

ICAR-NBAIR

Newsletter

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ICAR-National Bureau of Agricultural Insect Resources



DECODING THE CREEPY CRAWLIES

Technological advancements in molecular biology has spurred a new scientific revolution which made it possible to sequence DNA at high speed and low cost. Consequently, the race to sequence entire genomes in eukaryote multicellular species, which started with the nematode *Caenorhabditis elegans* in 1998, followed by the fruit fly *Drosophila melanogaster* in 2000, and humans in 2003, is advancing at a formidable speed. In the wake of these constant interventions and improvements in molecular biology, the field of agricultural entomology has also made great strides in generation of information.

Tribolium castaneum was the first agricultural pest to have its genome sequenced, with the assembly officially released in 2008. The rapid development of insect genomes certainly look promising, but the existing bottlenecks like high heterozygosity that affects the assembly quality is an impediment in the annotation of insect genomes. ICAR-NBAIR attempts to overcome this problem by developing isofemale lines that could be used for insect genome sequencing projects.

With genome assemblies representing 600+ insect taxa available in a public repository, the stage has been set to conduct new studies of insect genome biology and evolution. Building on these resources, entomologists have accomplished the generation of a plethora of information on functional genomics including transcriptomes, proteomics and metabolomics. Genome sequencing followed by genome-wide association studies has become an efficient strategy to uncover the mechanisms of many important traits, such as insecticide resistance, geographical polymorphism and host adaptation.

ICAR-NBAIR took the tiny steps of venturing into the field of molecular entomology through DNA barcoding. With the addition of the expertise of DNA barcoding in the quiver, NBAIR has pulled off the difficult task of supplementing morphological taxonomy with molecular taxonomy. NBAIR has also proved itself instrumental in the identification of insects which are intercepted in imported cargo with the help of DNA barcoding.

Gaining from the momentum obtained from this, NBAIR has come a long way ahead now by accomplishing the genome sequencing and generation of valuable data for three agriculturally important pests, viz. *Amrasca biguttula biguttula*, *Leucinodes orbonalis* and *Polyphagotarsonemus latus*. With the availability of the genome sequences, the scientists in NBAIR have succeeded in identifying the key metabolic genes involved in insecticide degradation. Having the genomes of these three economically important pest species laid out in detail gives further impetus to our understanding which will eventually pave the way for formulating alternative and eco-friendly strategies for their management.

In addition to the commendable achievements made by NBAIR in the field of insect genomics, there are many more avenues of molecular entomology research where NBAIR has proved its mettle. The transcriptome sequencing of nearly 15 insect species has been accomplished by NBAIR so that the underlying mechanisms of various traits like insecticide resistance, pheromone recognition etc. can be understood better. A tremendous amount of research have been done with entomopathogenic nematodes too. To date, mitochondrial and draft whole genomes of five entomopathogenic nematode species have been sequenced and also, explorations are being made to understand the tri-trophic relationships among insect host, entomopathogenic nematode and the associated bacterium.

With the experience and knowledge gathered from all these endeavours, NBAIR has an ace up its sleeve to bravely plunge into the advanced areas of molecular entomological research like genome editing, gene drive etc.

Dr M. Nagesh
Director (Acting)

Two new species of parasitoid wasps

Two new species of parasitoid wasps, *Pambolus (Phaenodus) infuscatus* Gupta & van Achterberg (Braconidae: Pambolinae) and *Paroplitis khajjiarensis* Gupta & Fernández-Triana (Fig. 1)(Braconidae: Microgastrinae) were described and illustrated from Himachal Pradesh, India. A key to the Oriental species of *Pambolus* and an updated key to world species of *Paroplitis* were provided. Additionally, *Centistes (Centistes) cuspidatus* (Braconidae: Euphorinae) (Figs 2 & 3) was reported for the first time from the Indian geographical boundaries.

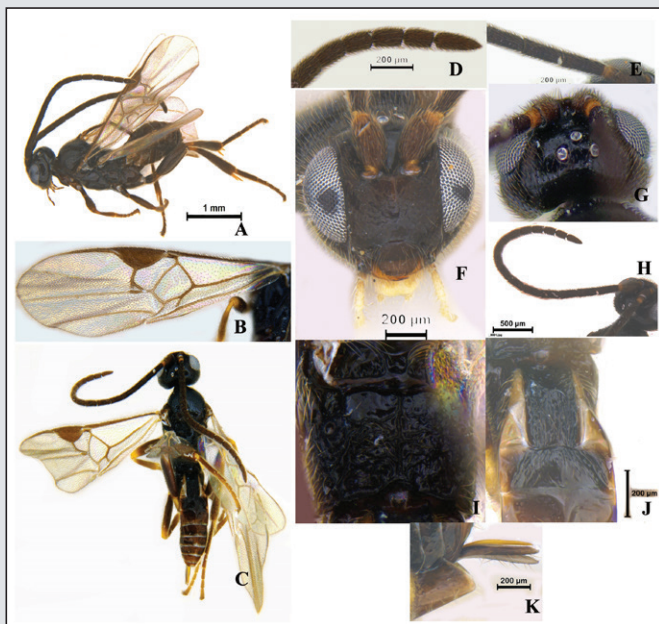


Fig. 1: *Paroplitis khajjiarensis*: A, male in habitus (lateral view); B, female fore wing; C, female (in dorsal aspect); D, female F10–F15; E, female F1–F3; F, female head in frontal view; G, female vertex; H, female antenna; I, female propodeum; J, female T1 and T2; K, ovipositor sheaths



Fig. 2: *Centistes (Centistes) cuspidatus* female in habitus (lateral view)

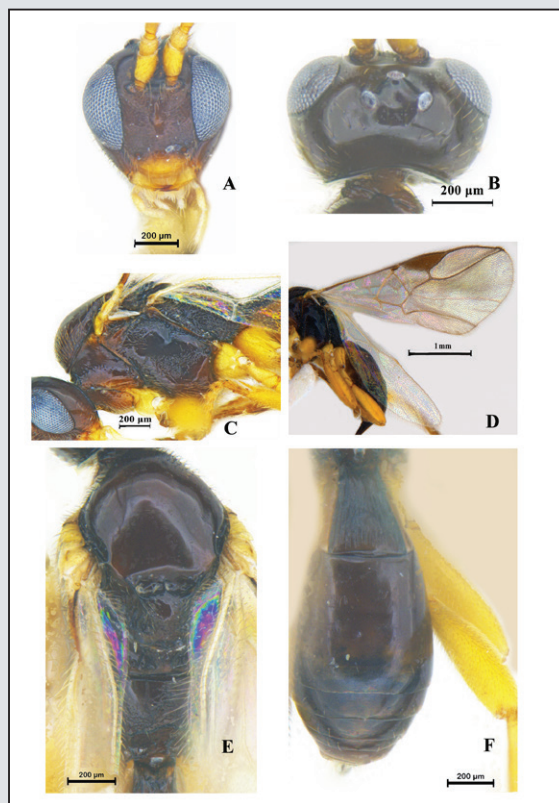


Fig. 3: *Centistes (Centistes) cuspidatus* (Female): A, head in frontal view; B, vertex; C, mesopleuron; D, wings; E, mesosoma; F, metasoma

A new fruit fly species

A new species of fruit fly, *Rhabdochaeta nigroapicalis* David, Hancock and Sachin (Fig. 4) was described from Assam, India. Flies were found infesting flowers of *Ageratina* sp. (Asteraceae).



Fig. 4: Habitus of female *Rhabdochaeta nigroapicalis*

Seasonal outbreak of a banded awl butterfly, *Hasora chromus* at ICAR-NBAIR Yelahanka campus

A seasonal outbreak of banded awl butterfly, *Hasora chromus* (Lepidoptera: HesperIIDae) was observed at ICAR-NBAIR Yelahanka campus during the second week of March 2022. Thousands of butterflies were observed laying eggs on *Pongamia* trees with the initiation of new leaf buds and shoots after shedding of old leaves (Fig. 5). The outbreak was also observed during March 2016.



Fig. 5: Damaged *Pongamia* tree

The adult butterfly laid its egg singly in the new leaf buds of the tree. Egg was spherical shape, pearl-white in colour with raised reticulations all over its surface. The first instar larvae fed upon the freshly emerged leaf buds and young shoots of the tree. The later larval instars (Fig. 6) migrated to nearby *Pongamia* trees having fully opened leaves and fed voraciously resulting in complete defoliation. The mature larvae after the feeding phase were observed to pupate in *Pongamia* trees and the rest of them climbed down the trees and migrated to nearby available plants (more than 25 species) in large numbers like armyworms. Pupae were oblong, pale greenish-white initially (Fig. 7) and later turned into brownish-black. The adult was a blackish-grey coloured butterfly (Fig. 8), an active flier and found feeding the nectar from the flowers of *P. pinnata*.

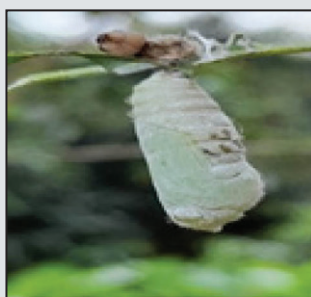
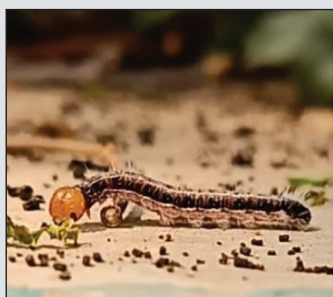


Fig. 6: Larva of *Hasora chromus* Fig. 7: Pupa of *Hasora chromus*



Fig. 8: Adult *Hasora chromus* Fig. 9: Silken web stitch

The mature instar larvae made longitudinal leaf rolls in the nearby available plants by fastening two ends of the leaves using a silken web (Fig. 9) secreted by the larvae. More than 25 plants species were preferred by the late instar larvae of *H. chromus* for pupation (Fig. 10).



Fig. 10: *H. chromus* pupa

Ants are very important predators of the marching population of the later instar larvae (Fig. 11). Solitary wasp, *Polistes* sp. were observed hunting for the larvae in the host plants. Several species of birds, viz. crows, mynahs and sunbirds were observed to feed on the larvae and pupae of *H. chromus*.

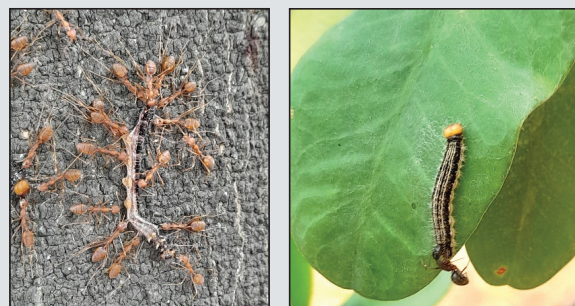


Fig. 11: Predation by ants

Though the outbreak of *H. chromus* was observed, the infested trees rejuvenate/reshoot in a short while after the feeding phase of the caterpillars. As conservation of butterflies is a globally debated topic, withholding the control measures for the management of the larvae will help in in-situ conservation of the emerging population of adult butterflies.

Synthesis of ZnO and chitosan alginate nano particles

Chemically synthesized chitosan alginate nanoparticles for the first time in the history of nanotechnology research. Nanoparticles with polymer matrix dispersion have variable crystallinity. Intense interactions between chitosan, sodium alginate, & AG/CS NPs result in a less intense peak and far less crystallised entity. XRD analysis of AG/CS NPs (Fig. 12) indicated that they are very amorphous and suited for a wide range of applications.

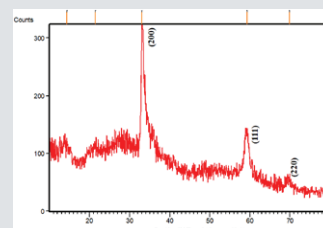


Fig. 12: XRD analysis of CS/AG nanoparticles

The Sol gel approach has been used to chemically synthesize ZnO nanoparticles. The prominent absorption peak at 342 nm in the spectroscopic investigation indicated that ZnO nanoparticles were homogeneous in size. Zinc oxide has a Zn–O bond with a distance of 618 cm⁻¹. SEM images of chemically produced ZnO NPs (Fig. 13) showed a hexagonal and spherical form.

Nanotechnology is a territory of science and improvement that centers around making objects on the size of particles and atoms, such as materials and hardware. Insect pest control and formulations of possible insecticides and pesticides will also benefit from nanomaterials in various ways. The evolution of new insect tolerant varieties may benefit from nanoparticle-mediated gene transfer. Because of this, it may be concluded that nanotechnology can provide environmentally beneficial and sustainable insect pest management options.

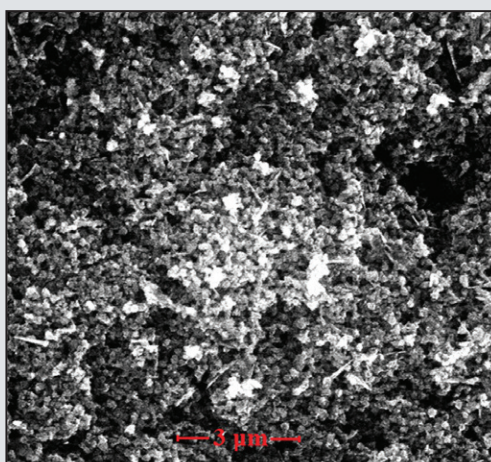
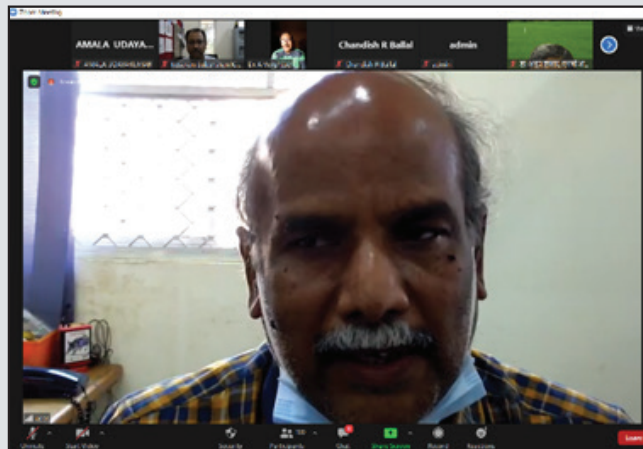


Fig. 13: SEM image of ZnO Nanoparticles

ICAR–NBAIR organised webinar on ‘Application of Genome Editing in Insect Pest Management’

ICAR–NBAIR organised an online webinar series 009 on ‘Application of Genome Editing in Insect Pest Management’ as a part of Azadi Ka Amrit Mahotsav on 20 January 2022. One hundred participants from ICAR institutes, AICRP (BC) and State Agricultural Universities attended the webinar. Dr M. Nagesh, Director (Acting) in his introductory remarks, explained the importance of genome editing tools and their importance in insect pest management with special emphasis on insect vector management. The speaker, Dr R. Asokan, Principal Scientist & Fullbright Fellow, ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru delivered a talk on ‘Application of Genome Editing in Insect Pest Management’. In his talk, he covered the basic concepts and evolution of genome editing tools in agriculture. He explained about the role of genome editing tools in biotic and abiotic stress management, improvement of natural enemies for desirable characteristics like female biased sex ratio and efficient host searching behaviour. The potential application of using genome editing to change the volatile blend in the plants to repel the insect pests or to change the behaviour of virus vectors was deliberated. The need to develop SOPs/ guidelines of arthropod containment

for such genome editing studies was discussed. Dr M. Nagesh, in his concluding remarks highlighted upon the need to develop gene knockdown of critical genes that is responsible for the virus transmission to gain immediate visibility for the genome editing technology. The program was organised and coordinated by Drs Kesavan Subaharan, Amala Udayakumar and M. Pratheepa.



Republic Day celebrations at ICAR-NBAIR

ICAR–NBAIR celebrated the “73rd Republic Day” on 26 January 2022. Dr M. Nagesh, Director (Acting) hoisted the national flag at ICAR-NBAIR, Hebbal campus and delivered the republic day speech. Dr T.M. Shivalingaswamy, the Farm-Incharge, unfurled the national tricolor flag at Yelahanka campus of NBAIR. Commemorating the celebrations of Azadi Ka Amrit Mahotsav, it was decided to recognise the motivating and contributive leadership of two of the founder Directors of PDBC, AICRP-BC and NBAIR, late Dr S.P. Singh (1989–2001) and Dr R.J. Rabindra (2001–2012) by naming two lab complexes at Hebbal and Yelahanka, respectively in their names.



Blood donation camp at ICAR-NBAIR

ICAR–NBAIR organised a voluntary blood donation camp on 14 February 2022. The camp was conducted by the Grace Voluntary Blood Bank, a unit of Nagashankara Charitable Trust. Staff Welfare Association of the Bureau co-ordinated the camp and 18 units of blood were collected in the camp. Around 15 staffs (both permanent and contractual) and their family members participated for this noble cause.

ICAR-NBAIR organised 'Skill Development Training on Honeybee and Stingless Beekeeping'

ICAR-NBAIR in collaboration with ICAR-Agricultural Technology Application Research Institute, Hyderabad and Krishi Vigyan Kendra, Gopichettipalayam, Erode district, Tamil Nadu organised two days "Skill Development Training on Honeybee and Stingless bee keeping" during 17-18 February 2022 at Gopichettipalayam and Thattachankaraivazhi in Erode district, Tamil Nadu. A brief lecture on honey bee and stingless beekeeping was given to the participants. Stingless bee colony maintenance for high value honey production was explained to the participants. The domestication techniques of stingless bees and the benefits of stingless bees were explained to the farmers. Different hive designs for domestication and hive architecture of stingless bees were displayed to the participants. The programme was attended by 100 farmers. Inputs, viz. honey bee boxes, honey extractor and other accessories were distributed to the participants.



ICAR-NBAIR organised "National Workshop on identification of insect-pests, invasion of crops and their bio-control in North-Eastern region of India"

ICAR-NBAIR organised National Workshop on 'Identification of insect-pests, invasion of crops and their bio-control in North-Eastern region of India' at College of Fisheries, Central Agricultural University, Agartala during 2-4 March 2022.



Dr. Agarwala, Chairman, Tripura Pollution Control Board, Chief Guest spelled out the importance of taxonomy and the role played by Bureau in the taxonomic identification of insect pests. Dr M. Nagesh, Director (Acting) delivered a talk on 'An overview of biological control in India: constraints and opportunities' in which he enumerated the potential bioagents available in the country for effective eco-friendly insect pest management. Dr Sunil Joshi, Principal Scientist & Head of Division, Division of Germplasm Collection & Characterization delivered a lecture on 'Taxonomy of Coccids, their damage potential and the methods involved in their management'. Dr K. Subaharan, Principal Scientist (Entomology) delivered a talk on 'Exploiting the olfactory cues of natural enemies and insect pests to devise insect pest management strategies'. Dr G. Mahendiran, Senior Scientist (Entomology) delivered a lecture on 'Taxonomy of Coleopteran pests and

their impact in North-Eastern region'. Dr R.R. Rachana, Scientist (Entomology) delivered a talk on 'Taxonomy of thrips and their management' followed by a lecture on 'Microbial agents for insect pest management' by Dr C. Manjunatha. Dr Navik Omprakash Samodhi, Scientist (Entomology), delivered a lecture on 'Mass production and utilization of natural enemies of crop pests'. Dr S.M. Haldhar, Associate Professor explained about the use of potential botanical pesticides for sustainable insect pest management in North-East India and highlighted the toxic effects of chemical pesticides.

International Women's Day at ICAR-NBAIR

ICAR-NBAIR celebrated 'International Women's Day' on 8 March 2022 with the theme 'Gender equality today for a sustainable tomorrow'. Dr Leela Saijaram, Retd. Principal Scientist, ICAR-IIHR, Bengaluru was the Chief Guest and Smt Vijaya, Progressive farmer, Bengaluru, was the Guest of Honour. Dr K. Sreedevi, Officer In Charge, Institute Women's Cell delivered the welcome address. Chief Guest, Dr Leela Saijaram addressed the gathering and emphasised women's empowerment and rights and highlighted the contribution of women in several fields. The chief guest also stressed upon gender equality in all fields, which is pivotal in attaining harmony for better future. Dr A.N. Shylesha, Principal Scientist & Head of Division, Division of Germplasm Conservation and Utilisation in his presidential address emphasised on the role of women in leadership and highlighted gender equity in all areas and expressed concern for women's welfare in the work places and sensitised about laws and rules that are in place for the protection of women and their rights. The women participants in the competitions and the Guests of the day were felicitated by the Director.



ICAR-NBAIR organised first field release programme of the parasitoid, *Anagyrus lopezi* to tackle invasive Cassava mealybug menace in India

ICAR-NBAIR Bengaluru have imported the beneficial parasitoid, *Anagyrus lopezi* (Hymenoptera:Encyrtidae) from International Institute of Tropical Agriculture (IITA) with its subcentre at Republic of Benin through International cooperation ably facilitated by Dr T. Trilochan Mohapatra, Secretary, DARE & Director General, ICAR; Dr Ravi Prakash, Plant Protection Adviser, DPPQ&S; Dr T.R. Sharma, DDG (Crop Science) and Dr S.C. Dubey, ADG (PP&B), ICAR. The country representatives Dr Manuele Tamo, and Dr Georg Goergen, Entomologists from IITA, Benin supplied this parasitoid (Govt. of India import permit No. 17/2020-21 dated 29.10.2020) which was received at Bengaluru on 13 August 2021. The team of scientists comprising of Drs M. Sampath Kumar, M. Mohan, A.N. Shylesha, Sunil Joshi and Ankita Gupta carried out the mandatory quarantine studies on biology, safety and host specificity of *A. lopezi* at

NBAIR QC-2 quarantine facility to ensure its non-target impacts. ICAR-NBAIR has optimised the mass production and field release protocol of this parasitoid wasp in small as well as large scale setup on cassava mealybug colonies. Further, ICAR-NBAIR has conducted the trainer's training programmes in four batches and trained the staffs of State Agricultural Universities, State Horticulture Departments and Krishi Vigyan Kendras on mass production and field release techniques of *A. lopezi*.

The first field release programme of the parasitoids and its distribution to the cassava farmers was organised by ICAR-NBAIR in collaboration with Tapioca and Castor Research Station (TNAU), Yethapur, Salem district of Tamil Nadu on 7 March 2022. About 300 tapioca farmers from six districts of Tamil Nadu attended the event. Shri A.K.P. Chinraj, Member of Parliament, Namakkal constituency; Dr J.P Singh, Additional Plant Protection Advisor, GOI; Dr S.C. Dubey, ADG (PP&B), ICAR; Dr M.N. Sheela, Director, ICAR-CTCRI, Thiruvananthapuram; Dr M. Nagesh, Director (Acting), ICAR-NBAIR, Bengaluru; Dr. Subhash Chander, Director, ICAR-NCIPM, New Delhi; Dr Harsh Vardhan Singh, Director, ICAR-NBAIM, Mau; Dr A.S. Krishnamoorthy, VC, TNAU, Coimbatore and Mr C. Kathiravan IAS, Managing Director, Sago Serve, Salem graced the occasion. Other senior officials and scientists from ICAR-NBAIR and TNAU participated in the event and provided technical inputs to the farmers.



ICAR-NBAIR organised webinar on 'Entomophilately – Collecting Insects Without a Net'

ICAR-NBAIR organised an online webinar series 0010 on 'Entomophilately – Collecting Insects Without a Net' as a part of Azadi Ka Amrit Mahotsav on 9 March 2022. One hundred participants from ICAR institutes, AICRP (BC) and State Agricultural Universities attended the webinar. Dr A.N. Shylesha, Principal Scientist & Head of Division, Division of Germplasm Conservation and Utilisation, in his introductory remarks explained the importance of entomophilately and the need to sensitise students and research scholars towards the collection of insect stamps as a scientific hobby. The speaker Dr S. Ramani, Former Project Coordinator, AICRP on Honey bees and Pollinators delivered a talk on 'Entomophilately – Collecting Insects Without a Net'. In his talk, he explained the history of the first use of insects ie. honeycombs and butterflies in stamps. He explained the scope of using insect stamps

as a way to link the art and culture of different countries. He elaborated upon the widely used insect in stamps ie. Odonata (dragonflies and damselfiles) in insect stamps of different countries where its habitat, life cycle and behaviour were depicted. The depiction of honeybees and butterflies in the special covers to commemorate the celebration of scientific events in India was also elaborated. The way of using insects in stamps to build relationships between countries was explained. The programme was organised and coordinated by Drs Kesavan Subaharan, Amala Udayakumar and M. Pratheepa.



ICAR-NBAIR organised Industry Interface Meet

ICAR-NBAIR organised Industry Interface meet at Yelahanka campus on 25 March 2022. Dr K. Srinivas, Assistant Director General (ADG) (IP&TM) and Dr. Sudha Mysore, CEO, Agrinnovate attended the meeting as Chief guests. Dr K. Srinivas, ADG (IP&TM) released the ICAR-NBAIR Technology catalogue and briefed on the benefits of the biological control technologies in the present era of organic farming. He also suggested wide circulation of technologies in social media for wide publicity. Dr Sudha Mysore, CEO, Agrinnovate briefed about the activities of Agrinnovate and its benefits to scientific organisations and stakeholders. Dr A. Kandan, Principal Scientist & ITMU In Charge made a brief presentation on the technologies developed by the Bureau that are ready for commercialisation. Dr K.L. Gurjar, Joint Director (Plant Protection), Central Insecticide Board and Registration Committee (CIB & RC), Faridabad gave a lecture on guidelines for CIB&RC registration of biopesticides through online mode to the participants. An exhibition of the technologies/ products developed by the Bureau was also organised. After the inaugural session, one-to-one interaction between the technology innovators and private entrepreneurs was held. Around 89 participants, including 20 private companies participated in the programme.



OBITUARY



Dr N S Rao

Dr Nellara Srinivasa Rao was born on 15th July 1945 to N. V. Ramanayya and Seetamma in the small town Ichchapuram located on the banks of river Bahuda in the Srikakulam district of Andhra Pradesh.

On graduating from Agricultural College, Bapatla (ANGRAU), he joined the College of Agriculture, Bhubaneswar (OUAT) to complete his masters in Agricultural Entomology in 1968. Immediately after this, he joined Regional Rice and Sugarcane Research Station, Rudrur, Nizamabad as Research Assistant. After passing the Agricultural Research Services examination, he joined the Central Horticultural Experiment Station of IIHR at Chettalli (1974) and later at the ICAR Research Complex for the North East Hilly Region, Shillong before moving to the Project Directorate of Biological Control (known as Biological Control Center then) in June 1991. He completed his Ph. D. as an in-service candidate at the University of Agricultural Sciences, Bengaluru in 1988. While at the university, he worked on the biology and behavior of crazy ant, *Anoplolepis longipes* (Jerdon) (Hymenoptera: Formicidae). His work is cited even today by several ecologists across the world. At PDBC, he single-handedly managed the All India Co-ordinated Research Project on Biological Control of Crop Pests and Weeds and Prioritizing,

Monitoring and Evaluation Cell and contributed immensely to all institute building activities. His role in the formation and advancement of PDBC as an independent institute was remarkable.

After serving for 33 years for the Indian Council of Agricultural Research, Dr Rao superannuated from his active service on 31 July 2007 and departed on 3 January 2022. He is survived by his wife Mrs Rajakamala and well-brought-up sons N. Sridhar and N. Ravindra.

PDBC family always fondly remembers Dr Rao for his accurate administrative information, quick decision-making, and effective workload governance, which made him an able project manager.

Sunil Joshi



Dr B. S. Bhumannavar

Dr B.S. Bhumannavar was born at Khalaghatgi, a small village in Dharwad district of Karnataka on 18 May 1951. After graduated in 1974 from the College of Agriculture, Dharwad, he went on to complete his M.Sc. (Ag.) degree in Agricultural Entomology from the same college in 1976 securing a gold medal. He obtained a doctorate from the College of Agriculture, University of Agricultural Sciences, Bengaluru, in 2000, again with a gold medal.

Dr Bhumannavar joined the Agricultural Research Service of ICAR in September 1977 and was first posted at the Central Horticultural Experiment Station (CHES), Chettalli. There he researched citrus entomology for 10 years, mainly screening citrus germplasm for the incidence of leaf-miner, psyllid, black citrus aphid, oriental red mite, green and purple scale. He worked out the biology of the citrus shoot borer, *Oberea lateapicalis*, for the first time. While at Chettalli, he also maintained more than 60 bee colonies, conducted pollination studies in coffee and niger, and measured the quantum of extra-floral nectar in *Schefflera*.

Subsequently, he opted to serve at the Central Agricultural Research Institute (CARI, Port Blair) in the Andaman and Nicobar Islands. He spent the four years of his stay studying the diversity of insects attacking different crops grown on these bay islands. After getting all the collected insects and natural enemies identified from the British Museum, He published a bulletin on 'Insects of Agricultural Importance in Bay Islands', which serves as a guide for new entomologists.

Dr Bhumannavar joined Project Directorate of Biological Control (PDBC; NBAII) during November 1991. His focus was on the mass multiplication of egg parasitoids, *Trichogramma* species, as well as the standardisation of mass multiplication of their laboratory host, *Coryra cephalonica*. Over time, as the chief of the insect systematics laboratory, he was responsible for the importation of exotic natural enemies such as *Diglyphus begini*, *Trichogramma mwanzai*, *T. brassicae*, parasitoids of papaya mealybug and the *Chromolaena* gall fly, *Cecidochares connexa*, from across the world.

He was in charge of Prioritising, Monitoring and Evaluation Cell of the institute from July 2007 till his taking over charge as Director (Acting) of NBAII on 10 August 2012. During his short stint as Director till April 2013, he was most popular and affectionate towards all his fellow staff at NBAIR. He retired from service on 31 May 2013. Dr Bhumannavar suddenly left for a heavenly abode on 17 March 2022.

We at NBAIR miss this humble, down-to-earth, friendly, always active and hardworking human being but his work will be remembered forever. May God bless the family to handle this sudden demise.

T.M. Shivalingaswamy



Dr K Srinivasamurthy

Dr Kotilingam Srinivasamurthy (b. 1962), Principal Scientist, landed up at NBAIR (then PDBC) in April 2001 after a six-year-long productive stint at NCIPM in New Delhi. His untimely passing away on 15 March brought an abrupt end to his creditable career with ICAR that had begun on 25 July 1994.

His time at Ambajipeta for doctoral research work on the coconut black-headed caterpillar, and his pre-Ph.D. tenure at ICRISAT in Hyderabad, were instrumental in moulding Dr Srinivasamurthy as an all-round entomologist. At NBAIR, he tried his hand at multiple areas, including artificial diets, insect cell culture, endosymbionts and DNA barcoding, with considerable success.

Colleagues and friends will remember Dr Srinivasamurthy for the air of benignity and geniality that always surrounded him.

Prakya Sreerama Kumar

Participation of ICAR-NBAIR in Pusa Krishi Mela 2021

ICAR-NBAIR participated in the 'Pusa Krishi Vigyan Mela' organised by ICAR-Indian Agricultural Research Institute, New Delhi during 9–11 March 2022 to showcase various technologies developed at the institute.



Promotions

Scientific category

Dr R. Gandhi Gracy: Senior Scientist
Dr K.J. David: Senior Scientist
Dr S.Salini: Senior Scientist
Dr Jagadeesh Patil: Senior Scientist
Dr M. Sampath Kumar: Senior Scientist
Dr K. Selvaraj: Senior Scientist
Dr U. Amala: Senior Scientist
Dr R.R. Rachana: Scientist
Dr R.S. Ramya: Scientist
Dr Navik Omprakash Samodhi: Scientist

Technical category

Mr H. Jayaram: Assistant Chief Technical Officer
Dr A. Raghavendra: Technical Officer

Transfer of Technologies

“Novel insecticidal WP formulations of *Heterorhabditis indica* for the biological control of white grubs & other soil insect pests” to M/s Zytex Biotech Pvt. Ltd, Mumbai.

Publications

Amala, U., Kandan, A. & Shivalingaswamy, T.M. 2022. Nesting and predatory behaviour of potter wasp, *Rhynchium brunneum brunneum* (Eumeninae: Vespidae: Hymenoptera) in an urban farm landscape. *Biocontrol Science and Technology*. <https://doi.org/10.1080/09583157.2022.2047612>.

Amala, U. & Shivalingaswamy, T.M. 2022. Leafcutter Bees (Hymenoptera: Megachilidae) as pollinators of pigeon pea (*Cajanus cajan* (L.) Millsp., Fabaceae): artificial trap nests as a strategy for their conservation. *Sociobiology*. <https://doi.org/10.13102/sociobiology.v69i1.7202>.

Gupta, A., Achterberg, C.V. & Fernández-Triana, J.L. 2022. Two new species of Braconidae (Hymenoptera) from the foothills of western Himalayas, India, with a key to Oriental species of *Pambolus* Haliday and an update to the key to world species of *Paroplitis* Mason. *Journal of Hymenoptera Research*, 90: 59–73.

David, K.J., Hancock, D.L., Gracy, R.G., Sachin, K. & Swathi, R.S. 2022. Taxonomic notes on fruit flies of tribes Schistopterini and Eutretini (Diptera: Tephritidae: Trphritinae) in India, with description of a new species of *Rhabdochaeta* de Meijere. *Journal of Asia Pacific Entomology*, <https://doi.org/10.1016/j.aspen.2021.1018586>.

Yandigeri, M., Mahendiran, G., Mohan, M. & Sampath Kumar, M. 2022. Evaluation of different substrates for multiplication and waste reduction potential of black soldier fly, *Hermetia illucens* (Stratiomyidae: Diptera). *Journal of Entomological Research*, 46(1): 40–46.

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