

agricultural importance, techniques to construct keys, use of e-resources in insect identification, molecular characterisation and DNA barcoding, apart from methods of collection, curation and preservation of arthropods. Twenty-three participants from across the country attended the course.

Training programme on computational biology

A training programme entitled “Application of Computational Biology for Studying Abiotic Stresses in Insects” under the NAIP-NABG project was conducted by NBAIL during 5–17 March 2012. The focus of the programme was on some major areas of bioinformatics, including computational biology, biological databases, genomics, proteomics, gene expression, DNA barcoding, NGS, insecticide resistance management and RNA secondary structure prediction. Several of the topics were covered by experts from Mysore University, Pondicherry University, University of Agricultural Sciences (Bangalore), MVIT, National Centre for Biological Sciences and Genotypic Technology. Pre- and post-evaluation tests for the trainees indicated a 60% improvement in their knowledge on the subject. Ten participants from across India participated in the programme, which was overseen by Dr S.K. Jalali (Fig. 8).



Fig. 8: Participants of the training programme on computational biology

Insect Barcode Informática (IBIn) developed by NBAIL

Insect Barcode Informática (IBIn) (Fig. 9) is an online database resource developed on insect domain by NBAIL. IBIn furnishes support on acquisition, storage, analysis and publication of DNA barcode records of agriculturally important insects to researchers in India. A wealth of information on the diversity of insect species in India and the world, the number of insects barcoded thus far and the related statistics. Besides, researchers also have access to submit new barcodes, perform BLAST, create barcode image and so on. Barcodes can be submitted at <http://202.141.78.173/barcode/>.



Fig. 9: Screenshot of the home page of Insect Barcode Informática

Selected Publications

- Ankita Gupta & Pereira, B. 2012. One new species of *Glyptapanteles* (Hymenoptera: Braconidae: Microgasterinae) as a larval parasitoid of *Elymnias hypermnestra* (Linnaeus) (Lepidoptera: Nymphalidae) along with some new host records of parasitoids from Peninsular India. *Zootaxa*, 3227:54–63.
- Prashanth Mohanraj & Veenakumari, K. 2011. Butterflies of the Andaman and Nicobar Islands: History of collection and checklist. *Zootaxa*, 3050:1–36.
- Sreerama Kumar, P. & Leena Singh. 2012. A simple method of storing nonsynnematos and synnematos isolates of *Hirsutella thompsonii* while conserving their pleomorphism, pathogenicity and genetic purity. *Folia Microbiologica*, 57(1):15–19.
- Srinivasa Murthy, K., Rajeshwari, R., Jalali, S.K. & Venkatesan, T. 2011. Host searching efficiency of *Cotesia flavipes* Cameron (Hymenoptera: Braconidae) an important parasitoid of the maize stem borer *Chilo partellus* Swinhoe. *Indian Journal of Fundamental and Applied Life Sciences*, 1(3):71–74.
- Srinivasa Murthy, K., Rajeshwari, R., Venkatesan, T. & Nesil Liz Baby. 2011. Detection and characterization of *Wolbachia* in *Cotesia plutellae* Kurdjumov (Braconidae:Hymenoptera), a parasitoid of the diamondback moth *Plutella xylostella* (Linn.). *Journal of Biological Control*, 25(3):213–216.
- Veenakumari, K. Prashanth Mohanraj & Peigler, R. 2011. First description of a female of *Antheraea meisteri* Brechlin and notes on some pre-imagines of three recently described species of Saturniidae (Lepidoptera) from the tropical moist forests of the Andaman Islands. *Journal of the Lepidopterists' Society*, 65(2):94–100.



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We are growing!



It has been an eventful first quarter of the New Year. We started off with the Institute Research Council Meeting that lasted four days — three in January (10th, 11th and 13th) and one (7th) in February — to complete due to the extensive reworking of our research priorities keeping in view the changed mandate, national priorities and recommendations of the National Meeting on Agricultural Entomology held last year.

It was decided to bring in previously unaddressed areas of entomological research into our focus. New projects will now address issues such as virus-vector relationships, insect transmission of phytoplasmas, leafhopper resistance and pollinators, besides the already established thrust areas like insect systematics, parasitoids, predators, biotechnology and insect behavioural studies.

We are planning to organise a series of brainstorming sessions throughout the year. The identified topics include fruit flies; coccids and mealybugs; insect diversity; pheromones; invasive pests and biosecurity; and vector dynamics in phytoplasma transmission. Of course, the meeting on entomopathogenic nematodes is round the corner.

On 21 March, representatives from the Dutch firm, Koppert Biological Systems, an international leader in the fields of biological crop protection and natural pollination, visited NBAIL to seek prospective collaboration in biocontrol

research. Mr Henri Oosthoek, Director, Koppert, delivered a talk on their products and services, and interacted with our scientists on the opportunities for collaborative research and development on biological control.

I am happy to share that Prof. G.K. Veeresh, former Vice-Chancellor of the University of Agricultural Sciences (Bangalore) is nominated as the Chairman of the Quinquennial Review Committee to review the research work of the All-India Coordinated Research Project (AICRP) on Biological Control of Crop Pests and Weeds. I am sure Prof. Veeresh, a distinguished entomologist and advocate of organic farming, will guide the AICRP as well as NBAIL in taking biological control and entomological research to greater heights.

Our Science Club has lined up a number of entomologists, pathologists, biotechnologists, etc. of distinction for delivering talks on their chosen subject.

NBAIL plans to celebrate the successful biological control of the papaya mealybug and eucalyptus gall wasp. Besides, it is also intended to establish a National Agricultural Biosecurity Network (NABM) at our Bureau.

As committed in the Vision 2030 document, we will have three Divisions from April onwards: Insect Systematics, Molecular Entomology and Insect Ecology. Once the new laboratory building at our Attur campus is ready, more scientists will function from there.

In all, NBAIL is vibrant with an atmosphere of research in the air. Let us keep up the spirit!

N.K. Krishna Kumar
Director



Koppert representatives at NBAIL



New laboratory building coming up at Attur

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New Research

New hymenopteran described

A new hymenopteran species, *Glyptapanteles hypermnestrae* Gupta and Pereira (Hymenoptera: Braconidae) (Fig. 1), has been described from Maharashtra. The new species of parasitoid was bred from parasitised larvae of the common palmfly, *Elymnias hypermnestra* (Lepidoptera: Nymphalidae), on coconut (Fig. 2).



Fig. 1: Female wasp of *Glyptapanteles hypermnestrae*



Fig. 2: Parasitised larva of *Elymnias hypermnestra*

New host recorded

Apanteles folia (Hymenoptera: Braconidae) has been found parasitising the larvae of *Arhopala amantes* (Lepidoptera: Lycaenidae) for the first time in southern India.

New species of Platygasteridae

Two new species of Platygasteridae, *Odontacholus markadicus* Veenakumari and *Odontoscelio vikata* Veenakumari and Rajmohana, have been described from southern India, both of which are the first representatives of the genera from India.

First reports for southern India

Three genera, viz. *Eumicrosoma*, which was hitherto reported only from Delhi and Haryana; *Dyscritobaeus* and *Palpoteleia*, both of which were earlier recorded only from Uttarakhand; and *Encyrtoscelio*, which was till now reported only from Delhi, have been found for the first time in southern India.

Endosymbionts of Trichogramma species

Endosymbionts are beneficial organisms living within the body of another organism, which may be an insect. In a parasitoid, they may enhance the host's biological fitness and ability to tolerate abiotic stress. Recently, NBAll scientists isolated several endosymbionts, including *Metschnikowia reukauffii*, *Pichia ohmeri*, *Wickerhamomyces anomalus*, *Candida apicola* and *Zygosaccharomyces rouxii*, from *Trichogramma* spp. These were fed to the laboratory population of *T. japonicum* and *T. chilonis* for 15 generations.

Studies indicated that these microbes have a definite role in enhancing the biological fitness of laboratory-reared *T. japonicum*. Nucleotide sequences of symbionts were aligned with the CLUSTAL W algorithm, and phylogenetic and molecular evolutionary analyses were performed using the software MEGA 4.0. The tree was constructed by the neighbour-joining method using the distance matrix from the alignment. The results confirmed by clustering *Pichia anomala* as one group, *Candida* as another and other related ones joining with each other.

Endosymbionts of chrysopid predators

Endosymbiotic bacteria (Fig. 3) and yeasts (Fig. 4) were isolated from the alimentary canal, fat bodies and diverticulum of *Chrysoperla zastrowi sillemi* adults that originated from several cotton-growing states across India. Two endosymbiotic bacterial genera, viz. *Paenibacillus* and *Enterobacter* were found associated with the larvae of *C. z. sillemi*. The yeast species, *Wickerhamomyces anomalus*, *Pichia anomala*, *Candida blankii*, *Zygosaccharomyces rouxii*, *Kodamea ohmeri* and *Candida pimensis*, were identified through molecular characterisation. Adults of the other predator, *Mallada desjardensi*, harboured *W. anomalus*, *T. delbrueckii*, *Kodamaea ohmeri* and/or *Saccharomycetales* sp. in different organelles. ITS1 and 16S rRNA regions of the isolated microbes were sequenced and the sequences were submitted to GenBank.

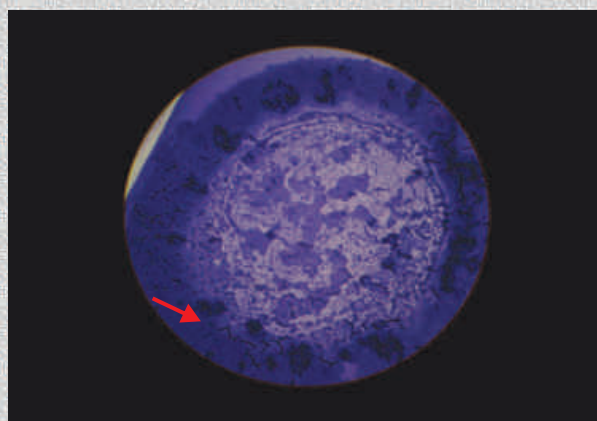


Fig. 3: Presence of bacteria in the gut of *Chrysoperla zastrowi sillemi* adult

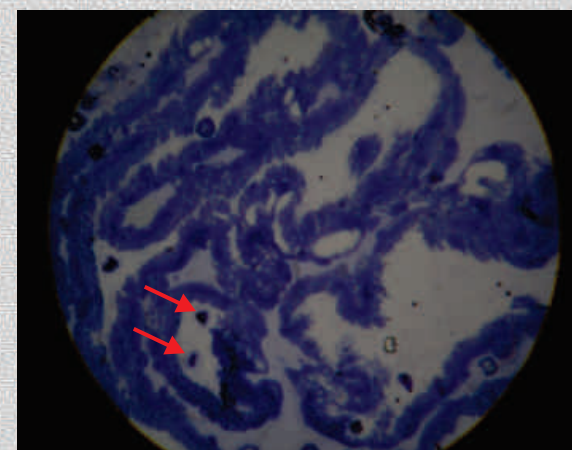


Fig. 4: Presence of yeasts in the diverticulum fold of *Chrysoperla zastrowi sillemi* adult

Entomopathogenic nematodes from hot areas

Entomopathogenic nematodes (EPN) are known to be adapted to most climatic conditions. Soil samples from high-temperature areas of Kadapa and Chittoor districts of Andhra Pradesh were found to harbour EPN, especially *Heterorhabditis* spp., when baited through the greater wax moth, *Galleria mellonella*. The last instar larva of the insect was killed within 36 h of exposure to 25 infective juveniles of the EPN. Each dead larva yielded over 1,20,000 infective juveniles of the nematode after 8 days of incubation (Fig. 5).



Fig. 5: Infective juveniles of *Heterorhabditis* exiting from *Galleria mellonella* cadaver

Bacillus megaterium works against bacterial wilt of tomato and brinjal

Combined application of talc-based formulation of *Bacillus megaterium* NBAll 63 as seed treatment (4g/kg of seed), soil application (2.5 kg/ha), seedling root dip (10g/L of water) and foliar spray (10g/L of water) resulted in 56% and 62% reduction in *Ralstonia solanacearum*-incited wilt in tomato and brinjal, respectively. Besides, application of *B. megaterium* improved the seedling establishment and growth of both tomato and brinjal plants.

Other Activities

NBAll commercialises Bt formulation technology

A low-cost liquid formulation technology for *Bacillus thuringiensis* var. *kurstaki* (PDBC-BT1), with one-year shelf-life, was sold to Kottayam-based M/s Agro Bio-Tech Research Centre Ltd, a commercial producer of various biocontrol agents. The company came forward to purchase the technology from NBAll after it was showcased to prospective entrepreneurs through the Zonal Technology Management Unit at Kochi. The deal fetched a revenue of Rs 2,20,600 to NBAll with the signing of an MoU on 25 February 2012 (Figs 6 & 7).



Fig. 6: Director, NBAll, handing over a sample of Bt liquid formulation to the Managing Director of M/s Agro Bio-Tech Research Centre Ltd



Fig. 7: Director, NBAll, receiving the cheque from the Managing Director of M/s Agro Bio-Tech Research Centre Ltd

Short course conducted

A 10-day short course entitled "Introduction to Biosystematics of Insects, Mites, Spiders and their Biodiversity" was organised by Dr K. Veenakumari, Principal Scientist, during 14-23 November 2011 as part of the capacity-building initiative of NBAll. The curriculum consisted of taxonomy of various groups of insects of