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BIO-MANAGEMENT OF SOIL DWELLING INSECT PEST IN ARECANUT

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Introduction

Arecanut (*Areca catechu* L.), belonging to the family Palmae, is a key plantation crop extensively cultivated in the Western Ghats of India. It provides vital income and livelihood security to many small and marginal farmers. Primarily used for human consumption as a masticatory substance, it also forms an important component of traditional rural medicine. Despite its significance, arecanut production is severely affected by abiotic and biotic stresses. A major biotic constraint is root grub (*Leucopholis* sp.), a soil-dwelling pest prevalent across coastal districts of Karnataka and Kerala, causing yield losses of approximately 40–42%. Infestation symptoms include stem tapering, crown reduction, yellowing, wilting, and weakened soil anchorage. Larval feeding on roots reduces water and nutrient uptake, leading to significant quantitative and qualitative yield losses. Current management largely depends on chemical insecticides, which harm soil ecosystems. Consequently, eco-friendly alternatives like biopesticides based on indigenous entomopathogenic nematodes (EPNs) are being explored for sustainable pest control.

Indigenous Entomopathogenic Nematodes (EPNs)

Indigenous entomopathogenic nematodes (EPNs) are locally collected biological control agents belonging to the families *Steinernematidae* and *Heterorhabditidae*. Their infective juveniles (IJs) are specifically adapted to the environmental conditions of their native regions, offering superior adaptability and efficacy compared to non-native strains. EPNs, defined as nematodes pathogenic to insects, can kill insect hosts within 48 hours of infection. They are particularly effective against cryptic soil pests such as root grub larvae. Cryptic habitats provide ideal conditions for EPN infectivity, survival, and persistence by reducing mortality from ultraviolet radiation and desiccation. Additional advantages of EPNs include long-lasting infective stages, active host-seeking behaviour, ease of mass production, safety to mammals and non-target organisms, and exemption from registration requirements in many countries, making them promising candidates for sustainable pest management.

Fig.1. Microscopic view of infective juveniles (IJs) of EPN

Mode of Action

Steinernematids and heterorhabditids are uniquely associated with mutualistic symbiotic bacteria—*Xenorhabdus* and *Photorhabdus*, respectively—which reside in their intestines. Upon entering the body cavity of an insect host, the nematodes release these bacteria, causing rapid septicemic death of the insect. The bacteria not only kill the host but also create a suitable environment for nematode development and reproduction. The nematodes feed on bacterial cells and on host tissues digested by the bacteria, completing one to three generations over a period of 1–4 weeks. Once host resources are exhausted, hundreds to hundreds of thousands of new infective juveniles (IJs), each carrying symbiotic bacteria in their nonfunctional digestive systems, emerge from the host cadaver to seek new insect hosts.

Mass production of EPNs

Mass production of EPN, *Steinernema carpocapsae* was using the laboratory host insect,

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Galleria mellonella. A total of fifty billion infective juveniles (IJs) were mass produced for the field demonstrations and supplied to the needy farmers in Kerala and Karnataka for the management of root grubs in palms. These EPNs can be stored in formulated liquid suspension up to 3-4 months at room temperature, making nematode based products more feasible for commercialization.

Fig.2. White trap - Newly emerged IJs from *Steinernema* infected *G.mellonella* cadavers

Fig.3. Collected IJs were processed and packed in polypropylene covers for transportation to the field

Application

The ICAR - CPCRI, Kasaragod, is documenting and validating the native EPN strains for the sustainable management of root grubs in palms eco-system. These root feeding, subterranean June beetle larvae complete one generation per year, progressing through the life cycle stages of egg, larva, pupa, and adult over a period of 12 months. To combat root grub infestations, chemical insecticides are commonly recommended. However, prolonged use of these chemicals leads to soil pollution and biodiversity loss. Therefore, field demonstration were undertaken to evaluate the environment friendly approaches *Steinernema carpocapsae* in aquaeous suspension. The EPNs were applied to the soil @ 1.5 billion IJs/ha, after loosening the soil around the base of the palm to a depth of 5-10cm during June –July and September –October.

This was followed by the application of neem cake @ 2kg/palm during December – January, along with measures to conserve soil moisture to support EPN survival. Over three consecutive years integrated management practices resulted significant decline in grub population and no palm death were recorded from the treated gardens.

Fig.4. Application of infective juveniles of *S. carpocapsae* in root zone of arecanut palms

Fig.5. Healthy root grub larvae and EPN, *S.carpocapsae* -infested root grub larvae

Fig.6. Application of Neem cake

Fig. 7. View of improved palm health in gardens treated with EPN

Farmers training programme

To create awareness about the sustainable integrated management of root grubs using entomopathogenic nematodes (EPNs), training programmes were conducted in root grub-infested farmers' gardens in the districts of Kasaragod (Kerala) and Dakshina Kannada (Karnataka) on 27.10.2022 and 09.11.2022, respectively. More than 225 farmers benefited from the training.

Fig.8. View of awareness programme on EPN-based root grub management

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