

Conservation of Biological Control and Bio-scavenging: in Rugose Spiralling Whitefly Management in Coconut

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Biological control is one of the critical components of Integrated Pest Management and owing allegiance to environmental and human safety, this approach formed the centrepiece of sustainable pest suppression these days. It could be Classical Biological Control, Augmentative Biological Control, Conservation Biological Control

a) Classical Biological Control where importation and area-wide release of a specific natural enemy of the invasive pest in the new outbreak location is usually undertaken from the centre of origin of the pest. For instance, bio-suppression of the papaya mealy bug, *Paracoccus marginatus* Williams & Granara de Willink in India through introduction of the encyrtid parasitoid, *Acerophagus papaya* Noyes & Schauff from Puerto Rico during July 2010 and field released after quarantine screening.

b) Augmentative Biological Control, where it could be either inoculative with one time release of natural enemies (e.g. release of green lacewing fly, *Chrysoperla zastrowii sillemi* for the bio-suppression of sucking pests of cotton such as aphid, *Aphis gossypii* and leaf hopper, *Amrasca devastans*) or inundative with frequent release of natural enemies based on the pest incursion status (e.g. systematic delivery of stage-specific bethylid and braconid parasitoids viz., *Goniozus nephantidis* or *Bracon brevicornis* inducing an effective bio-suppression of coconut black headed caterpillar, *Opisina arenosella* which is rated as one of the most successful stories in biological control as early as 1970's).

c) Though Conservation Biological Control is not so prominent and successful in several cropping systems, its silent but significant role in the bio-suppression of two invasive whiteflies, viz., spiralling

The recent invasion of the exotic Rugose Spiralling Whitefly in coconut ecosystem from Tamil Nadu and Kerala had initially alarmed plantation sector. However, the conservation biological control strategy resorting to no pesticide spray by ICAR-Central Plantation Crops Research Institute turned out to be a success.



Black headed caterpillar-infested field



Black headed caterpillar



G. nephantidis parasitising black headed caterpillar



Microscopic view of rugose spiralling whitefly



RSW colony on infested palm leaf



Parasitized RSW pupa

whitefly (*Aleurodicus dispersus* Russell) and rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin) is noteworthy and highlighted in this article.

A. dispersus and *A. rugioperculatus* got introduced into our country from Central America during 1993 and 2016, respectively and in a span of two years, it had invaded different parts of the country including north-east states (Assam) and Lakshadweep Islands recorded on different host plants including coconut causing moderate to severe damage symptoms.

Conservation Biological Control

The recent introduction and invasion of the exotic *A. rugioperculatus* in coconut ecosystem from Tamil Nadu and Kerala during July, 2016 had initially alarmed plantation sector. However, the conservation biological control strategy advised very efficiently and launched successfully by resorting to no pesticide spray (pesticide holiday) by ICAR-Central Plantation Crops Research Institute turned out to be a real success.

This approach could completely subdue the pestiferous potential of *A. rugioperculatus* in a short period of five to eight months after initial report. There was tremendous build up of the aphelinid parasitoid, *Encarsia guadeloupa* Viggiani completely eliminating *A. rugioperculatus* in the region of infestation. A good monsoon showers and high humidity favoured more parasitism on rugose spiralling whitefly. Un-parasitized healthy pseudo pupae of *A. rugioperculatus* is cream coloured,

whereas, parasitized pupae turn blackened and the vibrating movement of the parasitoid inside the pseudo pupae is quite conspicuous.

Since no pesticides were sprayed against rugose spiralling whitefly, the population build up of parasitoids was enhanced in the natural ecosystem. Parasitism which had initially found to be 10-15% rose to as high as 70-80% in a period of five to eight months. Such an approach of natural and ecologically safe method of management ensured ecological services to the mankind as well as to the environment. Though the strategy by conservation bio-control approach without using any chemicals, initially not well received by the farming community, was finally well appreciated from all corners because of the twin benefits of environmental security and human safety experienced in the long run.

When *A. dispersus* was introduced during 1993 on cassava (*Manihot esculenta*), several approaches adopted to combat the pest, including use of insecticides, failed to suppress the pest population at the initial phase of introduction. However, with the advent of the aphelinid parasitoids, *Encarsia*



Leaf bit containing *E. guadeloupa* parasitized RSW pupae used in augmentative biological control

dispersa and *E. guadeloupa* subsequently into the country during early 2000, could effectively suppress *A. dispersus* in a year's time.

Fortuitous introduction of *E. guadeloupa* from Minicoy, Lakshadweep Island during the last phase of *A. dispersus* incursion into the mainland could effectively suppress *A. dispersus* population and serve as a residual bio-agent which could later get involved in the conservation bio-control of *A. rugioperculatus* infesting coconut. Conservation biological control, has not been felt successful, though in the perennial coconut system, its role in the bio-suppression of *A. rugioperculatus* is very classical.

As a word of precaution, farmers are advised not to carry any infested planting materials or any plant parts from one region to another and should ensure absolute freedom from any invasive pests



Scavenging action by
L. nilgiranus



Pre-pupa of *L. nilgiranus*



Adult tenebrionid beetle



Sooty mould on intercrops

on the planting materials they carry by adopting strict quarantine measures including at domestic level.

Bio-scavenging action

Extensive de-sapping by nymphs and adult rugose spiraling whiteflies from undersurface of palm leaflets produced enormous quantity of honey dew that are deposited on the upper surface of palm leaflets and under storey crops in palm-based cropping system. Such deposits of honey dew attracts sooty mould fungus belonging to *Leptoxiphium sp.* and become blackened interfering with the photosynthetic activity of the plants. In certain severe case, the entire upper surface of palm leaflets and under storey intercrops are deposited with a thick layer of sooty mould fungus producing a sick look on palms and intercrops.

In the history of insect as scavengers, discovery of a sooty mould scavenging beetle, *Leiochrinus nilgiranus* Kaszab was reported from Kayamkulam, Kerala, India for the first time by ICAR-CPCRI that is actively involved in the bio-scavenging activity of palm leaflets. Grubs and adult beetles of *L. nilgiranus* devour huge quantum of sooty mould during morning wetness and are generally confined on the undersurface after sunrise indicating the photosensitiveness of the beetle and immature stages. In a period of two months in Kayamkulam, Kerala,

the entire mould deposits on palm surface could be cleansed by the scavenger beetle, mainly attributable to the favourable wet and humid weather conditions prevailed during August-September 2017.

The bio-cleansing action was prompt, sharp and timely in a niche that was experiencing pesticide holiday with no pesticide residue as well. This favoured build up of the scavenger beetle in a short period of time and performing timely scavenging



Release of sooty mould scavenger beetles

action of cleansing palm leaflets and rejuvenating health status of palms by enhancing photosynthetic efficiency as well.

ICAR-CPCRI has made efforts to introduce the sooty mould scavenger beetle, *L. nilgiranus* into different parts of the country such as Andhra Pradesh, Tamil Nadu and Assam in coconut gardens infested by the rugose spiralling whitefly during July-August 2018. The establishment of the tenebrionid scavenger beetle will be monitored during 2019. The beetle that hibernated during summer re-emerged during monsoon showers.

Thus, natural bio-suppression by *E. guadeloupe* in synergy with the cleansing action by sooty mould scavenger beetle, *L. nilgiranus* could bring down the population of non-native *A. rugioperculatus* by both bio-control and bio-scavenging action. Not only the pest population diminished, but the improvement in palm health by cleansing off sooty mould is one of the first instances of natural scavenging on economically important crop by an insect reported so far. This forms a typical example of conservation biological control coupled with bio-scavenging highlighted in a perennial plantation crop, coconut. Considering the environment and human security ensured in this non-chemical approach resulting in the successful bio-control and bio-scavenging, we could save several crores of rupees by protecting the fragile ecosystem and biodiversity with safety to mankind. ■