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Beneficial Role of Nematodes in Soil Health

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SUMMARY

Nematodes are one of the most abundant animals on earth and they play a key role in the food webs of soil ecosystems, including microbial ecosystem due to their ubiquitous nature. Nematodes help regulate the population of other soil organisms as entomopathogenic nematodes including predatory nematode and are also being used as indicators for environmental disturbance and predaceous pest in managing plant diseases. The main function of nematodes is that they decompose organic matter and mineralize nutrients into plant available forms and indirectly effect the microbial-feeding nematodes.

INTRODUCTION

Nematodes are used as bio indicators of soil health because of their cosmopolitan distribution and due to their diverse feeding behaviours and life strategies, ranging from colonizers to persisters. Nematodes are worms like that live freely in the soil environment, marine and fresh water, they are one of the soil microorganisms which have important role in the soil habitat. In soil, nematodes functions as by decreasing the remains of larger animals and plant tissues (Dropkin, 1980). Nematodes contribute to a variety of functions within the soil system Predaceous nematode reduce population of plant parasitic nematodes and also release nutrients in plant available forms, which enable plants to better withstand nematode burden on the roots. Biocontrol potential of predatory nematode depends upon the rate of predation, prey searching abilities, strike rate, resistance to environmental conditions. Nematodes as Entomopathogenic nematode helps in controlling nematode population. EPNs are able to locate their host in response to carbon dioxide, vibration and other chemical cues in soil environment. These nematodes have a broad host range, are safe to non-targeted organisms, compatible with chemical pesticides, and can be genetically manipulated for desired traits such as host finding etc.. In agricultural systems, nematodes can enhance nutrient mineralization and act as biological control agents.

Role of Nematodes in Soil Habitat

In agricultural systems, nematodes can enhance nutrient mineralization and act as biological control agents. Due to the cosmopolitan distribution of nematodes, they inhabit most environments and play a key role in the food webs of many microbial ecosystems, including agricultural soils. Nematode can also be a benefit to growers by helping to control insect pests and more importantly, in the recycling of nutrients. They are increasingly being used as indicators of environmental disturbance and reduced biodiversity. Nematode community analysis is attracting huge attention as they are good monitors of biodiversity and environmental indicators.

Dispersal of microbes: Nematodes help distribute bacteria and fungi through the soil and along roots by carrying live and dormant microbes on their surfaces and in their digestive systems.

Food source: Nematodes are food for higher level predators, including predatory nematodes, soil micro arthropods, and soil insects. They are also parasitized by bacteria and fungi.

Role of Nematode in Nutrient Cycling

Like protozoa, nematodes are also important in mineralizing nutrients into plant available forms. When nematodes ingest bacteria or fungi, ammonium (NH4+) is released because bacteria and fungi contain more nitrogen than the nematodes. Nematodes contribute directly to nutrient mineralization through their feeding interactions. For example, bacterial-feeding nematodes consume N in the form of proteins and other N-containing compounds in bacterial tissues and release excess N in the form of ammonium, which is readily available for plant use. Indirectly, nematodes enhance decomposition and nutrient cycling by grazing and rejuvenating old, inactive bacterial and fungal colonies, and by spreading bacteria and fungi to newly available

organic residues. In the absence of grazers, such as nematodes and protozoa, nutrients can remain immobilized and unavailable for plant uptake in bacterial and fungal biomass. Nematode grazing control the balance between bacteria and fungi, and the species composition of the microbial community.

Role of nematodes as predators

The soil-inhabiting nematodes dominate over all other animals, both in numbers and species. They mainly fall under four groups based on their feeding types-the microphagous which feed on microorganisms, the saprophagous obtaining food from the dead and decaying organic matter, the phytophagous feeding on plants and the predaceous which kill other organisms for food. Predatory nematodes generally feed on smaller organisms like protozoa and other nematodes and help regulate population growth of bacterial- and fungal-feeding nematodes and protozoa, and help regulate populations of plant-parasitic nematodes. The possibility of using predatory nematodes specially the mononchus for checking populations of plant parasitic nematodes in soil was speculated by Cobb (1917) while making observations on their biology and predatory ability. Predatory nematodes belong to order *Mononchida*, *Diplogasterids*, *Aphelenchida*, *Enoplida* and *Rhabditida* and are most suited for biocontrol of nematodes, because of their short life cycles, easy culture, prey-specificity, chemotaxis sense and resistance to adverse condition. As a biocontrol agent the predaceous nematodes offer an ecologically safe alternative to chemical nematicides.

Role of nematodes in organic matter decomposition

The soil nematodes, especially bacterial- and fungal-feeding nematodes, can contribute to maintaining adequate levels of plant-available N in farming systems relying on organic sources of fertility (Ferris *et al*., 1998). The chemotropic bacteria convert the excretory product of nematodes (i.e., ammonia) to nitrate and nitrite compounds. The predominance of bacteriophagus nematodes in agricultural soil systems helps in faster rate of mineralization, decomposition, and nutrient turn over. Nematodes contribute directly to nutrient mineralization through their feeding interactions.

Role of nematode as Bioindicators

Nematodes can be used as bioindicators of soil health because they are ubiquitous and they have many biological features that reinforce their use as indicators and nematodes indicate resource availability at the lower end of the c-p scale and are considered enrichment opportunists and Persister nematodes indicate soil system stability, food web complexity and connectance at the high end of the scale. Nematodes have a, permeable cuticle which allows them to respond to a range of reactions like pollutants and correspond with the restorative capacity of soil ecosystems. Some nematodes have resistant stages such as cryptobiosis or cysts that allow them to survive inactively during environmental conditions unfavorable to growth and development. Nematodes have heat shock proteins that are highly conserved. Some nematodes can survive harsh, polluted, or disturbed environments better than others, and some nematodes have short life cycles and respond to environmental changes rapidly. Nematodes are easy to sample and extract from soil, because of these characteristics, nematode faunal analysis provides insight into soil habitat conditions. Nematodes respond rapidly to disturbance and enrichment: increasing microbial activity leads to changes in the proportion of bacterial feeders in a community. Nematodes are used as biological indicators of soil health because the number and types present in a soil reflect changes in the microbes they consume, and the soil's physical and chemical environment. Some nematodes have been used as environmental biomonitors for aquatic systems. For example, *Panagrellus redivivus* has been used as a biomonitor to detect toxin concentrations that affect molting and organism size through stimulation, inhibition, or lethality, and provides a rapid bioassay that costs less than 10% of a *Salmonella* bioassay.

CONCLUSION

For a sustainable approach towards agriculture and maximum results can be obtained with the effectiveness of other practices without any hindrance. Since beneficial nematodes can interact synergistically with several chemicals and bioagents a combination of various strategy can be put together to achieve a satisfactory result. For instance increase in shelf life of nematodes, improvement in transport logistic and marketing will substitute nematicides and contribute towards achieving a stabilize agriculture environments and increase crop production and yields.

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