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Entomopathogenic Nematodes: Bioagents for Management of Insect Pests

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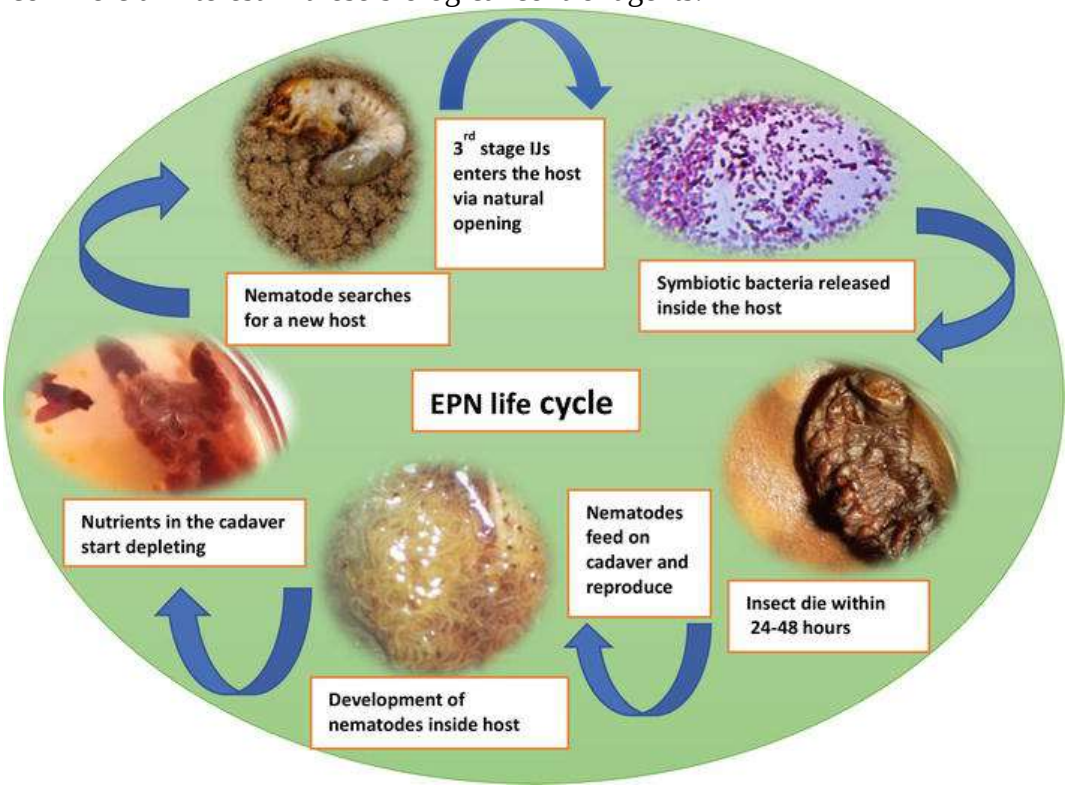
SUMMARY

Use of chemical pesticides in agriculture posed a concern about hazardous effects of pesticides on environment. There is an urgent need for methods that are eco-friendly. Development of resistance and emergence of new biotypes is another concern about using chemical pesticides which drive us for a change in pest management methods. Biological control is an attractive alternative which is environmentally safe and feasible in crop protection. Understanding the biology and adaptability of bio-control agents has an important role in successful application of bio-agent based products in different crop ecosystems. Entomopathogenic Nematodes (EPNs) are effective bio-control agents for the management of insect pests, especially soil dwelling insects. Two genera, *Steinernema* and *Heterorhabditis* are highly virulent EPNs, killing the insect host within 1-2 days. *Steinernema* and *Heterorhabditis* have symbiotic bacteria *Xenorhabdus* and *Photorhabdus* respectively in their guts which they will release upon entering the insect.

INTRODUCTION

Entomopathogenic nematodes (EPNs) are a kind of parasitic roundworms that invade and eliminate insects. Nematodes are used in biological pest management to regulate insect pests in agricultural and horticultural settings. They serve as natural adversaries to several subterranean insect pests and are regarded as a vital asset in integrated pest management (IPM) tactics. EPNs are among one of the best biocontrol agents to control numerous economically important insect pests, successfully. EPNs differ from other parasitic or necromenic nematodes as their hosts are killed within a relatively short period of time due to their mutualistic association with bacteria. They have many advantages over chemical pesticides are in operator and end-user safety, absence of withholding periods, minimising the treated area by monitoring insect populations, minimal damage to natural enemies and lack of environmental pollution. Improvements in mass-production and formulation technology of EPNs, the discovery of numerous efficient isolates and the desirability of increasing pesticide usage have resulted in a surge of scientific and commercial interest in these biological control agents.



Characteristics of EPNs :

Below are many prominent characteristics of entomopathogenic nematodes.

Parasitic Behavior :
EPNs have a parasitic lifestyle. They actively search for and invade the immature stages of insects, such as larvae or pupae that are present in the soil. Upon entering the insect host, they discharge symbiotic bacteria (usually belonging to the genera Xenorhabdus or Photorhabdus) that aid in the internal extermination and digestion of the insect.

Host Specificity :
Various species of entomopathogenic nematodes exhibit distinct preferences for different hosts. Certain insecticides have greater efficacy against certain insect pests, whilst others include a wider spectrum of targets. This characteristic makes them valuable for selectively targeting certain pest species.

Application :
EPNs are often administered either to the soil or directly to the areas affected by pests. The parasites actively search for their hosts and invade them, ultimately causing the pest's demise.
Ecologically Sustainable :

Entomopathogenic nematodes are regarded as ecologically sustainable and pose no harm to people, animals, and plants. They have no detrimental effects on non-target species and have few ecological repercussions.

EPNs undergo reproduction :
EPNs undergo reproduction within the insect host, leading to population growth as they progressively infect and eliminate other pests. Nevertheless, environmental factors may impact them, leading to variations in their durability and efficacy.

Commercial use of EPNs :
EPNs may be acquired and used for commercial purposes in the fields of agriculture, horticulture, and pest control. They are often used as a component of an integrated pest control strategy to decrease the dependence on chemical pesticides.

Examples of entomopathogenic nematodes (EPNs) :
- Examples of entomopathogenic nematodes are Heterorhabditis and Steinernema, which are often found genera. *Steinernema feltiae* and *Heterorhabditis bacteriophora*, which belong to these genera, are often used in pest management applications.
- To summarize, entomopathogenic nematodes are advantageous microorganisms used for the biological management of insect pests.
- These substances serve as an environmentally friendly substitute for conventional pesticides, making them a useful asset in the realm of sustainable agriculture and pest control.
- Heterorhabditis and Steinernema are two types of entomopathogenic nematodes (EPNs) used in the practice of biological pest management. Although they exhibit several commonalities, they also possess some distinctions.

Classification :
- Heterorhabditis is a member of the Heterorhabditidae family.
- Steinernema is classified under the Steinernematidae family.

Form and Dimensions :
- Heterorhabditis nematodes are often characterized by their shorter and thicker bodies, which exhibit a distinctive S-shaped form.
- Steinernema nematodes often have a greater length and slimmer physique, characterized by a more linear body form.

Distribution by geographical location :
- Heterorhabditis species have a broader ecological tolerance and greater resistance to low temperatures compared to Steinernema species.

- Steinernema species are more abundant in regions with higher temperatures.

Range of Hosts :

- Steinernema nematodes are recognized for their wide variety of hosts, including several insect pests. They possess a remarkable capacity to infect a diverse array of hosts.
- Heterorhabditis nematodes have a narrower variety of hosts and display a greater degree of selectivity when it comes to choosing insect hosts.

Actions or conduct :

- Steinernema nematodes use a "cruise foraging" tactic, whereby they actively traverse the soil in order to locate their hosts.
- Heterorhabditis nematodes use a "sit-and-wait" tactic, whereby they maintain a relatively fixed position in the soil and depend on chemical signals sent by their symbiotic bacteria to attract new hosts.

Bacteria that engage in symbiotic relationships :

- Both nematode taxa have a mutualistic association with symbiotic bacteria, which aid in the extermination of the insect host.
- The bacteria found in Heterorhabditis species are normally classified under the name Photorhabdus, however in Steinernema species, they are classified under the genus Xenorhabdus.

Utilization for business purposes :

- Both Heterorhabditis and Steinernema nematodes are readily accessible for commercial usage and are used in the field of pest management. The selection of which option to use often relies on the particular target insect and prevailing environmental circumstances.
- Utilizing commercial products containing entomopathogenic nematodes (EPNs) in pest control and agriculture has several benefits. The aforementioned benefits provide EPNs a compelling choice for biological pest control and integrated nematode management (INM) initiatives:

Eco-Friendly Pest Control :

- Commercial EPN solutions provide a sustainable and ecologically conscious method for managing pests.
- These substances pose no threat to non-target creatures, such as people, animals, and plants, and have a negligible effect on beneficial insects. Consequently, they serve as a sustainable substitute for chemical pesticides.

Precision Pest Control :

- EPNs have a strong preference for certain host insects. This particular characteristic enables precise regulation of certain pest species, hence decreasing the effects on beneficial insects and limiting unintended harm.

Decreased Dependency on Chemical Pesticides :

- The use of EPNs may diminish the need for chemical pesticides.
- It is crucial to prioritize these actions in order to effectively decrease the presence of pesticide residues in food, safeguard the environment, and mitigate the development of pesticide resistance in insect populations.

Residual Impact :

- Entomopathogenic nematodes (EPNs) have the ability to remain in the soil and continue to infect and suppress pests for a prolonged duration after their application. The lasting impact of this might provide continuous pest control.

Many Modes of Action :

- EPNs use many modes of action to effectively manage pests.
- The pests harm and ally invaded, resulting in mechanical harm, and are also exposed to symbiotic bacteria that produce poisons to eliminate the host.
- By using this dual method, the probability of pests acquiring resistance is minimized.

Safety :

- Electric pulse nets (EPNs) are usually considered to be safe for both people and animals. Applying EPN products does not need the use of substantial personal protective equipment, in contrast to chemical pesticides which often demand more rigorous safety precautions.

Included in IPM Programs :

- EPNs may be included into IPM programs, enabling a comprehensive pest management strategy that encompasses cultural, biological, and chemical techniques as necessary.

Commercial EPN solutions :

- Commercial EPN solutions are designed to be easily applied in several pest management situations, including agriculture, horticulture, and landscaping.

EPNs are widely acknowledged:

- EPNs are widely acknowledged in organic farming operations and are fully compliant with the requirements required for organic certification.
- As a result, they are highly acceptable for use by organic producers.

Minimized Environmental Contamination :

- EPNs mitigate the potential for water sources and the environment to be contaminated by chemical pesticide residues, a significant problem associated with traditional chemical pest management techniques.

Elevated Resistance Probability :

- Owing to the diverse mechanism of action and intricate life cycle of nematodes, pests have a diminished likelihood of developing resistance to EPNs in comparison to chemical pesticides.

CONCLUSION

To summarize, commercial solutions that include entomopathogenic nematodes have several advantages for pest control, environmental sustainability, and integrated pest management. They provide an efficient and environmentally benign method of controlling insect populations while reducing the adverse effects linked to chemical pesticides.

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