

## ENTOMOPATHOGENIC NEMATODE (EPN) FOR THE MANAGEMENT OF ROOT GRUB IN ARECANUT

### Introduction

Integrated pest management (IPM) is an ecosystem-based pest suppression that integrates practices to keep the pest population below economic threshold level (ETL). In the recent past, use of entomopathogenic nematode (EPN) as component in IPM is gaining momentum in order to avoid insecticide resistance, pest resurgence and pesticide residues. Nematodes that cause disease through symbiotic bacteria within an insect and have the ability to kill insect pests are referred as entomopathogenic nematode. EPN belonging to *Steinernema* and *Heterorhabditis* genus have potential to infect insect pests and have been demonstrated to control pests like root grubs in high value crops including arecanut. The third stage infective juveniles (IJs)(Fig. 1) of EPN survive outside an insect host and move from one insect to another in the soil. The IJs of steinernematids and heterorhabditis enter a living host and release symbiotic bacteria of the genus *Xenorhabdus* and *Photorhabdus* respectively. The bacteria kill the host quickly within two to three days and emerging nematodes feed on the insect cadaver and digested tissues (Fig. 18 & 19). The nematodes go through two or more generations, producing new IJs which enters into the soil as host resources are depleted. Safe to ecosystem, short life cycle and easy multiplication are some of the advantages of EPNs. Among various pests of arecanut, root grub is a key pest which feeds on roots of arecanut palms resulting in deterioration of palm health and production potential. The perennial nature of the crop and abundance of canopy levels helps to maintain microclimatic conditions which act as a favorable niche for the establishment of EPN in arecanut based ecosystem.

### Mass production of EPNs

Entomopathogenic nematodes are easily multiplied on larvae of Greater wax moth, *Galleria melonella* because of its high susceptibility to EPN and ease in rearing under laboratory conditions. Around 250 to 300 IJs of EPN is inoculated on fully grown larvae (10 larvae) in each petri plate. After two to three days, discolored dead larvae are collected (Fig. 2), rinsed in water, incubated for three days and placed on white trap for emergence (Fig. 3). Nematodes harvested from white traps are cleaned and packed in polypropylene covers/flasks (Fig. 4). These cleaned nematodes are ready for field application (Fig. 5) and can be stored under ambient temperature upto three months and shelf life can be extended upto six months at controlled conditions of 15 – 20°C.

### Root grubs in arecanut garden

Root grub, *Leucopholis* species complex are found infesting the roots of arecanut particularly in the sandy and sandy loam soils. The host range



Fig. 1. EPN – *Steinernema carpocapsae* IJs

of *Leucopholis* species complex includes areca, banana, coconut, tuber crops, cashew, rubber and coffee. Peak population is observed during September to February which causes damage to arecanut as well as intercrops grown in arecanut based cropping system. There are three species of root grub. *L. coneophora* (Fig. 11) dominating species in coconut and arecanut growing regions of Kerala. *L. burmeisteri* (Fig. 12) and *L. lepidophora* (Fig. 13) dominating species in the hilly tracts of Western Ghat regions of Karnataka. Large scale and non judicious usage of insecticides have resulted in development of resistance, escalation of cost of production and environmental pollution. On the other hand, entomopathogenic nematodes can be an alternative to the pest control, mainly because of their eco-friendly nature and are compatible with a wide range of chemical and biological pesticides used in IPM programs.



Fig. 2. *Galleria* cadavers infected with EPN



Fig. 3. Emergence of EPN on white trap



Fig. 4. Packing of EPN with polypropylene cover/flask



Fig. 5. Packed EPN for field application

### Symptoms of root grub infestation

Continuous feeding by the grubs (Fig. 6 & 9) on roots results in poor supply of water and nutrients to the palm which lead to pale yellowing of leaves (Fig. 7) and decrease in yield. Reduction in stem girth and size of the crown and tapering of palms are characteristic symptoms in the advanced stage of damage (Fig. 8). In severely infested plots, 15-24

grubs can be seen at the base of a single palm (Fig. 9). Severely infested juvenile areca palms can be easily pulled out as most of the roots are eaten away by the grubs (Fig. 8). After feeding on the roots the grubs may enter the bole region and cause severe damage. The suspected garden may be examined at random by digging the base of the palm to a depth of 30 cm for the presence of grubs at the root zone.



Fig. 6. Damage on roots



Fig. 7. Reduction in crown size, yellowing of leaves and stem tapering



Fig. 8. Advanced stage of infestation (Wilting and drying)



Fig. 9. Root Grubs



Fig. 10. Toppled palms with damaged roots



### Feeding behavior of arecanut root grub

Adults emergence pattern and timing of all the three species of *Leucopholis* differs from each other depending upon soil moisture and temperature first instars grubs feed on the roots of grasses and weeds. The second and third instar grubs feed on roots of arecanut and other alternate hosts. Grubs initially feed on the tender feeder roots and later they shift to the bigger anchoring roots. Among the three species, *L. coneophora* has a one year life cycle but *L. burmeisteri* and *L. lepidophora* have two years life cycle. The long life cycle of this pest facilitates perennial existence.



Fig. 11. *L. coneophora*



Fig. 12. *L. burmeisteri*



Fig. 13. *L. lepidophora*

Adults of different species of root grubs

### Integrated Pest Management

- Periodical digging (Fig. 14), hoeing and ploughing to reduce the root grub population by exposing them to predators/destruction.
- Manual collection and destruction of adult beetles during peak period of emergence to reduce grubs population but invariably

- emergence occurs after three to four pre-monsoon showers.
- Proper drainage reduces the population of root grubs as the grubs prefer moist soil (Fig. 15).
- Removal of weeds and fallen leaves prevents the movement of grubs.
- Application of powdered neem cake @ 2kg/palm in the root zone induces the emergence of new roots (Fig. 16).
- Entomopathogenic nematodes (EPN), *Steinernema carpocapsae* liquid suspension @1.5 billion infective juveniles (IJs)/ha (Fig. 17) (approximately 1 crore IJs/palm) during June - July with commencement of monsoon and second application during September - October along with insecticide, Imidacloprid 17.8 SL @ 0.0045% (0.5ml/2 liters of water/palm) drenching around the root zone. Imidacloprid is synergistic with EPNs and exhibits good compatibility in managing the root grubs.
- Providing irrigation regularly to maintain optimum soil moisture for better survival and establishment of nematodes during the period of treatment.
- Application of nutrients as per soil test based recommendations for improving the health of the palms.

All management practices should be undertaken continuously for a minimum period of three years for effective management of this pest



Fig. 14. Digging of interspaces



Fig. 15. Drainage facilities



Fig. 16. Application of neem cake



Fig. 17. Application of EPN



Fig. 18. Root grub infected with EPN

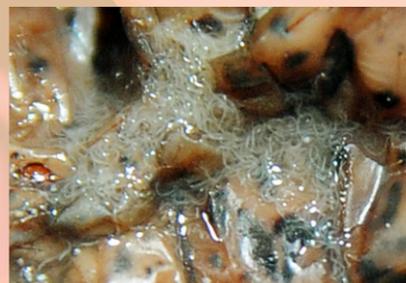


Fig. 19. Emergence of EPN from infected root grub

in a severely affected garden. Root grub infestation may spread to neighbouring arecanut gardens. Hence, area wide pest management strategies should be adopted by all the farmers of the root grub affected area.

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