PROGRAMME

Sl. No.	Trainee (s)	Particulars of the Training Programme	Date (s)	Coordinator(s) or Resource Person(s)	Number of Participants	Income Generation If any (in Rs.)
1.	Tamil Nadu Farmers, ATMA Scheme, Nanguneri Block, Tirunelveli District, Tamil Nadu	Plant Health Management	22 February 2023	Dr. M. Sampath Kumar Mr. P. Raveendran	22	-
2.	Tamil Nadu Farmers, Thoothukudi District, Tamil Nadu	Biocontrol pest and disease management in Horticultural crops	7 June 2023	Dr. M. Sampath Kumar Mr. P. Raveendran	21	-
3.	Tamil Nadu Farmers, Madhanur, Thirupathur District, Tamil Nadu	Use of macrobials/microbials for management of insect pests in protected cultivation of vegetables and cut flowers.	22 August 2023	Dr. M. Sampath Kumar Mr. P. Raveendran	21	-

INSTITUTE VISITS - 2023

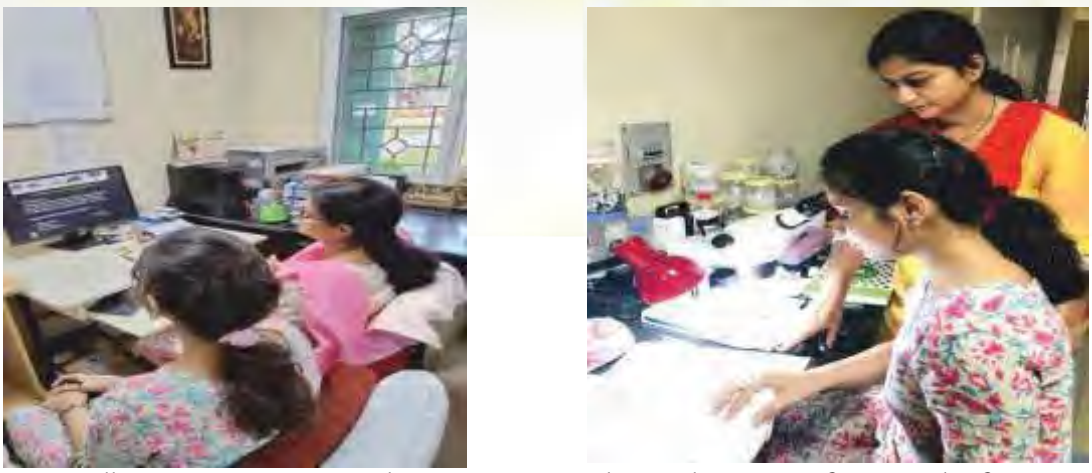
Sl. No.	Category	Date (s)	Institution	No. of Visitors
1.	Final B.Sc. (Agri.) students	23 January 2023	College of Agriculture, Ambalavayal	60 + 4 staff
2.	M.Sc. Entomology students	31 January 2023	Shivaji University, Kolhapur, Maharashtra	8 + 1 staff
3.	Final B.Sc. (Agri.) students	6 February 2023	College of Agriculture Technology, Theni, Tamil Nadu	118 + 3 staff
4.	Final B.Sc. (Agri.) students	13 February 2023	Don Bosco College of Agriculture, Tamil Nadu	115 + 4 staff
5.	Winter School Participants of "Implications and Impact Assessment of Climate Change on Pests, Natural Enemies and Pollinators in Horticultural Ecosystem (7-27 Feb. 2023)"	20 February 2023	ICAR–IIHR, Bengaluru	23
6.	Final B.Sc. (Agri.) students	21 February 2023	Krishna College of Agriculture & Technology, Tamil Nadu	86 + 4 staff
7.	Participants of DAESI programme	23 February 2023	UAS, GKVK, Bengaluru	40 + 1 staff
8.	Participants of training programme on IPM	24 February 2023	ICAR–KVK Chandurayanahalli, Magadi Taluk., Ramanagara District	39 + 1 staff
9.	Final B.Sc (Horticulture) Students	28 Feb. 2023	Horticulture College and Research Institute for Women, Trichy, Tamil Nadu	64 + 2 staff
10.	Final B.Sc. (Agri.) students	2 March 2023	College of Agriculture, Central Agricultural Univeristy, Iroisemba, Imphal, Manipur	91 + 4 staff
11.	Second year B.Sc. (Horticulture) students	8 March 2023	College of Horticulture, Mudigere, Chikkamagaluru	86 + 1 staff
12.	Final B.Sc. (Agri.) students	13 March 2023	Annamalai University, Annamalai Nagar, Tamil Nadu	99 + 3 staff
13.	Final B.Sc. (Agri.) students	16 March 2023	Annamalai University, Annamalai Nagar, Tamil Nadu	85 + 3 staff

Sl. No.	Category	Date (s)	Institution	No. of Visitors
14.	Final B.Sc. (Agri.) students	17 March 2023	Amrita School of Agricultural Sciences, Coimbatore, T.N.	114 + 4 staff
15.	Third year B.Sc. (Agri.) students	23 March 2023	Goa College of Agriculture, (SAMETI), Ela, Old Goa, Goa	20 + 2 staff
16.	Third year B.Sc. (Horticulture) students	27 March 2023	Mahatma Gandhi University of Horticulture and Forestry, KD–CHRS, Dharmpura, Jagdalpur	32 + 4 staff
17.	M.Sc. (Agri.) students	6 April 2023	College of Agriculture, UAS, GKVK, Bengaluru	17+1 staff
18.	School Students	24-28April 2023	Vishwa Vidyapeetha, Bengaluru	3
19	Diploma Students	19 May 2023	GPS Institute of Agricultural Management Peenya 1st stage, Bengaluru	5 + 1 staff
20.	Third year B.Sc. (Agri) students	21 June 2023	Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu	55+ 2 staff
21.	KVK programme coordinators under ICAR–ATARI, Bengaluru	21 June 2023	ICAR–ATARI, Bengaluru	48
22.	Second year, B.Sc.(Hons.) Agri. students	17 July 2023	College of Agriculture, Latur, Maharashtra	97+ 7 staff
23.	Diploma in Agricultural Extension Services for Input Dealers (DAESI)	3 August 2023	KVK, Kalyandurgam, Anantapuram District Andhra Pradesh	40 + 1 staff
24.	Second year B. Sc. (Agri) students	18 August 2023	Dr. D. Y. Patil College of Agriculture, Talsande, Kolhapur Dist. Maharashtra	107 + 6 staff
25.	Grade II students	18 August 2023	Vishwa Vidyapeeth CBSE School, Yelahanka, Bengaluru	120 + 5 staff
26.	Tamil Nadu Farmers	22 August 2023	SSEPERS-ATMA, Madhanur, Thirupathur District	20 + 1 staff
27.	Final B.Sc. (Agri) students	30 August 2023	Annamalai University, Annamalai Nagar, Tamil Nadu	90 + 3 staff
28.	Final B.Sc. (Agri) students	7 September 2023	Kalasalingam School of Agriculture & Horticulture, Anand Nagar, Krishnankoil, Srivilliputtur, Tamil Nadu	59 + 2 staff
29.	Ph.D. Entomology students	4 October 2023	Tamil Nadu Agricultural University, Coimbatore	22 + 2 staff
30.	M.Sc. Entomology students	5 October 2023	Annamalai University, Tamil Nadu	16 + 3 staff
31.	Second year B.Sc. (Agri) students	5 October 2023	Vignan's Foundation for Science, Technology and Research, Vadlamudi, Andhra Pradesh	84 + 4 staff
32.	Third year B.Sc. (Agri) students	11 & 12 October 2023	Acharya N. G. Ranga Agricultural University, Agricultural College, Bapatla District Andhra Pradesh	146 + 8 staff
33	Final B.Sc. (Horticulture) students	16 December 2023	Kalasalingam School of Agriculture and Horticulture, Krishnakoil, Virudhunagar, Tamil Nadu	32 + 2 staff
34.	Professional attachment trainees	16 November 2023	ICAR–Indian Institute of Horticultural Research, Bengaluru	5
35.	Final B. Sc. (Agri) students	24 November 2023	Aravindhar Agricultural Institute of Technology, Tiruvannamalai District, Tamil Nadu	124 + 3 staff
36	Grade VII students	4 December 2023	Vishwa Vidyapeeth CBSE School, Yelahanka, Bengaluru	90 + 3 staff
37.	Final B.Sc. (Agri) students	18 December 2023	Rani Lakshmi Bai Central Agricultural University, Jhansi	33 + 3 staff
38.	Third year B.Sc. (Agri) students	28 December 2023	Adhiyamaan College of Agriculture and Research, Hosur	16 + 3 staff

B) Capacity building programme undergone by NBAIR staff

Sl. No.	Name, Designation and Division	Name of the training programme attended	Place	Dates
1.	Dr. M. Sampath Kumar, Senior Scientist, Division of Germplasm Collection and Characterisation	NABL Assessor Training	ICAR–NIVEDI, Bengaluru	6 - 10 February 2023
2.	Dr. K. J. David, Senior Scientist, Division of Germplasm Collection and Characterisation	NABL Assessor Training	ICAR–NIVEDI, Bengaluru	6 - 10 February 2023
3.	Dr. R. S. Ramya, Scientist, Division of Genomic Resources	Training on Transcriptomics	M/s Mediomix Diagnosis & Research, Bengaluru	13 February - 3 March 2023
4.	Dr. R. Gandhi Gracy, Senior Scientist, Division of Genomic Resources	Training on Transcriptomics	M/s Mediomix Diagnosis & Research, Bengaluru	13 February - 3 March 2023
5.	Mr. R. Maruthi Mehanth Technical Assistant	Online Training Programme for technical personnel of ICAR	IT unit, ICAR– IASRI, Library Avenue, Pusa, New Delhi	22 - 28 February 2023
6.	Mr. Venugopala Technical Assistant	Online Training Programme for technical personnel of ICAR	IT unit, ICAR– IASRI, Library Avenue, Pusa, New Delhi	22 - 28 February 2023
7.	Dr. Gundappa, Senior Scientist, Division of Germplasm Conservation and Utilisation	Online training programme on "Data Science in Agriculture"	ICAR–IASRI, New Delhi	4 - 15 September 2023
8.	Dr. M. Sampath Kumar, Senior Scientist, Division of Germplasm Conservation and Utilisation	Online training programme on "Biosecurity and Biosafety: Policies, Diagnostics, Phytosanitary Treatments and Issues"	ICAR–NBPGR, New Delhi	4 - 15 September 2023
9.	Dr. Gundappa, Senior Scientist, Division of Germplasm Conservation and Utilisation	Lepidopteran Taxonomy	Butterfly Research Centre, Bhimtal, Uttarakhand	17 - 27 September 2023
10.	Dr. S. Salini, Senior Scientist, Division of Germplasm Collection and Characterisation	Enhancing Pedagogical Competencies for Agricultural Education	National Academy of Agricultural Sciences, New Delhi	25 - 30 September 2023
11.	Dr. K. Selvaraj, Senior Scientist, Division of Germplasm Conservation and Utilisation	Enhancing Pedagogical Competencies for Agricultural Education	National Academy of Agricultural Sciences, New Delhi	25 - 30 September 2023
12.	Dr. R. S. Ramya, Scientist, Division of Genomic Resources	Online Training Programme on "Omics Data Analysis: Genome to Proteome"	ICAR–IASRI, New Delhi	9 - 18 October 2023
13.	Dr. M. Pratheepa, Principal Scientist, Division of Genomic Resources	Training programme on "Geospatial Analysis using QGIS & R"	ICAR–NAARM, Rajendranagar, Hyderabad.	20 - 24 November 2023

STUDENT IN-HOUSE TRAINING PROGRAMME



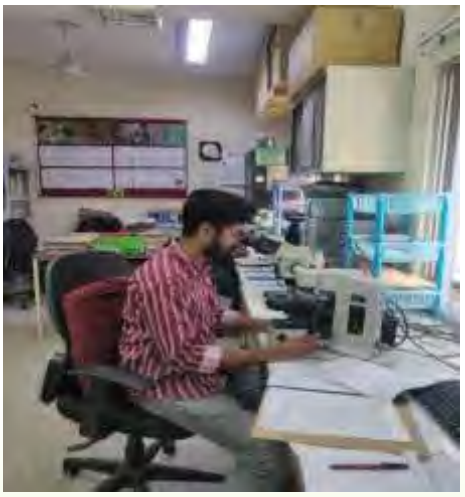
Training on collection, preservation, preliminary sorting and general overview of parasitoids of Hymenoptera

Training on electrophysiological and behavioural methods for insect olfaction

Training on collection and identification of spiders

Student in-house training on mass production of host-specific parasitoid, *Anagyrus lopezi*

Student in-house training programme on white grub rearing



Training on techniques in thrips taxonomy

International training for Nepal and Bangladesh participants on "Production protocol of biocontrol agents for the management of Fall armyworm" during 22-27 May 2023

Five days training for Officials of Mizoram Government on Scaling up of production of macrobials and microbials for the management of fall armyworm during 7-11 August 2023.

ICFRE sponsored training programme on "Insect Taxonomy" to the scientists of ICFRE (3-7 July 2023)

16. DISTINGUISHED VISITORS

• **Ms. Shobha Karandlaje,** Union Minister of State for Agriculture and Farmers' Welfare, Minister of State for Food Processing Industries, 19 October 2023.

• **Dr. Himanshu Pathak,** Secretary (Department of Agriculture Research & Education) & Director General, Indian Council of Agricultural Research, 29 August 2023.

• **Dr. P. K. Singh,** Agriculture Commissioner, Govt. of India, 25 August 2023.

• **Mr. Kunal Satyarthi,** Joint Secretary (Policy & Plan), NDMA, 20 October 2023.

• **Dr. J. P. Singh,** Plant Protection Advisor, Directorate of Plant Protection, Quarantine & Storage, New Delhi, 19 October 2023.

• **Dr. S. K. Malhotra,** Project Director, DKMA & Former Agriculture Commissioner, 20 January 2023.

• **Dr. S. C. Dubey,** ADG (PP&B), ICAR, New Delhi, 19 October 2023.

Ms. Shobha Karandlaje, Union Minister of State for Agriculture and Farmers' Welfare, Minister of State for Food Processing Industries, being greeted by Dr S N Sushil, Director, ICAR–NBAIR, on 19 October 2023

Dr. Himanshu Pathak, Secretary (DARE) & Director General, Indian Council of Agricultural Research, being greeted by Dr S N Sushil, Director, ICAR- NBAIR, on 29 August 2023

Dr. P. K. Singh, Agriculture Commissioner interacting with NBAIR scientists on 25 August 2023

17. MERA GAON MERA GAURAV

A field demonstration on WP formulation of entomopathogenic nematode, *Heterorhabditis indica* NBAIIH38 was organised by ICAR–NBAIR, Bengaluru on 8 August 2023 at Koluvanahalli, Chikkaballapura in Karnataka under the "Mera Gaon Mera Gaurav" programme to popularize the EPN technology. Over 50 farmers attended the event. Dr. Jagadeesh Patil addressed the farmers and gave the occurrence, distribution and the damage symptoms of FAW in maize and also explained the FAW management in maize using EPN at the farmers rally followed by demonstration of application of *H. indica* NBAIIH38 formulation in maize fields infested with FAW and white grubs. He assured the farmers that WP formulation of *H. indica* developed by ICAR–NBAIR was effective and could be used for the management of FAW, white grubs, ash weevil, diamond back moth and also other insect pests occurring especially in soil.

Demonstration of entomopathogenic nematode for the biological control of fall army worm and white grubs in maize

18. EXHIBITIONS

ICAR-NBAIR participated in various exhibition activities to showcase various biological control technologies developed at the Institute to students, extension & research workers and other stakeholders. Detailed exhibition activities conducted by the institute are given below.

Sl. No.	Exhibition	Date	Venue
1	Krishi Mela -2023	January 10 -12, 2023	University of Agricultural Sciences, Raichur
2	National Horticultural Fair - 2023	February 22 - 25, 2023	ICAR- Indian Institute of Horticultural Research Bengaluru
3	Pusa Krishi Vigyan Mela – 2023	March 2 -3, 2023	ICAR- Indian Agricultural Research Institute, New Delhi
4	Exhibition on coconut and arecanut plant health	August 11 -12, 2023	ICAR–Krishi Vigyan Kendra, Salem
5	Exhibition on NBAIR technologies	August 29, 2023	ICAR –NBAIR, Bengaluru
6	Exhibition on NBAIR Technologies for the G-20 meet under One Health Programme	August 30, 2023	ICAR– NIANP, Bengaluru
7	India International Crop Protection Expo	September 5 -6 ,2023	HITEX Exhibition Centre, Hyderabad
8	16th Agricultural Science Congress Expo 2023	October 10-14, 2023	ICAR-CMFRI, Kochi
9	Biocontrol Expo 2023	October 19, 2023	ICAR-NBAIR, Bengaluru
10	Krishi Mela- 2023	November 17 - 20, 2023	University of Agricultural Sciences, Bangalore

ICAR-NBAIR participated in "Krishi Mela-2023" at UAS Raichur

ICAR-NBAIR participated in "Krishi Mela-2023" from 10-12 January, 2023 held at UAS, Raichur, Karnataka. NBAIR organized exhibition stall to showcase various biological control technologies developed at the Institute to students, extension & research workers and other dignitaries. About 3,000 farmers, students, extension & research workers and other dignitaries visited NBAIR stall and learnt biological control activities

ICAR-NBAIR Bengaluru stall in Krishi Mela-2023, UAS Raichur, 10-12 January, 2023

ICAR- NBAIR participated in "Pusa Krishi Vigyan Mela- 2023"

ICAR- NBAIR participated in "Pusa Krishi Vigyan Mela-2023" held at ICAR-IARI, New Delhi from 2-3 March, 2023, to showcase various technologies developed at the Institute to farmers, students, extension & research workers and other dignitaries. Dr S. C. Dubey, ADG (PP&BS), ICAR, New Delhi and Dr Rajender Parsad, Director, ICAR-IASRI, New Delhi visited the NBAIR stall. About 5,500 farmers, students, extension & research workers and other dignitaries from various states of India visited NBAIR stall and learnt biological control activities.

Dr S.C. Dubey, ADG (PP&BS), ICAR, New Delhi and Dr Rajender Parsad, Director, ICAR-IASRI, New Delhi visited ICAR-NBAIR stall in Pusa Krishi Vigyan Mela 2023

ICAR–NBAIR participated in exhibition organised by ICAR–Krishi Vigyan Kendra, Salem

ICAR–NBAIR participated in exhibition organized at Krishi Vigyan Kendra, Sandhiyur, Salem Dist. from 11- 12 August, 2023 to showcase various technologies developed at the Institute to farmers, students, extension & research workers. About 1,500 farmers, students, extension & research workers visited to NBAIR stall and learnt biological control activities.

ICAR–NBAIR stall at Krishi Vigyan Kendra, Sandhiyur, Salem

ICAR–NBAIR participated in 'IICP Expo - 2023', Hyderabad

NBAIR participated in "India International Crop Protection Expo- 2023" held at Hyderabad from 5-6 September, 2023 to showcase various technologies developed at the Institute to farmers, students, extension & research workers and other dignitaries. Dr S. K. Malhotra, Director, Directorate of Knowledge Management in Agriculture, ICAR, New Delhi visited ICAR–NBAIR stall. About 1,000 farmers, students, extension & research workers and other dignitaries from various states of India visited NBAIR stall and learnt biological control activities of the institute.

ICAR–NBAIR stall at the India International Crop Protection Expo-2023, Hyderabad

ICAR-NBAIR participated in "Krishi Mela" at UAS, GKVK, Bengaluru

ICAR-NBAIR participated in "Krishi Mela" held at UAS, GKVK Campus, Bangalore during 17-20 November, 2023, to showcase various technologies developed at the Institute to farmers, students and extension & research workers. About 4,500 farmers, students, extension & research workers and other dignitaries visited the NBAIR stall and learnt about biological control activities.

ICAR–NBAIR Bengaluru Showcased its technologies in "Krishi Mela - 2023", at UAS GKVK, Bengaluru

OTHER ACTIVITIES

ICAR–NBAIR organized a workshop on "IPR issues in Agricultural Sciences"

ICAR–NBAIR organized a Workshop on 'IPR issues in Agricultural Sciences' on 8 February 2023 at ICAR-NBAIR, Yelahanka campus. The workshop was chaired by Dr.S.N.Sushil, Director, ICAR–NBAIR. Dr. Vikram Singh, IP&TM unit of ICAR and Dr. Ashwini Siwal Director, Entrepreneurial Law Clinic, Delhi University were the resource persons. Dr. S.N. Sushil, Director, ICAR-NBAIR highlighted the importance of IP rights in agricultural research and urged the scientists to take up intellectual property-driven research in the future. Dr. Ashwini Siwal, delivered a talk on 'Copyright issues in agricultural research'. The basic qualifications of an invention for applying patent (novelty, non-obviousness, technical advancement, economic significance), trademarks (distinctive, non-descriptive) and copyright were briefed and discussed. The issues related to patents and trademark applications, patent infringements and patentability of microbial strains were discussed. Dr.Vikram Singh delivered a talk on 'Three tier IP Management system and its impact on Technology Transfer'. He deliberated on the coordination of IP-related issues and the roadmap of IPR initiatives at ICAR. He presented the IP scenario and encouraged the scientists to apply for a trademark for the products and copyright for works churned out at the Bureau.

Celebration of IX International Yoga Day at ICAR-NBAIR, Bengaluru

On 21 June 2023, ICAR–NBAIR celebrated the IX International Yoga Day which serves as a reminder to the power of yoga that brings about positive social change and for well-being of all staff members is valued beyond their scientific development. The celebration continued with an invigorating yoga session led by certified instructors. The participants wholeheartedly followed the expertly guided sequences, which incorporated various *asanas* (poses), *pranayama* (breathing exercises), and *dhyana* (meditation) techniques.

International Yoga Day celebration at ICAR-NBAIR, Bengaluru

ICAR-NBAIR celebrated 'World Intellectual Property Day

ICAR–NBAIR celebrated "World Intellectual Property Day" under the theme "Women and IP: Accelerating Innovation and Creativity" on 26 April 2023 at ICAR – NBAIR, Hebbal campus. Dr K. Subaharan, Principal Scientist & Incharge, ITMU cell, ICAR–NBAIR, Bengaluru welcomed the participants. The meeting was chaired by Dr A.N. Shylesha, Principal Scientist, GCU. In his introductory remarks, he briefed the importance of women's participation in IP rights and the commercialisation of technology. He stressed the need to bring down the gender bias in IP-related matters. Dr Sudha Mysore, Former CEO of Agrinnovate and Principal Scientist (Retd.), ICAR–IIHR, Bengaluru delivered the guest lecture on "Women and IP: Accelerating Innovation and Creativity". The genesis of intellectual property rights and the activities of the World Intellectual Property Organization (WIPO) and its approach to public-private partnership were briefed. She informed the participants about the open courseware and training programmes organised by WIPO for creating awareness of IP rights and called upon the scientists and researchers to make use of this platform to upgrade their knowledge and skill related to IP management. The evolution of innovative entrepreneurship and technology incubation systems in India and the three-tier system adopted in ICAR were discussed. The role played by the IP&TM unit in trying to collate the information related to IP-related matters and encouraging the researchers in filling the IP rights was appreciated. The opportunities provided by ICAR to women scientist in being innovators and filing for IP rights was lauded by her. She informed that ICAR was well ahead of other organizations in the country in promoting women inventors. She elaborated upon the potential of women's participation in IP. The policy initiatives taken by the Government of India to promote IP through legislation viz., National Intellectual Property Rights 2006 and the extent of participation of women on a global scale was discussed. The technology evaluation centres and the mode of funding to the scientific personnel for commercialisation of the technologies in operation in India were briefed to the audience. The gender biases in the promotion of women's participation in the commercialisation of the technologies were discussed and the need to create awareness among the women workforce for commercialisation of the technologies was deliberated.

ICAR–NBAIR celebrated "World Intellectual Property Day" under the theme "Women and IP: Accelerating Innovation and Creativity"

World Environmental Day celebrated at ICAR–NBAIR, Yelahanka campus

On 5 June 2023, ICAR–NBAIR observed "World Environment Day" at its Yelahanka campus, Bengaluru. Dr. S.N. Sushil, Director of the institute welcomed everyone and gave a briefing on the theme of World Environment Day and underlined the need of planting drives for ecosystem restoration and protection of environment. He further emphasized the value of insects and butterflies in agriculture as well as the contribution of plants and insects to a sustainable ecosystem. Twenty five different species of host plants known to attract butterflies were planted by the staff of NBAIR. Dr. Gundappa, Senior Scientist (Entomology) and Dr. Mahesh Yandigeri, Principal Scientist, gave an overview of how eco-parks were developed at ICAR–NBAIR campus in the past. Dr. A.N. Shylesha, Principal Scientist, highlighted how establishing green ecosystems in urban areas will aid in the restoration of ecosystems. Dr. Venkatesan, Head (I/c), Division of GR underlined how organic matter can be converted and used to improve soil health and arthropod activity for betterment of the ecosystem. The issue of plastic pollution and the need to recycle plastic trash for a sustainable environment was emphasized by Dr. Kolla Sreedevi Head (I/c), Division of GCU Dr. G. Sivakumar, Principal Scientist gave a history of the NBAIR Yelahanka campus by explaining the role of the previous campus in-charge in transforming the barren land into a green oasis. In addition, he advised scientists to carry out investigations on plastic degradation by insects to beat the plastic pollution.

World Environmental Day celebrated at ICAR-NBAIR, Yelahanka campus

Workshop on "i-STEM – linking researchers & resources"

ICAR, NBAIR Bengaluru organised a workshop in collaboration with i-STEM, IISC Bengaluru ON "i-STEM – linking Researchers & Resources" from 14-16 June 2023.

Workshop on "i-STEM – linking researchers & resources"

Visit of Secretary, DARE & Director General, ICAR to ICAR–NBAIR, Bengaluru

Dr Himanshu Pathak, Hon'ble Secretary, DARE, and DG, ICAR visited the ICAR–NBAIR, Bengaluru on 29 August 2023. He visited the National Insect Museum and various laboratories and technology exhibits of ICAR–NBAIR. He addressed all the scientists of ICAR–NBAIR, as well as the ATARI, ICAR–NBSSLUP, and ICAR–IVRI at a meeting held at ICAR–NBAIR. The Director of ICAR–NBAIR, Dr S N Sushil presented an overview of the Bureau's activities, achievements, and accomplishments since its inception. Dr Pathak appreciated the work of ICAR–NBAIR and the other institutes in Bengaluru. He urged all scientists to focus more on research activities, since scientific achievements will lead to higher recognition at the personal, institute, and even council levels.

Dr Himanshu Pathak, Hon'ble Secretary, DARE and DG, ICAR with NBAIR scientists

Enhancing Women's Hygiene: An In-Depth Conversation

On 6 September 2023, Staff Welfare Association (SWA), ICAR–NBAIR had hosted programme on women's hygiene. This event was graced by Mrs. Sumita Sushil. She emphasized that women's hygiene transcends the realm of physical health and such initiatives that contribute to the personal and professional growth of our entire female workforce; it stands as a cornerstone of their overall confidence, dignity and empowerment. The expert Ms Pragathi Badarinath's informative session that followed delivered invaluable insights, practical tips, and knowledge, equipping everyone with the tools to prioritize their health and hygiene effectively.

Workshop on Enhancing Women's Hygiene: An In-Depth Conversation

Observance on Vigilance Awareness Week -2023 at ICAR-NBAIR, Bengaluru

Observance on Vigilance Awareness Week – 2023 (30 October – 5 November) at ICAR–NBAIR commenced with Integrity Pledge by all the staff of ICAR–NBAIR. The theme of the vigilance awareness week during 2023 is 'Say no to Corruption: Commit to the Nation".

Smt. Dr. Mamatha B. R., IAS, Inspector General of Registration & Commissioner of Stamps, Bengaluru was invited as the Chief Guest and she delivered a talk on "Say no to Corruption: Commit to the Nation". Dr. S.N. Sushil, Director, ICAR–NBAIR gave remarks on different facets of vigilance, ethics, moral, integrity and accountability to be followed in an institution, followed by remarks on Vigilance by the Administrative Officer, Mr. Mathew.

ICAR-NBAIR participated in Industry Interface meet organised by ICAR-IIHR, Bengaluru

ICAR–NBAIR participated in Industry Interface meet organised by ICAR–IIHR, Bengaluru on 31 October 2023. ICAR–NBAIR technologies on eco-friendly pest management strategies involving macrobial, microbial and pheromones developed at ICAR–NBAIR were displayed. In addition the technologies related to insect derived resources were displayed too. The stall were visited by Dr.Sudhakar Pandey, ADG (Flower/Veg/Spices/Med. Plants) ICAR, New Delhi, Dr Sanjay Singh, Director, ICAR–IIHR, Bengaluru along with other dignitaries visited the stall. In addition participants from industries, academia and farmers visited the stall and were briefed on benefit of the technologies. Dr. K Subaharan, Dr U. Amala and Dr.Ashika T.R participated in exhibiting the technologies.

Observance on Vigilance Awareness Week -2023

19. PERSONNEL

Sl. No.	Name	Designation
1.	Dr S.N. Sushil	Director
Scientists		
Division of Germplasm Collection and Characterisation		
2.	Dr Sunil Joshi	Principal Scientist (Agricultural Entomology) & Head, Division of Germplasm Collection and Characterisation
3.	Dr Kolla Sreedevi	ICAR National Fellow
4.	Dr G. Mahendiran	Senior Scientist (Agricultural Entomology)
5	Dr Ankita Gupta	Senior Scientist (Agricultural Entomology)
6.	Dr Jagadeesh Patil	Senior Scientist (Nematology)
7.	Dr K.J. David	Senior Scientist (Agricultural Entomology)
8.	Dr S. Salini	Senior Scientist (Agricultural Entomology)
9	Dr M. Sampath Kumar	Senior Scientist (Agricultural Entomology)
10.	Dr R.R. Rachana	Scientist (Agricultural Entomology)
11.	Dr Navik Omprakash Samodhi	Scientist (Agricultural Entomology)
12.	Dr N.N. Rajgopal	Scientist (Agricultural Entomology) [Joined on 1 January 2024]
Division of Germplasm Conservation and Utilisation		
13.	Dr Kesavan Subaharan	Principal Scientist (Agricultural Entomology) & Head, Division of Germplasm Conservation and Utilisation
14.	Dr T.M. Shivalingaswamy	Principal Scientist (Agricultural Entomology)
15.	Dr A.N. Shylesha	Principal Scientist (Agricultural Entomology)
16.	Dr Prakya Sreerama Kumar	Principal Scientist (Plant Pathology)
17.	Dr G. Sivakumar	Principal Scientist (Microbiology)
18.	Dr Deepa Bhagat	Principal Scientist (Organic Chemistry)
19.	Dr A. Kandan	Principal Scientist (Plant Pathology)
20.	Dr K. Selvaraj	Senior Scientist (Agricultural Entomology)
21.	Dr U. Amala	Senior Scientist (Agricultural Entomology)
22.	Dr Gundappa	Senior Scientist (Agricultural Entomology)
23.	Dr Richa Varshney	Scientist (Agricultural Entomology)
24.	Dr Prabhulinga Tenguri	Scientist (Agricultural Entomology) [Joined on 22 December 2023]
Division of Genomic Resources		
25.	Dr T. Venkatesan	Principal Scientist (Agricultural Entomology) & Head, Division of Genomic Resources
26.	Dr M. Nagesh	Principal Scientist (Nematology)
27.	Dr R. Rangeshwaran	Principal Scientist (Microbiology) [Superannuated on 31 July 2023]
28.	Dr M. Mohan	Principal Scientist (Agricultural Entomology)
29.	Dr M. Pratheepa	Principal Scientist (Computer Applications)
30.	Dr Mahesh Yandigeri	Principal Scientist (Microbiology)

Sl. No.	Name	Designation
31.	Dr R. Gandhi Gracy	Senior Scientist (Agricultural Entomology)
32.	Dr B.S. Gotyal	Senior Scientist (Agricultural Entomology)
33.	Dr D. Sagar	Senior Scientist (Agricultural Entomology) [Joined on 14 December 2023]
34.	Dr C. Manjunatha	Scientist (Plant Pathology)
35.	Dr R.S. Ramya	Scientist (Agricultural Entomology)
36.	Dr B.S. Manjunatha	Scientist (Microbiology) [Joined on 6 October 2023]
37.	Mr K.T. Shivakumara	Scientist (Agricultural Entomology)
Technical Officers/ Assistants		
38.	Dr B.K. Chaubey	Chief Technical Officer
39.	Mr Satendra Kumar	Chief Technical Officer
40.	Ms L. Lakshmi	Assistant Chief Technical Officer
41.	Mr H. Jayaram	Assistant Chief Technical Officer
42.	Mr P. Raveendran	Technical Officer (T5)
43.	Dr A. Raghavendra	Senior Technical Officer
44.	Mr M. Chandrappa	Technical Officer (Driver)
45.	Mr R. Narayanappa	Technical Officer (Generator Operator)
46.	Mr Umesh Kumar Sanjeev	Technical Assistant (Laboratory Technician)
47.	Mr R. Maruti Mehanth	Technical Assistant (Laboratory)
48.	Mr K.M. Venugopala	Technical Assistant (Laboratory)
49.	Mr P. Madanathan	Technical Assistant (Driver)
50.	Mr Ramakrishnaiah	Technician (T1)
Administrative Staff		
51.	Mr J. Mathew	Administrative Officer
52.	Ms S. Kusuma	Senior Finance and Accounts Officer
53.	Ms Dipanwita Deb	Assistant Administrative Officer
54.	Ms S. Kaveriamma	Private Secretary
55.	Ms M.S. Uma	Personal Assistant
56.	Ms Naziya Anjum	Assistant
57.	Ms P. Anitha	Upper Division Clerk
58.	Ms Sanjeevini Desai	Lower Division Clerk and Cashier
Supporting Staff		
59.	Mr P. Nagaiah	Skilled Supporting Staff
Superannuation and New Joining		
	Dr R. Rangeshwaran	Principal Scientist (Microbiology) [Superannuated on 31 July 2023]
	Dr D. Sagar	Senior Scientist (Agricultural Entomology) [Joined on 14 Dec. 2023]
	Dr Prabhulinga Tenguri	Scientist (Agricultural Entomology) [Joined on 22 Dec. 2023]
	Dr B.S. Manjunatha	Scientist (Microbiology) [Joined on 6 October 2023]
	Dr N.N. Rajgopal	Scientist (Agricultural Entomology) [Joined on 1 January 2024]

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