Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 05, Issue: 02 (MAR-APR, 2025)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Mastering Bio Control Leveraging Antagonistic Organisms to Combat Plant Parasitic Nematodes: Microbes vs. Nematodes

(*Sowmya R)
Assistant Professor (Plant Nematology), Department of Crop Protection,
MITCAT, Musiri, Trichy-621211, Tamil Nadu, India
*Corresponding Author's email: rsowmyaagri@gmail.com

The worldwide agricultural business is becoming increasingly concerned about the substantial reduction in crop output caused by plant parasitic nematodes, both in terms of quantity and quality. PPNs infect and multiply on a variety of plant species, and the three most commercially significant categories are root knot nematodes, cyst nematodes, and lesion nematodes. Watermelon was found to have inhibitory effects on the root knot nematode *Meloidogyne javanica* in mushrooms (*Cucurbits pepo*) infected with mosaic polyvirus. All of these impacts, whether positive or negative, happened or were more noticeable when the viral infection started two to three weeks after the nematode injection. The root knot nematode causes significant financial losses, hence controlling these plant parasites with appropriate measures is urgently needed. Numerous strategies, such as pesticides, crop rotation, soil solarization, host plant resistance, antagonistic organisms, etc., have been employed thus far to control them. In particular, RKN core sedentary Endo parasites are responsible for significant financial damages to agricultural crops around the world. The European Union's regulations on the use of nematodes have led to the discovery of environmentally friendly nematode antagonists in their natural state.

Bio Control Agents against Root Knot Nematode

Root knot nematodes (RKN), caused by *Meloidogyne sp*. are a significant agricultural pest. Several bio control agents have been developed to manage these nematodes, which are gradually safer and more environmentally friendly compared to chemical treatment. Bio control means the use of advantageous organisms and their products to increase beneficial responses and reduce negative ones and contribute to gross increase in productivity.

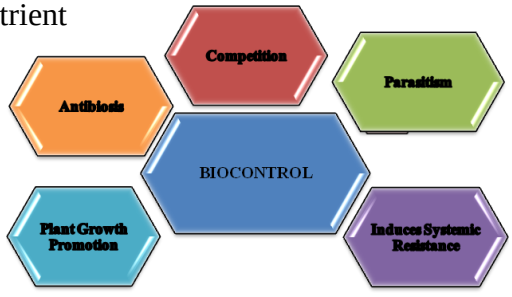
1. Competition: Competition, primarily for resources like water, nutrients, and space, lowers the organisms' growth and reproduction rates or has an impact on the fitness of nematodes.

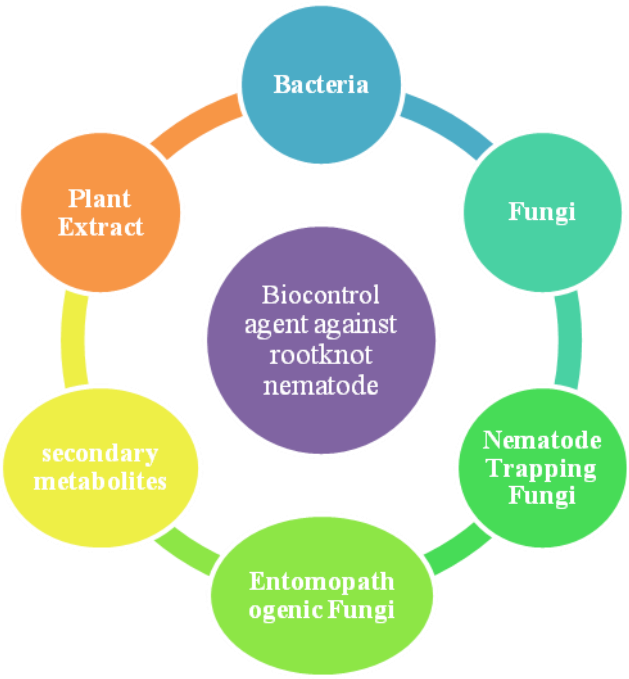
2. Antibiosis: Certain antibiotics or toxins that bacteria create and release may have an unfavorable impact on nematodes during their infectious stage. It is also known that allelochemicals can damage plant-parasitic nematodes.

3. Parasitism: Most nematophagous bacteria feed on nematodes and may use them as a source of nutrition.

4. Plant Growth Promotion: By improving nutrient solubilization, nutrient absorption, and nutrient sequestration, bioagents promote plant growth and help manage plant diseases.

5. Induced Systemic Resistance: Certain bacterial compounds produce systemic signals in plants that can help them become resistant or shield the entire plant from disease caused by different pathogens.





Bacteria as Bio Control Agent against Root Knot Nematode: Bacteria like *Bacillus subtilis* and *Bacillus thuringiensis* produce bioactive metabolites, including proteases, lipases, and nematicide peptides, which degrade nematode cuticles and disrupt their life cycle. *Enterobacter* sp. can colonize the rhizosphere, excluding pathogenic organisms, and suppress nematode populations through enzymes, antibiotics, and toxin. These agents promote plant health and growth. Nematicide peptides, lipases, and proteases are among the bioactive metabolites produced by bacteria such as *Bacillus subtilis* and *Bacillus thuringiensis* that break down nematode cuticles and interfere with their life cycle. Using enzymes, antibiotics, and toxins, *Enterobacter* sp. can invade the rhizosphere, keeping pathogenic organisms out, and decrease nematode populations. These substances support the growth and health of plants.

Fungi as Bio Control Agent against Root Knot Nematodes: Fungi can be used as biocontrol agents against Root knot Nematodes (RKN), a major pest in crops. They can suppress RKN populations by parasitizing nematode eggs and larvae, producing enzymes to degrade cuticles and release volatile compounds. Fungi can also improve soil quality by enhancing microbial biodiversity and promoting plant growth, making them an eco-friendly and sustainable alternative to chemical nematicides. Fungi, including endoparasites, nematode trapping, ovicidal, and toxin-producing fungi, play a crucial role in controlling *Meloidogyne* spp root knot disease in plants, using adhesive knob rings to kill nematodes.

Entomopathogenic Fungi as Bio Control Agent of Root Knot Nematodes: As entomopathogenic fungi (EPFs) possess nematode-controlling abilities, they can be utilized to manage nematodes that significantly reduce agricultural yields, such as Root knot nematodes (RKN). Infecting and killing both juvenile and adult RKN, *Beauveria bassiana* and *Metarhizium anisopliae* are efficient EPNs for biocontrol. They create enzymes that break down the cuticles of nematodes, killing the larvae, juveniles, and adults. *M. anisopliae* and *B. bassiana* have demonstrated substantial rates of nematode reduction, but *M. incognita* is toxically affected by beauvericin.

Toxin Producing Fungi: Fungi that produce toxins, such *Pleutrus Ostreatus* oyster mushrooms, have been investigated for their potential as biocontrol agents against RKN *Meloidogyne* species. As a sustainable and eco-friendly substitute for chemical nematodes, these fungus create poisons or secondary metabolites that can injure nematodes. The mushrooms have the ability to paralyze and inactivate worms, while organic amendants decrease nematodes and gall on cowpeas while boosting plant development and productivity.

Nematode Trapping Fungi: *Aspergillus awamori* isolate BS05 is a nematode-trapping fungus that uses hyphal rings to create traps that allow nematodes to enter and be digested. In tomato plants, this fungus has been demonstrated to suppress female galls and egg masses, decrease soil nematode populations, and boost plant shoot, root, and day weight. It was also effective as a predator against *M incognita's* J2.

Nematophagous Fungus-Derived Secondary Metabolites and Nematode Compounds: The nematicides activity of *Aspergillus niger* strain F22 against M. incognita resulted in decreased egg hatching and juvenile mortality. Nematicides activity and acetic acid were detected in the culture filtrate. The Vocs of *Fusarium oxysporum*, *Concertria cesati*, and *de*

Notaris are examples of volatile organic compounds from microorganisms that have been employed as bioagents for nematode control. Proteases and chitinases from fungi such as *Beauveria bassiana, Leucanicillium lecanii,* and *Trichoderma harzianum* have also been employed as biocontrol agents against worms that parasitize plants.

Plant Extract: In order to combat Root knot nematodes, a parasitic worm that corrupts crops by infecting roots, decreasing nutrient uptake, and lowering yields, plant extracts have been employed as biocontrol agents.

1. Toxicity & Nematodes: Toxic secondary metabolites such as alkaloids, flavonoids, saponins, and terpenoids found in plant extracts can damage nematodes and impair their ability to survive and reproduce.

2. Antifeeding Effects: Certain plant extracts can reduce the harmful effects of nematodes on plants by preventing them from feeding on their roots.

Conclusion

Microbes, including bacteria, fungi, and actinomycetes, are being used as a biocontrol agent against plant parasitic nematodes, offering a sustainable and eco-friendly alternative to chemical nematicides. These agents stimulate soil self-regulation, improve soil nutrient content, enhance biological activities, promote plant growth, and exert lethal effects on nematodes through various modes.

References

1. Adaka, P., Singh, A., Dhiman, P., Chandrika, K. P., Walia, S., Sirohi, A., and Parmar, B. S. (2017). Hydrogel based formulations of *Tagetes patula* root extract and MgSO4 to control *Meloidogyne incognita* in cucumber. Allelopathy J, **40**, 173-186.
2. Jacob, C. (2006). A scent of therapy: pharmacological implications of natural products containing redox-active sulfur atoms. Natural product reports, **23**(6), 851-863.
3. Fabiyi, O. A. (2021). Evaluation of plant materials as root-knot nematode (*Meloidogyne incognita*) suppressant in okra (*Abelmuscous esculentus*). Agriculturae Conspectus Scientificus, **86**(1), 51-56.
4. Gommer, F.J. Biochemical interaction between nematodes and plants and the irrelevance to control.Annu.Rev.Phytopathol.2002, **40**; 234-246.