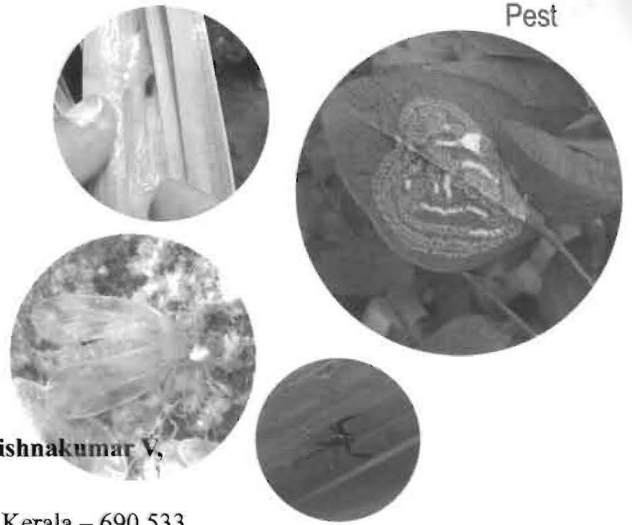


Gradient out break and bio-suppression of spiralling whitefly in coconut gardens in South India

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Spiralling whitefly, *Aleurodicus spp* is a polyphagous exotic hemipteran insect pest invading more than 500 plant species including coconut and native to New World tropics occurring in Central and South America and the Caribbean. During 1995, *Aleurodicus dispersus* was first reported as an invasive pest of cassava in Kerala, India and later from other parts of the country. This pest is presumed to have entered India from either Sri Lanka or Maldives (Mani, 2010). It caused severe damage to guava, papaya and many other crops and moderately infested coconut seedlings. In addition, moderate infestation of *A. dispersus* was reported from Minicoy, Lakshadweep Islands during 2010, but it was suppressed naturally through predators and parasitoids prevalent in the region. The natural enemy complex included two species of lady beetles viz., *Chilocorus subindicus* and *Scymnorphus sp.*, one hump-backed nitidulid predator, *Cybocephalus sp.*, and parasitoids belonging to *Encarsia spp.* (Josephraj Kumar et al., 2010). Despite its sporadic outbreak noticed in different ornamental plants and fruit trees especially guava and papaya during the initial period of occurrence, *A. dispersus* was biologically suppressed by natural build of entomophaga in all ecosystem.

During the initial outbreak occurred in late 90's, coconut was not reported as the preferred host for *A.*

dispersus. Very recently during August-November 2016, sporadic outbreaks of spiraling whitefly *Aleurodicus sp.* were reported in coconut from different regions of Pollachi (Tamil Nadu), Palakkad (Kerala), Kottayam (Kerala) as well as Pathanamthitta (Kerala). However, in the present scenario, coconut was found as the most preferred host for this whitefly pest especially in the context of deficit monsoon and therefore involvement of a different species is suggested. In the current survey, outbreak was confined to certain areas adjacent to water bodies especially in those regions of Chethankari (Pathanamthitta) and Kumarakom (Kottayam).

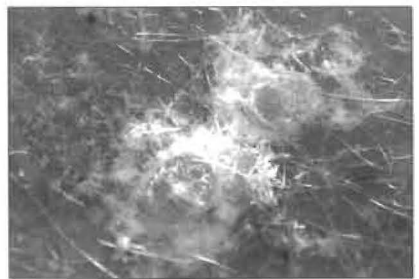
The shift in weather pattern reflected as deficit monsoon could be one of the primary reasons of immediate upsurge of spiraling whitefly. They are so sensitive to wet season and heavy rains and the recent deficit in monsoon (>35% in Kerala), which triggered a drop in relative humidity (up to 7% compared to the previous year), is the immediate reason for the flare up. Increase in temperature over 2°C during summer is another pre-disposing factor for the increase in pest population. Emergence of sucking pest as a victim of climate change thus, warrants close scrutiny. Besides, there are several potential invasive *Aleurodicus spp.*, viz., *A. pulvinatus*, *A. dugesii*, *A. pseudugesii*, *A. ruigopercualtus*, *A. cocois*, etc. reported from other



Eggs



Mobile crawler



Immature stages



Colony of whitefly



Female whitefly with brown patches



Male whitefly with claspers

countries causing severe damage. As coconut is a the homestead crop in Kerala with intercrops such as banana, vegetables, curry leaf, tapioca, etc. grown along with it, the sooty mould developed on coconut and other crops is of concern to the farmers.

The pest

Spiralling whitefly is a small sap sucking insect belonging to Hemiptera Order which is taxonomically related to mealy bugs and aphids. The adult whitefly looks like a very small moth and has a body length of about 2 mm. Wings of adults are white and have dark spots on the forewings. Adults have greyish eyes. The males are slightly smaller than females and have elongate claspers at the distal end of the abdomen. Eggs are elliptical and yellowish in colour, 0.3mm long, translucent with a short stalk and are laid singly and associated with irregularly spiralling deposits of white flocculent wax surrounding each egg in a semi-circular spiralling fashion. The spiralling of waxy material is the feature from which its common name, spiralling whitefly is derived. Adult whiteflies had opening on the ventral side through which the white flocculent material emerges out. The first-instar crawlers are the immature stage with functional legs and distinct antennae and are mobile. Subsequent larval stages are sedentary and have oval shaped soft bodies with cream colour studded with white waxy material on the sides. The final immature stage is the pseudo-puparium, which is about 1 mm in length and is used in taxonomic identification.

Nature of damage

The immature and adult whitefly by their sucking

feeding habit, siphon out coconut sap by selective feeding on the under surfaces of the leaflets. Extensive feeding of the insect leads to the excretion of honey dew which subsequently gets deposited on the upper surface of the leaves positioned down beneath or even on other under storey crops. Honey dew excrement, being sweet and watery, attracts ants and encourages growth of the fungus *Capnodium sp.* which causes disfigurement of hosts affecting the photosynthetic efficiency of the plant. Since the outer whorl of fronds of coconut palm, which already bear coconut bunches of different maturity, do not contribute to the nut yield considerably, the whitefly infestation with minimum tissue damage and sooty mould on the outer whorl of fronds may not result in yield loss. Since the black tinge on crop plants (sooty mould) are mere sugar feeding fungus, farmers need not be worried about such tinge on crops plants as they are not poisonous. Waxy flocculent material produced by the adult whiteflies, however, can be another nuisance to human beings, as they get dispensed with a fluff of white dust, the moment insects are disturbed. Despite heavy incidence of whitefly on coconut, it is not practically causing any economic crop loss and therefore, there is absolutely no need for any panic. In the recent survey conducted in heavily affected gardens, cutting across all age groups of palms, as high as 60-70% of the fronds were found infested by the pest. The prevalence of the pest was noticed from the outer whorls and slowly progressed towards the inner whorls, whereas, the emerging fronds were not infested.



Spiralling egg laying mode



Extensive damage on the lower leaflet



Coalescing of spirals



Aggregated adult whiteflies



Sooty mould symptom on upper leaflets

Host plants

In the recent survey, at least ten alternate host plants were observed (*Psidium guajava*; *Musa sp.*, *Myristica fragrans*; *Colacasia sp.*, *Garcinia sp.*, *Annona muricata*; *Murraya koenigii*; *Spondias mombin*; *Mangifera indica* and *Artocarpus heterophyllus*) in coconut homesteads, but the pest is relatively more confined to coconut and the reason for its selective preference more aligned towards coconut is a researchable issue warranting species level identification of the pest.

Natural enemies

In the present investigation, it is observed that more than 50% of the whitefly was parasitized by a tiny hymenopteran parasitoid, *Encarsia sp.* (<1 mm size) from different tracts of Kerala indicating the natural build of the parasitoids. This is one of the classical biological control strategies and any disturbance in the build up of *Encarsia sp.* would invariably affect the long term approach in pest bio-suppression. In addition, lady beetles belonging to *Jauravia sp.* and a wide array of spiders were also noticed. With the emergence of *Aleurodicus sp.* in coconut and natural build up of *Encarsia sp.* in Kerala, it could be well understood that the pest-defender system should be carefully conserved in the region so as to encourage population build up of the natural enemies. Fortuitous introduction of *Encarsia sp.* along with the pest or wide-range parasitic ability of the indigenous *Encarsia sp.* will be ascertained once the species is identified. However, the co-evolutionary occurrence of the parasitoid *Encarsia sp.* with the dynamic emergence of a new *Aleurodicus sp.* suggest

for the gradient outbreak of the pest, in tune with the weather change phenomena experienced in 2016 in South India. Under such situations, no insecticides should be applied to manage the pest. Introduction of parasitized pupae is a good strategy in the emerging pest inflicted zones for effective bio-suppression of whitefly.



Whitefly colony on curry leaf



Whitefly colony on Banana leaf

Strategies for whitefly management

Use of insecticides is not a viable option for the management of whitefly as it only reduces the build of natural enemies, especially those belonging to *Encarsia spp.* Therefore, population build up of natural enemies either through conservation or introduction of parasitized pupae would be a feasible and sustainable alternative approach at this point of time for the long-term bio-suppression of *Aleurodicus sp.*



Predatory grub of lady beetle



Jauravia sp



Spider



Parasitised pupa

Exit hole of *Encarsia* sp.*Encarsia* sp. (<1 mm size)

The integrated pest management strategies to be adopted include:

- 1) The pest population is likely to recede with monsoon showers and build up of natural enemies and hence, no insecticides should be applied.
- 2) Application of 1% starch on the sooty mould affected leaves to flake out the mould.
- 3) Fix yellow sticky trap of one metre width painted with white grease or castor oil on the trunk of infested palms.
- 4) Conservation and re-introduction of parasitized pupae, *Encarsia* sp. in new emerging zone for long-term pest suppression.
- 5) In severally infested gardens, spray neem oil @ 0.5% targeting the lower whorls of fronds.

Awareness campaign about the pest should be made through immediate capacity building programmes for sensitizing the farming community about the sustainable bio-suppression of the pest through natural enemies.

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