



Understanding insects at the molecular level

An expanding range of molecular techniques are now available, which can revolutionise certain fixed ideas and ideologies in life sciences. Molecular approaches can complement morphological taxonomic methods and can be used to manipulate biocontrol agents. NBAIR has made significant strides in the field of molecular entomology.

NBAIR has molecularly characterised 2,264 insects and their resources using multilocus genes and 317 barcodes for insects have been generated. DNA barcodes have been effectively used for identification of morphologically similar species and insects have been identified even from fragments. Single polymorphic nucleotide analysis of *CO1* for specific identification of *Heterorhabditis* species indicated 5–8 nucleotides unique to *H. indica*, *H. bacteriophora* and *H. megidis*. The whole genome sequencing of *Helicoverpa armigera* nucleopolyhedrosis virus (*HeanNPV*) was achieved. The assembled sequence of 136760-bp size and was submitted to GenBank (KT013224). Biodiversity of insects collected from Salt Lake of Great Rann of Kutch and Kaas Plateau in Satara district was quantified based on *COX1* gene. Over 50–60% of the species collected were identified up to the species level.

The Molecular Database on Indian Insects (MODII) developed for Indian insects contains information from the Insect Barcode Information System (IBIn), iGen Bank, Insect Whole Genome Sequence, Insecticide Resistance Gene and Whole Genome sequences. The website aids in matching sequences with online libraries. Allele mining with reference to genetic variation in *Helicoverpa armigera* populations revealed significant

gene flow between populations of *H. armigera*. Different *Bt* isolates harbouring *cry1Aa*, *cryAb*, *cry1Ac*, *cry2a*, *cry1I*, *vip3A* toxin genes were characterised to target lepidopteran pests. Metagenomics of dung beetles has been worked out to better understand the evolutionary relationship of gut microbes in insects. Transcriptome sequencing of diamondback moth, *Plutella xylostella* and *Leucinodes orbonalis* was done in order to identify the insecticide resistance genes and understand the mechanism of insecticide resistance. Molecular mechanisms behind multiple insecticide resistance and high temperature tolerance in the selected strains were understood by amplifying *Rdl*, *Ache*, *Kdr* and *VGSC*, and *HSP70* genes, respectively. These superior strains of natural enemies have been used against different pests all over the country in more than 3,000 ha on eight crops in 13 states providing benefits ranging from ₹ 5,000 to 20,000 per ha.



NBAIR researchers have contributed immensely to our knowledge of insect molecular biology with special reference to Indian insects and insect-derived resources. The current thrust is on developing whole genome sequences for some of the most important insect pests and natural enemies. NBAIR molecular entomologists seek active collaboration with Indian and international researchers working on insect taxonomy, insect ecology, insect biochemistry and insect physiology so that there would be a greater impact of Indian entomology globally.

Chandish R. Ballal
Director

Research Highlights

New species of *Crinibracon*

A new species, *Crinibracon chromusae* Gupta & van Achterberg (Fig. 1), parasitic on pupae of *Hasora chromus*, a skipper occurring on Indian beech (*Millettia pinnata*), has been described from India. Across the globe, for the first time, biological information for the genus *Crinibracon*, has been provided. Three species of hyperparasitoids, *Philolema braconidis*, *Nesolynx javanica* and an *Eupelmus* sp., emerged along with *C. chromusae* from pupae of *H. chromus*.

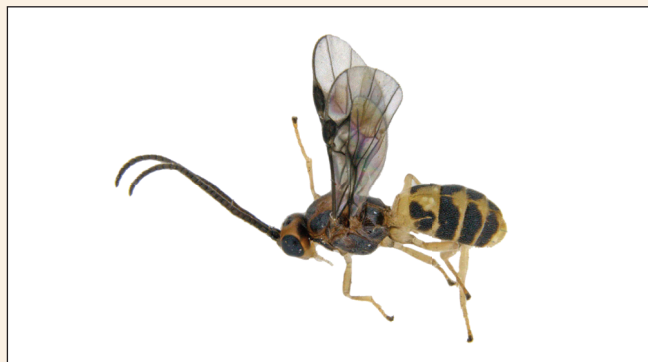


Fig. 1: *Crinibracon chromusae*

Pest alert!

Rugose spiralling whitefly, *Aleurodicus rugioperculatus*, has invaded India

Rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*, has recently been found infesting coconut, banana, custard apple and several ornamental plants across Tamil Nadu, Andhra Pradesh and Kerala in India. It has already reached an alarming level on coconut, causing extensive damage in prime regions like Pollachi in Tamil Nadu. Leaves are damaged by direct feeding, especially on the underside of the leaflets, and production of prodigious quantities of honeydew results in sooty mould development on the upper surface of leaves. Nymphs and adults suck the sap from the leaves and show typical concentric waxy spiralling symptoms on various parts of host plants. Immature stages of RSW produce profuse quantity of wax filaments. Across the survey locations, the severity of infestation ranged from 40–60% on coconut and 25–40% on banana. The population, including all the immature stages, varied from 18–43 nymphs/sq.cm. of leaf and was very high at the midrib region. Like the other spiralling whitefly (*Aleurodicus dispersus*), RSW females lay eggs on the underside of leaves in a circular or concentric waxy spiralling pattern and cover them with wax. Adults can be distinguished by their large size and the presence of a pair of irregular light brown bands across the wings. During the surveys, several natural enemies were recorded and maximum parasitism (20–60%) was recorded to be by *Encarsia guadeloupe*.



Egg spirals and nymphs of RSW



RSW adults



Encarsia guadeloupe

NBAIR scientists at ICE 2016

Dr Chandish R. Ballal (Director), Dr T.M. Shivalingaswamy (Principal Scientist) and Dr Y. Lalitha (ACTO) attended the “XXV International Congress of Entomology (ICE 2016)” organised by the Entomological Society of America in Orlando, USA, from 25–30 September 2016. Dr Ballal received the International Travel Grant from the Department of Science & Technology, New Delhi, while Dr Lalitha received financial support from the organisers.



NBAIR at the Northern Regional Agriculture Fair

NBAIR put up a stall at the exhibition arranged during the “Northern Regional Agriculture Fair: Krishi Kumbh 2016” in Muzaffarnagar, Uttar Pradesh, from 28–30 November 2016. Scores of farmers, students and extension workers visited the stall and were delighted to get information on biological pest control. Dr Sanjeev Kumar Balyan (Union Minister of State for Water Resources) (*in picture*), Prof. Gaya Prasad (Vice-Chancellor, Sardar Vallabhbhai Patel University of Agriculture and Technology), Mr Chaudhary Naresh Tikait (President, Bharatiya Kisan Union) and Mr Kapil Dev Aggarwal (Member of Legislative Council, Muzaffarnagar) were among the several dignitaries who visited the NBAIR stall.



Awareness campaign on biocontrol of Bihar hairy caterpillar

A severe incidence of Bihar hairy caterpillar, *Spilosoma* sp., was observed on potato at Yeluvahalli village in Chikkaballapura district of Karnataka. NBAIR scientists held an awareness campaign among farmers in that area on the biological control of the pest. The farmers were trained on crude extract preparation and spraying of nuclear polyhedrovirus to effectively control the pest.

Events and celebrations at NBAIR

“Swachhta Campaign”

On the occasion of Mahatma Gandhi Jayanti (2 October 2016), “Swachhta (Cleanliness) Campaign” was initiated at both Hebbal and Yelahanka campuses of NBAIR and a cleanliness drive was organised. In addition to campus cleaning, the areas outside NBAIR premises were also spruced up. All the NBAIR staff members actively and enthusiastically participated in the cleaning drive.



“Rashtriya Ekta Diwas” observed at NBAIR

NBAIR observed “Rashtriya Ekta Diwas” or National Unity Day on 31 October 2016, the birth anniversary of Sardar Vallabhbhai Patel. A pledge was administered to all the staff members of both Hebbal and Yelahanka campuses of NBAIR.

“Vigilance Awareness Week”

“Vigilance Awareness Week” (31 October–5 November 2016) was observed at NBAIR by taking the pledge. Director Dr Chandish R. Ballal highlighted the importance of the week to the staff members.



“Kannada Rajyotsava”

“Kannada Rajyotsava” (Karnataka Formation Day) was celebrated at NBAIR on 20 December 2016. Director Dr Chandish R. Ballal hoisted the Karnataka flag. Recipient of *Rajyotsava Award*, Dr G.K. Veeresh (Former Vice-Chancellor, University of Agricultural Sciences, Bengaluru), Dr Asha Devi (Associate Professor, Maharani College, Bengaluru) and Mr Ramesh Bhat (TV and cine artiste) graced the occasion and addressed the audience. Special invitee, Ms Nikhila Ballal, entertained the audience by rendering various Kannada songs. Prizes were distributed to the winners of various competitions that were held for staff members.



Capacity Building Programme on Microbials

A Capacity Building Programme on “Advances and Innovations in Promotion and Utilisation of Microbials for Biological Control of Crop Pests” was organised at NBAIR from 14–24 December 2016 by Dr M. Nagesh (Course Director). Fourteen participants representing Gujarat, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Tamil Nadu and Uttar Pradesh were trained on scale-up techniques,



practical demonstrations, quality control, assessment, IPR, registration and biosecurity issues related to microbial biocontrol agents. Visits were arranged to commercial biocontrol production units who have been issued licenses to utilise NBAIR technologies and make high-quality products available to farmers. Dr S.K. Jalali, Dr Jagadeesh Patil and Dr Mahesh S. Yandigeri coordinated the programme.

Recognitions

Dr Richa Varshney, Scientist, NBAIR, bagged the *Best Poster Award* for the scientific poster entitled “Evaluation of *Nesidiocoris tenuis* (Reuter) (Hemiptera: Miridae) preying on invasive insect pest, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in tomato” at the First International Agrobiodiversity Congress, 6–9 November 2016, New Delhi.

Ms R.R. Rachana, Scientist, NBAIR, secured the *Best Poster Award* for the scientific poster entitled “Invasive western flower thrips, *Frankliniella occidentalis* (Pergande) (Thripidae: Thysanoptera): a potential pest and tospovirus vector” at the First International Agrobiodiversity Congress, 6–9 November 2016, New Delhi.

Dr A. Raghavendra, Senior Technical Assistant, NBAIR, won the *Best Oral Presentation Award* at the International Conference on Green Technology for Health and Environment: Implementation and Policies, 15–16 December 2016, Bengaluru.

Selected Publications

- Aggarwal, N., Sharma, S. & Jalali, S.K. 2016. On-farm impact of biocontrol technology against rice stem borer, *Scirpophaga excerptalis* (Walker) and rice leaf folder *Cnaphalocrocis medinalis* (Guenee) in aromatic rice. *Entomologia Generalis*, 26(2): 137–148.
- Gupta, A. & Achterberg, C.V. 2016. A new species of *Crinibracon* Quicke (Hymenoptera: Braconidae) parasitic on pupae of *Hasora chromus* (Cramer) (Lepidoptera: Hesperidae) from India. *Zootaxa*, 4158(2): 281–291.
- Jayaram, C.S., Sreerama Kumar, P. & Gupta, S.K. 2016. First report of six predatory mites (Acari: Phytoseiidae) from the central Indian state of Chhattisgarh. *Entomon*, 41: 293–296
- Ojha, R., Jalali, S.K., Shivalingaswamy, T.M., Venkatesan, T., Poorani, J. & Galande, S.M. 2016. Identification of insect community inhabiting Kaas plateau, Western ghats through cytochrome oxidase subunit I gene. *Journal of Applied and Natural Science*, 8(4): 2170–2174.

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