NBAIR Newsletter

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ICAR-National Bureau of Agricultural Insect Resources

Waiting for the invited guest...

The worst fears of entomologists in India came true when an uninvited guest, the cassava mealybug, *Phenacoccus manihoti*, was first noticed in Kerala during February/March 2020. The scientific team consisting of Drs Sunil Joshi, M. Mohan and M. Sampathkumar, and scientists from AICRP Centres on Biological Control from KAU & TNAU, undeterred by the pandemic, made extensive surveys in Kerala and Tamil Nadu. The prevalence of *P. manihoti* in Tamil Nadu was surprisingly very severe with damage recorded on 50–70% of plants in Salem and Namakkal districts of Tamil Nadu. The question of how this pest entered India is still lingering in our minds; however, we assume that it is probably through the cassava seedlings imported from abroad, as several private nurseries are involved in the importation and supply of the exotic seedlings to farmers.

The surveys conducted at the infested sites in the districts of Tamil Nadu did not result in discovery of any tangible natural enemies. In several areas, these mealybugs are found to be cohabiting with the papaya mealybug, *Paracoccus marginatus*. Though parasitisation by *Acerophagus papayae* was observed on *P. marginatus*, no natural parasitisation was observed on *P. manihoti*.

A surprising report came from some quarters of Tamil Nadu, claiming that natural parasitisation was observed on *P. manihoti*. However, the specimens were identified as *Homalotylus* sp., a parasitoid of the larvae/pupae of coccinellid predators which were found feeding on *P. manihoti*. The population of predators, nevertheless, was very low to bring out any effect on the population of *P. manihoti*. I express a word of caution to the farmers to check the claims of any parasitoids for *P. manihoti* as species such as *Homalotylus* may be causing adverse effect in the natural control of *P. manihoti* as they destroy one of the important predators.

Tension has been mounting among the farming community in Tamil Nadu with several letters being written to our bureau with a request to devise an effective biological control strategy for managing *P. manihoti*. Invasion of this mealybug was even discussed in the Parliament.

Across the world, search for an effective strategy for managing *P. manihoti* yielded with the discovery of *Anagyrus lopezi*, a parasitoid. Introduction of this parasitoid has resulted in the effective management of *P. manihoti* in countries like Thailand, where an estimate recorded a saving of $ 700/ha by the cassava farmers through the use of *A. lopezi*.

I am thankful to the Indian Council of Agricultural Research for readily according necessary approvals to NBAIR to import this parasitoid from the Republic of Benin. Efforts were also made to import the parasitoid concurrently from Thailand. Despite the COVID-19 pandemic, both the countries have agreed to ship this parasitoid at the earliest possible time. The import permit has already been received.

Now the countries which are likely to ship are in the process of improving the quality of their cultures. Once the shipments are received, it will take only a few months for the quarantine screening and subsequent release of *A. lopezi* in the affected cassava fields. We hope the "*invited guest*" will do a better job in relieving the agony of cassava farmers caused by the "*uninvited guest*".

N. Bakthavatsalam
Director (Acting)

Cassava mealybug,
Phenacoccus manihoti
(Courtesy: Dr M. Mohan)

Anagyrus lopezi
(Courtesy: Dr Georg Goergen)

Research Highlights

Cassava mealybug, *Phenacoccus manihoti*, has invaded India

The notoriously destructive cassava mealybug, *Phenacoccus manihoti*, has recently been found infesting cassava in Kerala and Tamil Nadu. It has already reached an alarming level on cassava, causing extensive damage in areas like Kayamkulam and Thrissur in Kerala as well as Namakkal and Salem in Tamil Nadu. Eggs, nymphs and adults of the mealybug were found on aerial plant parts, including the underside of leaves and adventitious buds at the internodes (Fig. 1). Feeding causes curling of the leaves as well as growing tips resulting in bunchy top symptoms, causing the leaves to dry and fall off. The mealybug is also found to be multiplicating on other alternate hosts like *Alternanthera sessilis*, *Synedrella nodiflora* and *Blumea lacera*. Several natural enemies, viz. *Spalgis epeus*, *Scymnus coccivora*, *Hyperaspis maindroni* and an unidentified anthocorid bug, were recorded during the surveys.

Fig. 1: Life stages of *Phenacoccus manihoti*

DNA barcode of cassava mealybug

Different populations of the cassava mealybug were collected on cassava in Namakkal and Salem districts of Tamil Nadu, and were subjected to molecular characterisation through amplification of *cytochrome oxidase-1* gene (*CO-1*) (Fig. 2). The mealybug sequences thus developed were compared with the already available sequences in the database of National Center for Biotechnology Information (NCBI). The sequences matched 100% with *P. manihoti* having the GenBank accession numbers KY611349, KY611348, KY611347 and KY611346 from China. The developed sequences were confirmed as *P. manihoti* and GenBank accession number MT895817 was obtained for the first time in India.

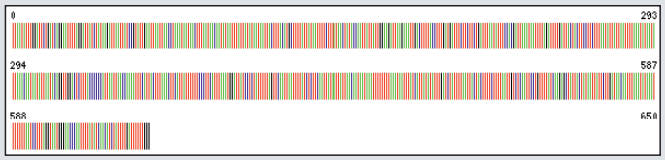


Fig. 2: DNA barcode of *Phenacoccus manihoti*

Monograph on Vespidae

A monograph on an annotated distributional Indian checklist of Vespidae (Hymenoptera: Vespoidea) providing species list, valid scientific names, synonyms and geographical distribution has been published. It includes 288 species belonging to 60 genera and 5 subfamilies. The largest subfamily, Eumeninae, has 193 species in 48 genera. The other subfamilies covered are Polistinae with 62 species in 4 genera, Vespinae with 26 species in 4 genera, Stenogastrinae with 6 species in 3 genera and Masarinae with a single genus and species.

Encarsia guadeloupae: a potential parasitoid of rugose spiralling whitefly

Encarsia guadeloupae, an aphelinid wasp (Fig. 3), is a potential parasitoid of rugose spiralling whitefly (RSW). During exploratory surveys, two aphelinid parasitoids, *Encarsia guadeloupae* and *E. dispersa*, were found naturally suppressing the pest. *E. guadeloupae* caused natural parasitism of 56–82% (Fig. 4), whereas, it was 5–10% for *E. dispersa*. Farmers were advised to redistribute the parasitoids for augmentation by placing the field-collected parasitised nymphs on or adjacent to the infested vegetation, and to maintain a pesticide-free environment for their conservation. Parasitoids were observed to have multiplied rapidly and natural parasitism increased phenomenally in pesticide-free areas and thus helped in preventing severe outbreaks. Since banana and *Canna indica* were found to harbour a significant amount of parasitoid population,

Fig. 3: *Encarsia guadeloupae*

Fig. 4: Parasitised puparia of rugose spiralling whitefly

farmers were advised to grow them as banker plants in coconut garden for the conservation and augmentation of parasitoids. The biocontrol strategy developed by NBAIR using these parasitoids for the efficient management of RSW resulted in saving approximately ₹ 9,500/ha and in reducing the pesticide usage by 900 ml/ha.

Parasitoids of oil palm leaf webworm, *Acria meyricki*

Three parasitoids, *Dolichogenidea* (*Apanteles*) *hyposidrae* (Fig. 5), *Elasmus brevicornis* (Fig. 6) and *Brachymeria albotibialis* (Fig. 7) were documented to be parasitising oil palm leaf webworm, *Acria meyricki*, an emerging defoliator of oil palm.

Fig. 5: *Dolichogenidea hyposidrae*

Fig. 6: *Elasmus brevicornis*

Fig. 7: *Brachymeria albotibialis*

Report on the invasive woolly whitefly, *Aleurothrixus floccosus*

Aleurothrixus floccosus, also known as the citrus whitefly, is of Neotropical origin and is prevalent throughout the warmer citrus-growing areas of the world. It is known to infest hosts belonging to more than 20 families, but exhibits a strong preference for citrus species. Invasion of this highly polyphagous woolly whitefly was recorded on guava in Kozhikode, Kerala (Fig. 8). Recently, it has expanded its geographical distribution to Bengaluru, Mandya, Mysuru and Ramanagara in Karnataka, and Coimbatore in Tamil Nadu. Besides mainland, its spread was also recorded on Amini, Kavaratti and Keltan islands of Lakshadweep, which is assumed to have happened through the transportation of infested seedlings. It is presently found to be coexisting with other invasive whiteflies, like *Aleurodicus dispersus*, *Aleurodicus rugioperculatus*, *Paraleyrodes bondari* and *Paraleyrodes minei* in guava ecosystem, and may replace these species by interspecific competition in due course of time. Females of this pest lay white-stalked eggs on newly emerged leaves in a circular pattern. The first instar nymphs are light green and the later instars turn brown with wool-like wax cover. Adults are yellowish-white having their wings covered with white waxy powder, and they prefer to feed on the underside of the young leaves (Fig. 9). Even though natural parasitism was not observed, several predators like *Acletoxenus* sp., *Scymnus* sp. and *Pseudomallada astur* were recorded during the surveys. The polyphagous nature of this notorious pest warrants immediate stringent quarantine mechanisms to prevent its further spread to the rest of India.

Fig. 8: Infestation of *Aleurothrixus floccosus* on guava

Fig. 9: Life stages of *Aleurothrixus floccosus*

Isaria fumosorosea for rugose spiralling whitefly management

Isaria fumosorosea (ICAR–NBAIR Pfu-5), an entomopathogen, exhibited excellent pathogenicity against all the developmental stages of the rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*. Sporulation of the pathogen on eggs and nymphs was observed after 48 hours of treatment (Fig. 10). Though not treated directly on adults, mortality/mycosis and deformation was observed on the adults that emerged from treated nymphs (Fig. 11). The Pfu-5 strain recorded 35.2–99.6% mortality on various developmental stages of RSW @ 1×10^8 spores/ml after 5 days of treatment. Large-scale field validation trials were laid out in Andhra Pradesh, Karnataka, Kerala and Tamil Nadu with foliar application of *I. fumosorosea* (two sprays @ 5 g/litre at 15 days intervals) for managing RSW. Foliar application was successful in reducing RSW population to the extent of 72% by causing significant mortality of eggs and nymphs. The results suggest that this is a potential biopesticide against RSW with a slight negative effect on the parasitoid *Encarsia guadeloupae*. These two compatible biocontrol agents can be combined together in biointensive

pest management programme of RSW in the coconut ecosystem.

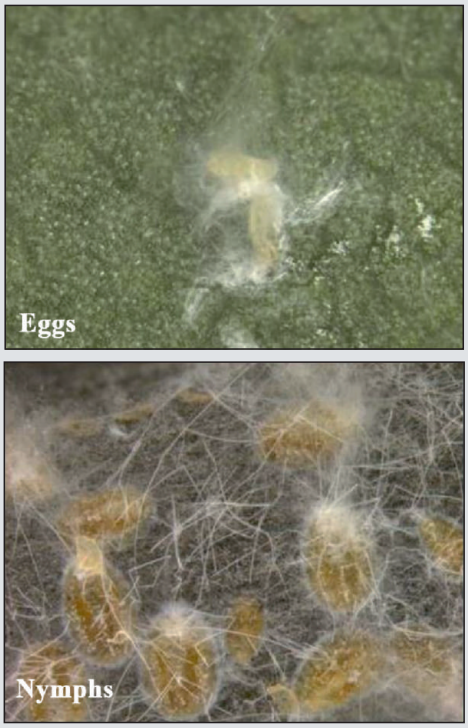


Fig. 10: *Isaria fumosorosea* infection in eggs and nymphs of *Aleurodicus rugioperculatus*

Fig. 11: An adult infected by *Isaria fumosorosea*

Invasion of palm-infesting Neotropical whitefly, *Aleurotrachelus atratus*, in India

Aleurotrachelus atratus is a polyphagous species of Neotropical origin occurring in Africa, Brazil, the Caribbean, Europe and the Americas, and is known to infest 110 plant species belonging to different families. Infestation of this highly invasive whitefly is reported for the first time from India as well as from the Oriental region. The pest was noticed on the coconut palm (Fig. 12) and ornamental areca palm, *Dypsea lutescens*, in Mandya and Mysuru districts of Karnataka. It was also observed to have infested arecanut and oil palm. From Mandya, it has further extended its distribution to Bengaluru, Mysuru and Ramanagara in Karnataka. The whitefly colonises the underside of leaflets in groups, and produces white waxy mass from second instar nymph onwards. Nymphs and adults (Fig. 13) suck the sap from leaves and thus result in necrosis, loss of vigour, drying and drooping of leaflets. Production of prodigious quantities of honeydew is found to be resulting in the development of sooty mould. Females lay creamy-white, stalked eggs in semicircular pattern. First instar nymphs are black with four pairs of wax plumes excreted by glands at the base of dorsal setae. Puparia are elliptical, black with a long marginal white wax fringe and dorsal wax filaments. Adults are creamy-white with yellow body and without wavy marking on the wings. This whitefly is found to be coexisting with other invasive whiteflies like *Aleurodicus dispersus*, *A. rugioperculatus, Paraleyrodes bondari* and *Paraleyrodes minei* in the coconut ecosystem. Surveys recorded a parasitoid, *Encarsia* sp., and four predators, viz. *Pseudomallada astur*, *Cybocephalus* spp., *Chilocorus nigrita* and *Jauravia pallidula*, associated with this whitefly.

Fig. 12: Damage symptoms caused by *Aleurotrachelus atratus* on coconut leaf

Fig. 13: Life stages of *Aleurotrachelus atratus*

Slow-release nanogel formulations of methoxy benzene for the management of white grub, *Holotrichia consanguinea*

Methoxy benzene has been identified as an aggregation pheromone of *Holotrichia consanguinea*. Suitable dispensers are currently not available for this highly volatile pheromone, necessitating frequent replacement of dispensers at night, which is practically not feasible for the farmers. To overcome this drawback, the AINP on Soil Arthropod Pests, Rajasthan Agricultural Research Institute (RARI), Durgapura, in collaboration with NBAIR, has developed a slow-release nanogel formulation of methoxy benzene (Fig. 14), and the technology has been tested in white grub-endemic areas of Rajasthan. This slow-release nanogel formulation is found to be effective in aggregation of beetles up to one month, and is available at NBAIR and RARI for ₹ 10/sample. The trap recorded up to 17.5 adult white grubs a day.

Fig. 14: Field testing of slow-release pheromone formulations: A, Trap with the nanogel formulation; B, Trap catch; C, Slow-release pheromone formulations

Opportunistic nesting behaviour of leafcutting bees

Leafcutting bee, *Megachile laticeps*, constructs its nests in pre-existing cavities of hollow stems, underground cavities, soft wood, etc. An adult bee was seen hovering around an asparagus fern/foxtail fern, *Asparagus densiflorus*, planted in an earthen pot on NBAIR's Yelahanka campus. A week later, the pot's drain-hole was found capped with flower petals of *Cassia javanica* (Fig. 15), and was suspected to be the nest of the leafcutting bee. Careful depotting revealed the nest constructed by the bee inside the pot. The nest, which was made out of leaf bits (Fig. 16), had eleven cells (Fig. 17) and was oriented downwards till it reached the pot's drain-hole. This showed the opportunistic nesting behaviour of *M. laticeps*.

Fig. 15: Flower petal used as nest closure at the drainage hole of the pot

Fig. 16: Nest built by *Megachile laticeps* inside the pot

Fig. 17: Larva feeding on pollen in an individual cell

First record of *Trichromothrips antidesmae*

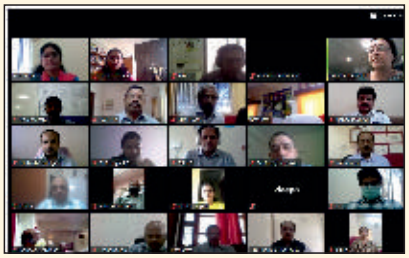
Trichromothrips antidesmae (Fig. 18), a member of the family Thripidae, was recorded for the first time in India on the leaves of *Citrus limon* in Chitradurga, Karnataka. It was described from China, and is known only from there. It is an unusual species in the genus *Trichromothrips* having two microtrichial rows on the dorsal surface of antennal segment II.

Fig. 18: *Trichromothrips antidesmae*

NBAIR scientists conduct surveys to assess the incidence of invasive cassava mealybug

NBAIR scientists, Drs M. Mohan and M. Sampath Kumar, undertook several visits to record the incidence of the invasive cassava mealybug in the predominant cassava-growing areas of Salem and Namakkal districts in Tamil Nadu. The cassava cultivars 'Mulluvadi', 'Thailand White', 'Sree Athulya' and 'Sree Vijaya' cultivated at Edappadi and Pethanaickenpalayam blocks of Salem district; and Rasipuram, Senthamangalam and Namagiripettai blocks of Namakkal district were found to be severely infested with the pest. Infested plants showed symptoms such as drying of leaves, distortion of stem, clumping of leaves, shortening of internodes and bunchy tops. The infestation was in the range of 7–86.7%. The bureau has taken initiatives to import the parasitoid wasp *Anagyrus lopezi* from Thailand and the Republic of Benin to contain this mealybug menace in cassava.

Research Advisory Committee Meeting



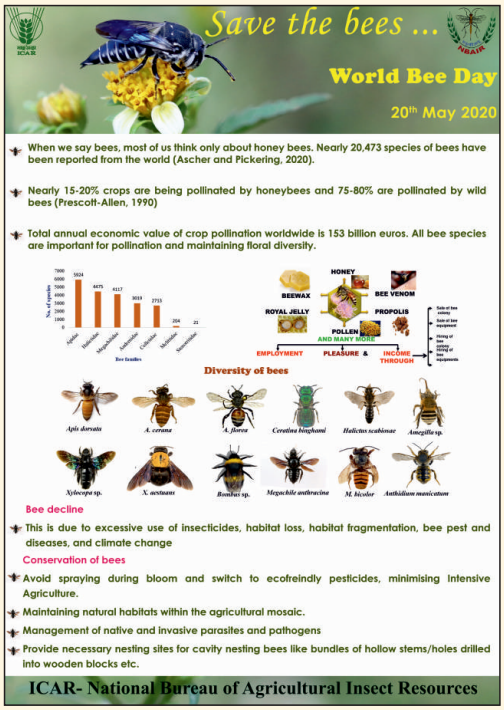
The "XXIV Research Advisory Committee Meeting" was held in virtual mode at NBAIR on 7 May 2020. The committee consisting of Drs H.C. Sharma, S. Rajan, S. Mohankumar, Sudhir Singh, Pradyumn Kumar, and two progressive farmers, Mr N. Nanjundappa and Mr Shivakumar, reviewed the research achievements and progress. The meeting began with a welcome note by Dr Chandish R. Ballal, Director of NBAIR. She also presented an overview of the research progress of the bureau. The divisional heads, Drs Sunil Joshi, M. Nagesh and N. Bakthavatsalam, presented the division-wise research achievements. Dr T.R. Sharma, Deputy Director-General (Crop Science), addressed the participants with his remarks on the achievements and progress of the ongoing projects. The committee advised NBAIR to lay stress upon biotechnological approaches to improve the strains of natural enemies, and suggested the development of basic concepts of ecological engineering for the promotion of biological control.

XXIX Workshop of AICRP on Biological Control of Crop Pests

The "XXIX Workshop of AICRP on Biological Control of Crop Pests" was organised in virtual mode during 21–22 May 2020. Dr Trilochan Mohapatra, Secretary, DARE & Director-General, ICAR, inaugurated the workshop. In his inaugural address, he emphasised that research organisations should commercialise their technologies with private companies, and also should validate and register the potential biocontrol products. He advised the centres to compile information on the extent of area covered under biocontrol technologies, and also on the reduction in the usage of pesticides by the adoption of biocontrol strategies. Dr T.R. Sharma, Deputy Director-General (Crop Science), emphasised the importance of using local isolates of biocontrol agents for insect pest management, and urged upon the need to study the market share of biocontrol agents in comparison with chemical pesticides. Dr H.C. Sharma, former Vice-Chancellor, Dr YSPUHF, Solan; Dr S.K. Jalali, retired HoD & Principal Scientist, NBAIR; and Dr H.B. Singh participated in the workshop as external experts. More than 100 scientists, biocontrol experts and private entrepreneurs participated. The work done by the different centres on documentation of biodiversity, biointensive pest management and large-scale demonstrations was presented, and the results were discussed to formulate appropriate recommendations.

NBAIR celebrates World Bee Day

NBAIR celebrated "World Bee Day" on 20 May 2020 to create awareness on the importance of pollinators and their contribution to sustainable crop production. Dr A.N. Shylesha, Principal Scientist, NBAIR, delivered a talk on the significance of celebrating this special day. Dr N.S. Bhat, retired Professor, University of Agricultural Sciences, Bengaluru, delivered a lecture entitled "Bee engaged". He explained about the importance of bee pollinators, the market potential of by-products of apiculture like royal jelly, and about the therapeutic properties of bee venom. A poster on "Save the bees" was prepared by Drs K.J. David and Veeresh Kumar to mark the celebration of the event.



NBAIR organises a virtual meet on desert locust management

NBAIR organised a virtual meet on "Desert Locust Management" on 5 June 2020 for the AICRP-BC workers so as to create awareness on the damage caused by the desert locust and the management options for the pest. Dr S.N. Sushil, former Plant Protection Advisor to the Government of India, and Principal Scientist, ICAR–Indian Institute of Sugarcane Research, Lucknow, delivered a talk on "Bioecology and management of desert locust". In his talk, he discussed the present status of incidence of this pest in the country. The role of the Directorate of Plant Protection, Quarantine and Storage in the survey, monitoring and rendering advisory on the locust swarms in different parts of Rajasthan and Gujarat was discussed. Sixty-five researchers from different AICRP-BC centres participated in the programme. Dr G. Sivakumar, Principal Scientist & Officer-in-Charge, AICRP-BC, organised the event.

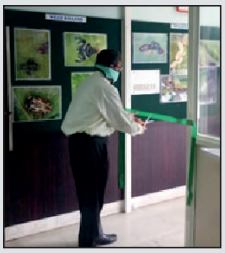
NBAIR celebrates World Environment Day

NBAIR celebrated the "World Environment Day" in virtual mode on 6 June 2020. Dr Priyadarshan Dharmarajan, Senior Fellow & Programme Leader (Ecosystems & Global Change), ATREE, Bengaluru, delivered a lecture on "Insect biodiversity". He explained about the importance of insects in sustaining ecosystems and their contribution to food production and food security. He also pointed out the threats to insect diversity, and the ways and means to conserve beneficial insects. He further discussed the role of pollinators in ecosystem services, and the factors that affect the diversity of pollinators, like monocropping, urbanisation, climate change and excessive use of plant protection chemicals. All the scientific staff of the bureau participated in the virtual meet.

NBAIR's Initiatives Against COVID-19

NBAIR has taken the following initiatives to combat COVID-19 situation:

- Inauguration of separate 'Visitors' Lounge' at NBAIR guesthouse to restrict the entry of external visitors inside the office during the pandemic period.
- Installation of foot-operated sanitiser dispensers at the entrance of main building and administration block on both the campuses.
- Restricted entry at the office entrance with the use of infrared digital thermometers.
- Disinfection of office premises.



Superannuation

Dr Chandish R. Ballal, Director, NBAIR, superannuated from service on 30 May 2020. To commemorate her retirement, colleagues at NBAIR organised a farewell function and felicitated her.

Welcome!

Dr N. Bakthavatsalam, Principal Scientist & Head (in-charge), Division of Germplasm Conservation and Utilisation, was welcomed as the Director (Acting) of NBAIR on 1 June 2020.

Awards and Recognitions

Dr K. Sreedevi

Elected as *Fellow of Entomological Society of India*, New Delhi.

Dr G. Sivakumar

Received funding from the ASEAN–India S&T Cooperation Programme for the project entitled "Collection, characterisation and evaluation of *Spodoptera frugiperda* nucleopolyhedrovirus (*Spfr*NPV) isolates of India, Vietnam and Thailand against maize fall armyworm (FAW)" (Co-PIs: Drs Namphueng Chomphukhiao[1] & Le Khac Hoang[2]).

[1]*Field and Renewable Crops Research Institute, Bangkok, Thailand* and [2]*Nong Lam University, Vietnam.*

Selected Publications

Gawas, S.M., Girish Kumar, P., Pannure, A., Gupta, A. & Carpenter, J.M. 2020. An annotated distributional checklist of Vespidae (Hymenoptera: Vespoidea) of India. *Zootaxa*, 4784(1): 1–87.

Pradhan, S.K., Shylesha, A.N., Selvaraj, K. & Sumalatha, B.V. 2020. Efficacy of insecticides against invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin on banana. *Indian Journal of Entomology*, 82(2): 246–251.

Saravanan, L., Kalidas, P., Phanikumar, T., Dwarakakumar, D., Gupta, A. & Arunkumar, R. 2020. Life history, phenology, host range and natural enemies of *Acria meyricki* Shashank and Ramamurthy (Lepidoptera: Depressariidae): an emerging defoliator of oil palm, *Elaeis guineenis* Jacq. in India. *Phytoparasitica*, 48: 427–454.

Sivakumar, G., Kannan, M., Babu, V.R., Mohan, M., Surabhi, K., Rangeshwaran, R., Venkatesan, T. & Ballal, C.R. 2020. Characterisation and field evaluation of tetrahedral and triangular nucleopolyhedrovirus of *Spilosoma obliqua* (*Spob*NPV) strain NBAIR1 against jute hairy caterpillar. *Egyptian Journal of Biological Pest Control*, 30(1): 1–7.

Sreerama Kumar, P. & Varshney, R. 2020. Efficacy of *Hirsutella thompsonii* and two other biological control agents against the broad mite in mulberry. *Arthropod Management Tests*, 45(1): 1–2.

Sumalatha, B.V., Selvaraj, K., Poornesha, B. & Ramanujam, B. 2020. Pathogenicity of entomopathogenic fungus *Isaria fumosorosea* on invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* and its effect on parasitoid *Encarsia guadeloupae*. *Biocontrol Science and Technology*, 30(10): 1150–1161.

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