

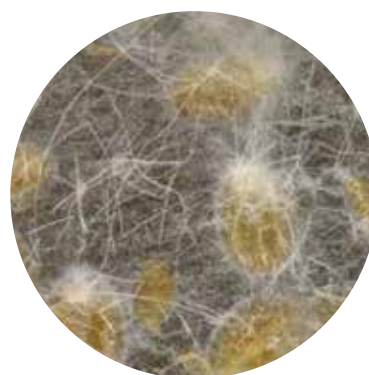
Isaria fumosorosea:

a Potential Biocontrol Agent for Management of Rugose Spiralling Whitefly

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Coconut is cultivated throughout the tropics where it is interwoven into the lives of the people and also provides a variety of products. Pest problem is one of the major constraints for achieving higher production and productivity in coconut. Coconut witnessed four exotic whiteflies viz., rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*, Bondar's nesting whitefly (BNW), *Paraleyrodes bondari*, nesting whitefly, *P. minei* and palm infesting whitefly, *Aleurotrachelus atratus* within a span of two years in India (Selvaraj *et al.*, 2016; Selvaraj *et al.*, 2019). Among invasive, RSW is more dominant and spread across the Kerala, Karnataka, Tamil Nadu and coastal districts of Andhra Pradesh, Assam, West Bengal, Goa, Gujarat, Telangana, Meghalaya and Lakshadweep on coconut and many other palm plants (Selvaraj *et al.*, 2017; Selvaraj *et al.*, 2019). Rugose spiralling whitefly is an invasive pest native to Central America and was first discovered in Florida in 2009. This pest attacks on more than 120 host plants but prefer to feed on Arecaceae family.

Rugose spiralling whitefly nymphs and adults feeds aggressively on leaf sap results in depletion of nutrients and water which leads to premature leaf drop and it produces wax and sticky honeydew on infested areas leading to extreme growth of black sooty mold which results in the reduction of photosynthetic efficiency in palms. It has now become regular pest of coconut, warranting control measures to avoid crop losses.

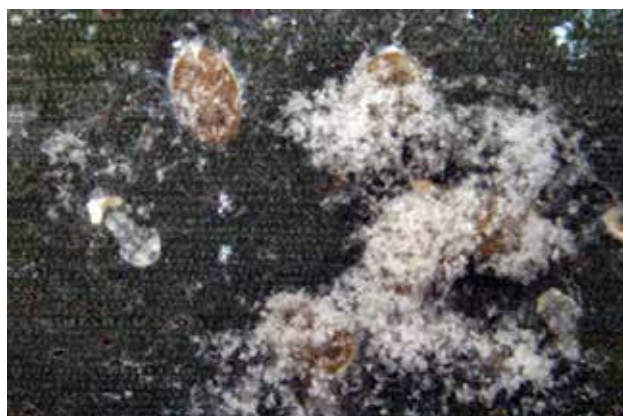


Rugose Spiralling Whitefly is an invasive pest native to Central America and was first discovered in Florida in 2009. This pest attacks on more than 120 host plants but prefer to feed on Arecaceae family.

Invasive species pose a constant threat to agriculture and a strategic science-based approach is needed to promote environmentally sustainable plant health management practices to reduce excessive reliance on chemical pesticides. Biological control through parasitoids and predators constitutes a significant component in holistic management of insect pests. As a joyful celebration of nature, the United Nations General Assembly declared 2020 as the “International Year of Plant Health” to “Adopt environmentally friendly pest-management practices, including those based on biological approaches that do not kill pollinators, and beneficial insects and organisms.”

So far, augmentation, redistribution and conservation strategies for the potential parasitoid *Encarsia guadeloupae* like avoiding chemical pesticides and habitat manipulation through intercropping of *Canna indica* and banana is recommended for the management of this pest in India. *E. guadeloupae* was found to be most abundant and its natural parasitization was recorded to the extent of 60-82% on coconut and other crops (Selvaraj *et al.*, 2017). Lack of uniform distribution of *E. guadeloupae* and absence of parasitoids for other invasive is matter of concern. In search of an alternative management strategy, entomopathogenic fungus *Isaria fumosorosea* (ICAR-NBAIR Pfu-5) seems effective against all life stages of RSW. This fungus is reported and being used as potential biocontrol agent against many whiteflies viz., *A. rugioperculatus* and *Paraleyrodes bondari* on coconut (Ali *et al.*, 2015; Kumar *et al.*, 2016 & 2018), *Singhiella simplex* on ficus (Avery *et al.*, 2019) in Florida. Thus, the present study was proposed to evaluate the efficacy of *I. fumosorosea* (ICAR-NBAIR pfu-5) against RSW in coconut.

Laboratory and field experiments were conducted with ICAR-NBAIR isolates of *I. fumosorosea* (Pfu-5) with five concentrations and tested on different RSW life stages. Fungal culture was produced on sterilized rice grains, talc and oil-based formulation. Spore suspension was prepared by suspending formulation at 5 g or ml/L in sterile distilled water containing 0.01% Tween 80. The suspension was filtrated through double layers of muslin cloth to get hyphal-free spore suspension and the concentration of the spore in the suspension was adjusted to 1×10^8 spores/ml using Neubauer’s improved haemocytometer. Mortality/hatching inhibition of eggs, first instar, second, third instar nymphs and pupae were recorded and statistically analysed the



Isaria fumosorosea infection on *Aleurodicus rugioperculatus* nymphs



Re-distribution and augmentation of *Encarsia guadeloupae* in Andhra Pradesh

percent reduction. To integrate the *I. fumosorosea* with *E. guadeloupae* to develop the bio-intensive pest management, the effect of this fungus on development of *E. guadeloupae* in RSW nymphs and adults were assessed.

The experimental results showed that *I. fumosorosea* exhibited excellent pathogenicity against all the developmental stages of *A. rugioperculatus* (Fig.1). The sporulation of the *I. fumosorosea* on eggs, early and late instar nymphs and adults of RSW was observed at 48 hours after treatment. Though *I. fumosorosea* not treated on adult, mortality /mycosis and deformation was observed in the adult emerged from treated nymphs. The Pfu-5 strain showed 35.2 to 99.6 % mortality on the different life stages of RSW at concentration of 1×10^8 spores/ml after 5 days of treatment. Least LC50 values 2.3×10^4 of *I. fumosorosea* was recorded for first instar nymphs of RSW with least LT50 values 41.39 hrs under laboratory condition. Significantly higher suppression and lower the LC50 and LT50 values indicate the higher virulence against RSW life stages. The impacts of *I. fumosorosea* on the



Isaria fumosorosea infection on *Aleurodicus rugioperculatus* nymphs and adult



parasitoid showed the inhibition of adult emergence was much lower in the Pfu-5 strain (5.8-19.6%) at a concentration of 1×10^8 spores/mL at different exposure time.

Based on laboratory results, large scale field validation of this entomopathogen (pfu-5) was carried out in Karnataka, Andhra Pradesh, Kerala and Tamil Nadu. The fungal suspension was prepared at 2×10^8 spores/ml, applied using high volume sprayer (5-7 litre of spray solution /palms along with tween 80). The results revealed that overall cumulative reduction to the extent of 72% in RSW population after 30 days and minimum two sprays advocated at 15 days intervals for reducing the pest population below damaging level. The results of present study suggest that the application of pfu-5 was found to be highly pathogenic and seems to be potential biopesticide against of all different life stages of RSW with very slight negative effects on beneficial parasitoid, *E. guadeloupae* and no infectivity on *Dichochrysa astur* and *Goniozus nephantidis*. These two biocontrol agents are compatible with each other; hence they can be utilized together in biointensive pest management programme for the control of RSW coconut ecosystem. In addition to efficacy, *I. fumosorosea* is considered as natural mortality agent, safety for humans and other non-target organisms, reduction of pesticide residues, preservation of other natural enemies and increased biodiversity in managed ecosystems.

ICAR-NBAIR supplied this entomopathogens to different stakeholders such as Indian institute of Oil Palm Research, Dr YSR Horticultural University, Tamil Nadu Agricultural University and Department of Horticulture, Andhra Pradesh for the large-scale mass production and field demonstration for the



Foliar application of *I. fumosorosea* on coconut

management of this invasive whitefly on coconut and other crops. Beside supply of isolate, hands on training on cost effective mass production techniques was provided to different stakeholders and farmers, department officials. Besides, ICAR-NBAIR initiated extensive studies on effective and ideal formulation technology for this entomopathogen for higher bio-efficiency, long shelf-life, and higher persistence with financial assistance from Coconut Development Board, Kochi. ■