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Entomopathogenic Nematodes: Lethal Parasites of Insects

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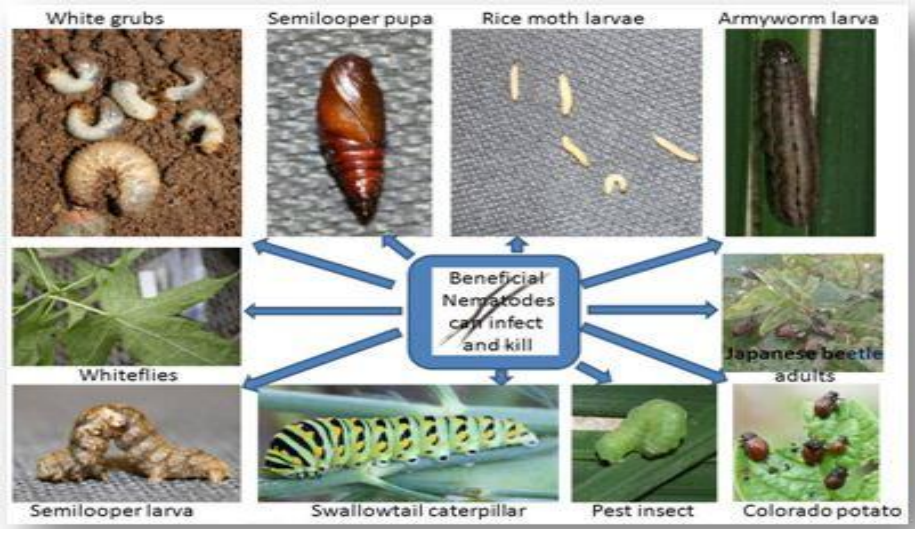
Introduction

The increased awareness regarding hazardous effects of chemical pesticides on environment, human health, wild life and beneficial organisms, besides inducing undesirable selection of resistant pests and pathogens in recent past has compelled the researchers to look for the safer and more environment friendly practices of nematode management. There are numerous other reasons that provoke the farmers to choose the alternative tools of nematode management other than chemicals. The use of bio control agents as biological insecticides has been considered as the most viable pest management alternative, being environmentally safe, and as an essential component of sustainable agriculture.

What are EPNs?

Nematodes that naturally occur in the soil can generally be divided into two groups: beneficial (which include EPNs) and non-beneficial (plant-parasitic) nematodes. EPNs are beneficial nematodes, because of their ability to parasitize insects without harm to humans, animals or the environment.



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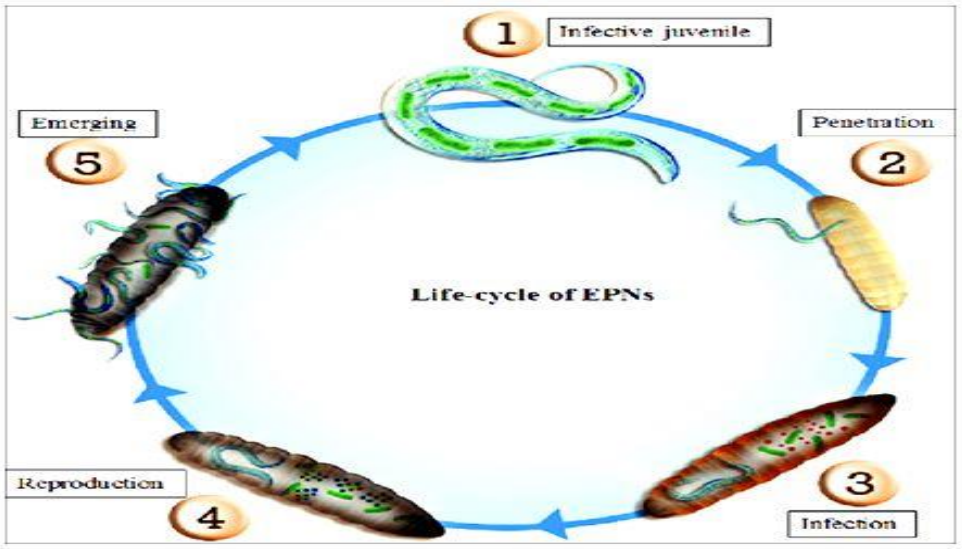
Nematodes that parasitize the insects, known as entomopathogenic nematodes (EPNs) which have been described from 23 nematode families. Naturally occurring entomopathogenic nematodes and their symbiotic bacteria are important biotic factor in suppression of insect pest populations in soil and cryptic habitats. The virulent species of these nematodes are commercially produced as biological control agents all over the world encompassing North America, Europe, Asia and Australia in glasshouse crops, orchards, ornamentals, turf, lawn, and forestry. The first nematode (*S. carpocapsae*) used successfully in the control of an insect pest from Australia; Commonwealth Scientific and Industrial Research Organization (CSIRO) was the first in the world to use EPNs commercially against black vine weevil in ornamentals and against currant borer moth in black currants.

Distribution

EPNs are ubiquitous in cultivated and uncultivated soils throughout the world *Heterorhabditis* and *Steinernema* nematodes are present on all continents, except Antarctica. The occurrence of *Heterorhabiditis* is often linked to tropical regions, but studies shows the presence of heterorhabditids in semi-arid climate zones as well. *Heterorhabditis bacteriophora* was originally found in Brecon, South Australia and occurs in regions of continental and Mediterranean climate in both the northern and southern.



Heterorhabditis zealandica was originally reported from Auckland, New Zealand, in 1990 and has since been isolated in New Zealand, Tasmania and South Africa. India has a great potential to exploit these beneficial nematodes for the suppression of insect pests. First discovered in the 1920s, entomopathogenic nematodes (EPNs) received increasing interest

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starting in the 1950, and their commercialization started in the 1980s. They have been largely excluded from pesticide registration requirements in many countries due to their high level of safety to humans, non-target organisms, and the environment.

Description

Entomopathogenic nematodes (EPNs) that belong to the families Heterorhabditidae and Steinernematidae are soil-inhabiting organisms that are obligate insect parasites in nature. These nematodes have evolved a mutualistic association with bacteria in the genera *Photorhabdus* is associated with *Heterorhabditis* spp., is carried in the intestine of infective juveniles (IJs).

Xenorhabdus is connected with *Steinernema* spp. and confined to a specific vesicle within the intestine of the IJs. Nematodes locate their potential host by following insect cues. After IJs locate a host, they infect it through an orifce such as the mouth, anus, or spiracles or by penetrating the cuticle (particularly in *Heterorhabditis* spp.). Once IJs enter the host, they shed their outer cuticle and begin ingesting hemolymph, which triggers the release of symbionts by defecation (in *Steinernema* spp.) or regurgitation (in *Heterorhabditis* spp.). The nematode–bacteria complex kills the host within 24–48 h through septicemia or toxaemia. Bacteria recolonize the nematodes, which emerge as IJs from the depleted insect cadaver in search of fresh hosts. More than 100 species of EPNs have been identified globally in which approximately 80% are steinernematid and 13% of these species have been commercialized. EPNs have been broadly used in the biological control of a variety of economically important pests occupying different habitats. However, EPN formulation to retard desiccation or the addition of adjutants to increase leaf coverage and persistence of the IJs has enhanced the use of EPNs against foliar pests.

Recently commericialized entomopathogenic nematodes species

Heterorhabditis spp.	**Country**	***Steinernema* spp.**	**Country**
H. bacteriophora	EU, NA	*S. carpocapsae*	AS, AU, EU, NA, SA, AF
H. indica	NA	*S. feltiae*	EU, NA
H. marelata	NA	*S. kraussel*	EU, NA
H. megidis	EU, NA	*S. riobrave*	NA
H.zealandica	AU, NA	*S. scarabaei*	NA

(AF-Africa, AS-Asia, AU- Australia, EU-Europe, NA-North America, SA- South America)

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Conclusion

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In present scenario, public concern is growing over ill effects of chemical pesticides, particularly ground water including food chain contamination, resistance development in target organism and threat to Human beings and wild life has fuelled an intense search for safer alternatives of pest management. The use of bio control agents as biological insecticides has been considered as the most viable pest management alternative, being environmentally safe, and as an essential component of sustainable agriculture. As entomopathogenic nematodes have great potential and have been broadly used in the biological control of a variety of economically important pests occupying different habitats.