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Review Article

Agro-Ecological Importance of Nematodes (Round Worms)

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Abstract

There are a number of major concerns regarding to Agricultural and ecological importance of Nematodes species.

Background: Nematodes are multicellular organisms with vermiform invertebrate animal species, almost microscopic, of which are nearly invisible to eye while they live in the soil and as parasites of both plant and animals. Nematodes are found almost everywhere in the world, from almost all terrestrial to aquatic habitat, parasites forms from exoparasites to endoparasites of both plants and animals and also nematodes are ubiquitous, present in all moist ecological niches in diverse situations, and in soil ecosystem. However, survival, growth and reproduction of nematode are largely depend on the soil moisture, temperature, availability of a food source and suitable host organisms. In addition, most species of nematodes are free-living, with their food consisting of micro-organisms fungi, bacteria, algae, and other nematodes and these play an important role in decomposition and organic nutrients recycling in an ecosystem.

Objectives: The objectives of this review is to focus on the biology of nematode species including basic characteristics, the diversity classification, its reproduction, habitat and habits of nematodes. In addition, it includes agricultural and ecological importance of nematodes such as biological control of insect pests, both advantages and disadvantages and also management of nematodes.

Methods: Reviewing relevant information's from related international published researches and review journals, books and other biological materials and rewrite based on scientific study of nematology.

Results and Conclusion: The science of nematology is relatively young compared to entomology and plant pathology and free living nematode species are abundant, including nematodes that feed on bacteria, fungi, and other nematodes, yet majority of species encountered are poorly understood, Thus, despite the significant role of nematodes in agricultural and ecological value, still much is not yet understood. Therefore, this review is important for brief description of nematodes biology, habitat and diversity of nematodes, agricultural and ecological importance and also integrated management system of nematodes.

Keywords: Agricultural Value; Ecological Importance; Nematodes Biology; Nematology

Introduction

According to different researchers and biological information's indicates that, nematodes are invertebrate animals of living organisms that found almost everywhere in the world, from aquatic to terrestrial habitat and from free living to parasite (endoparasites and exoparasites of other animals) with varied shape of elongate, threadlike, roundworms, or eelworms active animals and nematodes are one of the most successful and adaptable of animal groups, next to insects as regards range of habitats or number of species. Many nematode species are extremely successful parasites, most are free-living, their food consisting of micro organisms like algae, bacteria, and fungi, which play an important role in decomposition and nutrient recycling. Majority of soil free living nematodes mainly feed on fungi and bacteria and their biological process is largely depend on soil moisture and temperature, and also food availability and appropriate host of both plant and animal. Nematodes are multicellular organisms on earth with vermiform invertebrate animal species, almost microscopic, of which are nearly invisible to eye while they live in the soil as habitat and as endoparasites of both plant and animals [1-3].

Invertebrate animal species of phylum nematodes have great importance for agricultural values and ecological benefit due to they are the second most diversified invertebrates with adaptation of various habitat range and feeding behaviour. The habitat variety of nematodes are ranging from aquatic (such as fresh water, estuarine and marine water), terrestrial (as free living in the soil) and parasitic (either endoparasites and ectoparasites of animals and plants). Based on Pokharel, and Larsen [2] and Pokharel., *et al.* [3], soil nematodes are very important in protecting the organic nature of soil, particularly low organic content soil, and phytoparasitic nematodes are feed tissue of plants, reduce the growth and productivity of plants. In addition, soil nematodes also assist colonization of microbial substrates and nutrients mineralization in the soil

and also during metabolism of nematodes, important nutrients like nitrogen and vitamins also released which used to speed up bacterial growth in the soil. Many nematodes feed on bacteria and fungi within the soil as generalist predators like omnivorous and predatory nematodes which used to improve nutrient cycling and allows slow release of nutrients. The free-living nematodes used to make nitrogen available to plants and mineralization of other soil nutrients is relatively high compared to bacteria in soil ecosystems and also feed on other soil microbes including plant pathogens such as bacteria, fungi, and other nematodes. Free-living nematodes are important for any crop production system by protecting nature of soil and other nematodes are extraordinarily lethal to many important soil insect pests and yet safe for plants and animals and they are used to control many soil inhabiting insects [2,3]. Therefore, this review is significant to indicate briefly the importance of nematodes on both agricultural value and ecological benefits.

According to the American Phytopathological Society [4] information indicates that, nematodes have great economic benefits of both harmful and useful effect, most plant nematodes are less than 1 mm long in size with stylet (a sharp needle-like structure found in their mouth) are responsible for some 15% loss to crops per annum world-wide, equating to some US$78 billion. Majority of plant feeder nematodes found in the soil, feed on plants and reduce water and nutrient absorbed by the plants root, and so the plants can reduce its drought resistance ability and also some other nematodes transmit disease causing microscopic organisms like viruses to plants when they feed on plants. Therefore, if number eelworms are becomes high in the soil, it is advisable for farmers to apply chemicals such as fumigants or nematicides to their farm land soil to control agricultural productivity. But, such chemicals are toxic and dangerous to human health humans and surrounding environment and also some nematicides chemicals can contaminate drinking water due to simply leak via the soil and most nematodes species have helpful effect on human being and their activities. Large number of nematode species are free living in soil, in aquatic (marine and freshwater) and mainly feed on algae, bacteria, fungi, protozoans and other nematodes, and such nematodes play an important role in decomposition and recycling of nutrient by releasing of relevant nutrients for the plant growth of plants and also other nematodes control insect pests by assault insects. These nematodes which attack insect pests are a biological insecticide [4] used as biological control methods due to they are commercially reared and released to control some insect pest. Therefore, this review paper is important to address biology of phylum nematodes, agricultural and ecological importance of nematodes, the economic benefits of both harmful and useful effect of nematodes and also integrated management system of nematodes.

Biology, Agro-ecological importance and gastrointestinal impacts of Nematodes

The main body of this review mainly focus on the major points of Agricultural and ecological importance of Phylum Nematodes (round worms). Specifically, on the biology of phylum nematodes including basic characteristics, the diversity, classification, reproduction, habitat and habits of nematodes; Agricultural importance of nematodes as primary decomposers in most environments, as biological control of insect pests and other importance of nematodes in terms of both advantages and disadvantages; Ecological importance of nematodes with their biotic and abiotic environment; gastrointestinal impacts of Nematodes on human and also management of nematodes are explained briefly as follows.

Biology of nematodes

Biology of nematodes including general characteristics, diversity, classification, reproduction, habitat, habits and epidemiology of nematodes. The nematode species are found everywhere, roughly in all habitats and mostly nematodes are parasitic in nature infecting humans, animals, insects and other invertebrates and some other nematodes are plant parasites which can cause economic damage to cultivated plants and also nematodes are abundantly present in marine, freshwater, parasitic and free living in soil. Nematodes (roundworms) are a collection of wormlike invertebrate animal species grouped under phylum Nematoda with more than 15,000 identified species today, found in different range habitats from aquatic to terrestrial environments. Free living species of nematodes can live in both aquatic and terrestrial habitat or they can exist as parasites (endoparasites and ectoparasites) of both animal and plant species. Some of the worms belonging to the phylum Nematoda include:- Ascarids, Filarias, Whipworms, Adenophorea, and Enoplea. The general characteristics of nematodes (roundworms) includes a round cross section, have elongated body, reproduce sexually (separate sexes), very small and can be microscopic and some nematodes can measure up to one meter long [5,6]. Nematodes are classified under Kingdom Animalia, and they are eukaryotic, metazoa (multicellular organisms) that obtain nutrients from organic sources. Phylum Nematoda are one of the second diverse organisms of Kingdom Animalia with characteristics of tubular structure, elongated form and mostly microscopic with exception of some naked species. However, there are nematode infect sperm of whales can grow about the length of 9 meters such as *Placentonema gigantissima,* but head and tail of this nematodes are not separate, and they have nervous system and a cuticle used to controls their muscle cells [6,7].

The general characteristics of phylum Nematodes are briefly explained as follows. According to research studies of Donald [6]; Paul [7], and Alan and Bird [5], result indicates that, nematodes are competitor Arthropoda both in biodiversity and abundance of species. Nematodes are the second most diverse invertebrates animals found on earth with described number of about 20,000 species of nematodes. Therefore, their evolutional path resulted in their structural diversity, their physiology, and different mode of reproduction, gives nematodes to be the most successful species, adapt many habitats better than other multicellular organisms. In addition, nematodes have unsegmented cylindrical morphology and majority of nematode species have a complete digestive (alimentary) tract. Phylum nematodes have different feeding habits and adaptation of various environment from parasitic species (Ectoparasitic nematodes remain outside the host cells and feed on plant roots while endoparasitic nematodes establish residence within plant tissue secretions of the host), to some of the species feed on various plants, algae and detritus, and others are carnivores that feed on fungi, bacteria and other nematodes. Majority

of nematode species are free living organisms in the soil, a lot of them are parasitic (endoparasitic and ectoparasitic) species that infect human beings and animals. In addition, some of the species that are parasitic to human beings, such insects as mosquitoes act as intermediate hosts and via these insects, nematodes develop before infecting human beings with the potential of causing various diseases. Some nematodes may enter to the bloodstream of human beings can cause damages of tissue, spreading to other parts and affect internal organ of human. In addition to animals and human beings, nematodes can affect roots of plants, that can prevent them from absorbing water and nutrients can affect growth and cause reduction of crop production or can completely destroy the crops [5-7].

Phylum nematodes are a fascinating, biologically diverse group of organisms with the ability to adapt to a wide variety of habitats including freshwater, marine water, and soil, provides an evolutionary advantage for species longevity. Free living soil nematode species plays important role in decomposition of organic matters found in the soil that is beneficial to plant species. There are three main monophyletic groups of phylum nematode, such as Chromadoria (nematodes of various environments), Dorylaimia (parasitic trichinellids and mermithids) and Enoplia (marine nematodes) [8]. Freshwater nematodes due to their small size and taxonomic complexity, they doesn't have much attention in the habitats of freshwater, but they have great importance in freshwaters habitats ecological balancing with their densities of 1million m−2 in freshwater or less than length of 1 cm in most nematodes of freshwater [9].

An Agricultural importance of nematodes

According to different researchers results indicates that, nematodes are diverse population group of invertebrate animal species, which makes them as the primary decomposers in different environments. Their feeding type, digestion of food and excretion of waste products of nematodes are important to plants by allowing essential nutrients and minerals to be recycled from decaying organic matter, in addition to bacteria and fungi. Parasitic nematodes causes heavy losses to agricultural production and public health in the world. Majority of free living nematodes feed on microscopic organisms such as protozoans, bacteria, fungi and other creatures and nematodes and thus they play an important role in soil ecosystem by releasing relevant nutrient for plant growth and agricultural production, but parasitic nematodes can causes heavy losses to agricultural production and public health in the world and also beneficial nematodes are naturally occur in the soil to control soil pest insects. In addition, nematodes are also biological indicators of soil health due to reflecting changes of microbes that they feed, physical and chemical nature of soil environment. Therefore, the main agricultural importance of nematodes information's are explained as follows briefly.

The plant parasitic nematodes have great economic impact on crops production and they are a burden cost in agricultural production [10]. Collectively, they cause an estimated $80–$118 billion dollars per year in damage production of crops [11]. The encompassing 15% of all identified nematode species, the most economically important species are directly targeted plant roots of the major production of crops and they prevent uptake of water and nutrient, resulting reduced of agronomic performance, quality and yields of crops. There are also species of plant pathogenic nematodes, invertebrates, and fungi are considered as the most important agricultural pests. Of which, nematodes are the most successful species of the inactive groups which establish a permanent feeding site in the plant host and absorb nutrients while completing their lifecycles. The sedentary species of nematodes have a natural advantage more than their migratory relatives due to a charming and complex method of host cell alteration resulting in the development of a sustainable feeding structure. From more than 4000 described plant parasitic species of nematodes, only some of them produce economic losses in crops production. Some of the major genera of phytoparasitic species of nematodes cause crop losses are *Xiphinema, Rotylenchulus, Pratylenchus, Meloidogyne, Hoplolaimus* and *Heterodera* [12].

The majority of soil nematodes are present in the rhizosphere of plant root area are the soil surrounding the root of plant where microbiological activity is exceptionally high. Soil contains juvenile larval and eggs form of nematodes which are parasites of human, animals and insects. Most nematodes studied on the soil parasitic and they are classified on the basis of their feeding habits and therefore, most nematodes present in agricultural soil are the bacterial feeders, fungal feeders, plant parasites, predators, omnivores and others. The predatory nematodes feed on protozoa and other soil nematodes whereas omnivores feed on different foods depending on environmental conditions and food availability and so primarily feeds on protozoans and other small nematodes as predators as primary food source, and also they can feed on fungi or bacteria [13]. There are a number of impacts of plant parasitic species of nematodes on agricultural productivity, their biological control methods and the remove cytoplasm by killing the host cell while inactive nematodes become immobile after the development of a feeding site in the host tissue [14]. The migratory endoparasitic species of nematodes of economic implication such as the lesion species of nematode (Pratylenchus spp), burrowing species of nematodes (Radopholus spp) and rice root species of nematode (Hirschmanniella). Therefore, important role nematodes in agricultural health as explained bellow in terms of nematodes species used as biological pest control, improve soil fertility, nitrogen cycle, decomposition of organic matters, plant parasitic nematodes, used as bioindicators of soil health, and as pathogenic infection of organisms.

Nematodes used as biological pest control

Nematodes have great importance in agriculture in nutrient recycling and controlling insect pests as biological control methods. As increasing organic agricultural demands biological control methods concerns for environmental wellbeing and decreased chemical pesticides. According to Donald [6]; and Paul [7], nematodes have a range of agricultural benefits like biological control of various insects pest and ecological values. One of the main characteristics of some species of nematodes is that they are natural predators with a big advantage to hunt and kill well over 200 species of

pests and so these nematodes act as biological control of various pest insects that affect human beings and plants. Nematodes are beneficial as biological control, with the following advantages of that they do not negatively affect the health of human beings and other animals with various chemicals and while they may infect certain insects with bacteria that ultimately kills the insect, some also live as endoparasites in some of the agricultural pests and they are also beneficial to the soil given that they contribute to decomposition and do not pollute the soil [6,7]. Therefore, pest management needs another means of biological controls methods for great importance for crop producers [15,16]. The study reported by Gaurab [13] indicates that some predator species of nematodes ('entomopathogenic' nematodes) can attack and kill a number of pests including beetles, borers, grubs and thrips with insignificant effects on other organisms. In general, nematodes species mostly feed on very smaller organisms such as bacteria, fungi, protozoa, and other nematodes and also some other nematodes can live in association with specific bacterial species that can infects a number of insect pests, during infection nematodes releases bacteria that multiplies in the host and kill insects hosts [13].

Nematodes used as decomposition of organic matters

Nematode species have great significance in agriculture in various ways, in terms of decomposition of organic matter, improving soil fertility and recycling of nutrients in an ecosystem. Species of nematode are the most important invertebrate animals used for agriculture in terms of soil fertility and recycling of significant nutrients like nitrogen via nutrient mineralization directly via their interactions of feeding. For instance, when nematodes feed bacteria, it consume nitrogen in the form of proteins, other nitrogen compounds and excess nitrogen release in the form of ammonium (NH4+), which is important for plants [13]. The important plant parasitic nematode species and association of plant nematode have the development of feeding structures involved in host infection and absorption of host nutrients [17,18]. In addition, useful nematode species play an important role such as, used as decomposers, attack and kill a variety of organisms and feed on plant parts, and some of the nematodes also act as an intermediate decomposers which is responsible for the breakdown of organic matter by broking down for decomposition process done by microorganisms such as bacteria and fungus [6,7]. Soil nematodes are free living, very important for decomposition of organic matter and nutrients recycling in the soil. Bacteria and fungi feeder nematodes doesn't directly feed bacteria and fungi from soil, but it feed bacteria and fungi that decompose organic matter. The presence bacteria and fungi feeder nematodes with their feeding activity used to accelerate the process of decomposition of organic matter. Therefore, the feeding of nematodes used to recycles minerals and other important nutrients from microorganisms such as bacteria, and fungi in the soil where it is available by roots of plants [13].

Nematodes as plant parasites

Plant-parasitic nematodes utilize their a hollow and needle like structure to search and release plant tissue and a collection of proteinaceous secretions from their dorso-ventral glands of the host cell and which allow for the entry of nematode and these secretions of glandular encourage cellular modification which are necessary for the development of active metabolism of feeding cell [19]. There are some plant parasitic nematodes that can infects the roots of plants and damage agricultural crops, like Globodera. Anatomically, the mouthpart of such kind plant parasitic nematode species have a needlelike stylet sturucture which is used to pierce the plant cells while they are feeding. There are two types of plant parasitic nematodes are called endoparasitic and ectoparasitic nematodes. Endoparasitic nematodes which enter roots and can live and feed within the root and ectoparasitic nematodes which remain in the soil and feed at the root surface [13]. In addition, ectoparasitic nematodes are found remain outside the host cells either plant or animal species and they feed on plant parts like roots while endoparasitic nematodes are also internal parasites of plants and animals that found as home within plant tissue. Therefore, such parasitic nematodes resulting viral infection causes the tremendous economic losses in the worldwide [20]. The plant parasitic nematodes have developed specialized dorsal esophageal glands which considered as the most important evolutionary adaptations for nematodes plant parasitism [17,18].

Nematodes used as bioindicators on the conditions of the soil health and as dispense of microbes for infection

Nematode species used as bioindicators on the conditions of the soil health are depends on the condition of soil nature, surrounding climate and seasons, variety of crops and others. So, this dependency of nematodes indicates that the conditions of soil health, diversity and complexity of nematode species in the soil is a precious instrument that indicates the biological fertility of soil and health of soil [13]. In addition, nematodes also used as dispense of microbes for infection because there are nematode species which carrying both live and inactive microbes on their body surfaces and also inside of their digestive systems that can help for the distribution of microbes like bacteria and fungi via out the soil around rhizosphere region of the plants and sometimes other nematode species are acts as a vector for plant viruses, such as Nepo viruses and *Tobraviruses* [13].

Nematodes used as a pathogens of human and other animals

There are nematode species used as a pathogenic species to human and other animals, such as *ascaris lambriocoids* [13].

Ecological importance of nematodes

According to Salih., et al. [21] and other researchers report indicates that, free-living soil nematodes have great ecological importance due to they are the most common, abundant, and genetically diverse metazoan organisms found in many habitats particularly soils. The free-living soil nematodes constitute large proportion of total soil nematodes includes different trophic groups such as bacterivores, fungivores, predators and omnivores. Based on their trophic group, bacterivores nematodes feed on bacteria and other microflora; the fungivores nematodes have feeding habits on fungal mycellium, hyphae and conidia, including plant pathogenic fungi; the predatory nematodes feed on invertebrates such as protozoa,

nematodes and rotiferes and omnivorous nematodes feed on algae, bacteria, fungi, protozoas, rotiferas, tardigrads, etc. These trophic groups closely show a relationship to other microorganisms and participate in fundamental ecological processes in soil directly or indirectly. Because of their abundance, rapid life cycle, and strong interactions with other soil microbes and predators, free-living nematodes play an important role in decomposition of organic matter and nutrient cycling. Free-living soil nematodes feeding on primary decomposers of plant and animal debris contribute to the carbon cycle and increase soil mineralization and soil nutritional element which accessible for plant roots. They also regulate releasing of phosphorus and nitrogen from microorganisms they digest, immobilizing nutrients in their live tissues and excreting excess nitrogen as ammonium. Free-living nematodes also used as bioindicator for evaluating of soil condition [21].

Nematodes have great ecological functions in an ecosystem in various ways, such as their diversity due to adaptation, diverse feeding habits, recycling of nutrients, biological control of insect pests, economic impact on both plants and animals as pathogens, and others interactions in the environment. Specifically, a nematodes alone and/or grouping with other pathogenic species, constitute an important constraint to world food production [22]. Although not all plant parasitic nematodes are of economic importance, nematode damage to agricultural crops is estimated globally to cause losses in the range of 8.4-20.6% in life sustaining and economically commodity of crops [23,24]. In addition, a small number of species of some genera can act as virus vectors and some are post-harvest pests [25,26], thereby reducing the longevity and marketability of the harvested crop [27]. Nematode infection is also known to compromise plant resistance to other soil borne plant pathogens and to disruption of the usual root functions, processes such as nitrogen fixation in the root nodules of leguminous plants is suppressed by species of Meloidogyne (root knot) nematodes [28], even when there is no visual reduction in nodulation. Reduction in root depth extension caused by nematodes also increases crop susceptibility to water stress leading to wilting and yield loss. The completion of the life cycle of nematode is dependent on the three interacting components of the host plant, parasite species and environment (includes both biotic and abiotic components) [28].

Integrated management system of nematodes

Integrated management system of nematodes as pest is important to control both agricultural and ecological values of the ecosystem. Most nematode species assault of roots and underground parts of the plants species, and some nematodes feed on leaves and flowers parts of the plants. There are plant parasitic nematodes which have great economic importance, but due to most of them are live in the soil, they represent as the most difficult pest to identify their role, to show and control their impact [29]. The effect of nematode species are underestimated by farmers, agronomists and consultants of pest management, but lost of world crop production that damaged by nematode estimated as 10 percent [30]. In addition, nematode are the main factor of infection to soil borne pathogen and stresses of the environmental and deficiency of micronutrient. Therefore, management of nematode species is very important to focus on reducing harmful nematode numbers to the lower levels of damage than eradication of nematodes [2]. Large populations of free living nematodes can help to control many different plant parasitic nematodes in the soil, so to sustain these nematodes, provide sufficient food of organic matter to increase free living nematode populations in the soil. Soil solarization is very effective for control of many nematodes and other soil borne pathogens, however, this may not be effective if the nematodes are found in deep soil as these nematodes from deeper layer might come back by plowing [1-3].

Based on different researchers reports, nematodes have great importance in agriculture in nutrient recycling and controlling insect pests as biological control methods. As increasing organic agricultural demands biological control methods concerns for environmental wellbeing and decreased chemical pesticides. Therefore, pest management needs another means of biological controls methods for great importance for crop producers [16,29]. There are parasitic species of bacteria that infect nematode species of both plant parasitic and free living species of nematodes [31]. The three methods of application evaluated for the nematodes controlling are seed, transplant and treatments of post plant [32]. Based on the study of greenhouse involving cucumber, all the above three treatments shown to reduce galling as number of soil nematodes and reproduction of nematode and also in other study reports, suppression observed in the field soil treated comparison to untreated soil, bacteria have shown as a great assure in the management of nematode [33].

All management strategies are geared to break this 'pest triangle' by manipulating one or more of these factors. However, the diversity of plant parasite nematodes makes any overall control strategic problem. Whatever the strategy, the intent is similar to reduce the initial plant parasite nematodes in the soil prior to planting and to reduce the subsequent rate of nematode increase on the crop [34,35]. Management of nematodes may be approached by using an integrated methods of pest management system. Because, some of the most commonly practiced methods including crop rotation, developing resistant and tolerant cultivars, using chemicals and cultural practices [36,37]. The economic importance of nematodes has been associated with the levels of economic damage in the soils and so, it can cause the economic damage of soil type when the intensity of cereal cropping yield losses due to nematode [38-40].

Conclusions and Future Directions

Conclusion

Nematodes are large population and diversity around the globe, makes them the primary decomposers in most environments and feeding, digestion, and excretion enable nutrients and minerals which are essential to plants, to be recycled from decaying organic matter, with their diverse food consisting of micro-organisms such as protozoans, fungi, bacteria, algae and even other nematodes, and these play an important role in decomposition of organic material and recycling of nutrients in soil, release of nutrients for plant growth and they are a major component of soil and sediment ecosystems, so they are accessible to plants. Nematodes are elongate,

threadlike, roundworms, tubular organisms or eelworms active invertebrate animals found almost everywhere and causes heavy losses to agricultural production and public health in the world. Nematodes are one of the most successful and adaptable of animal groups, being rivaled only by insects as regards range of habitats or number of species. Most nematodes are harmless, but a troublesome nematode species can attack the outer surface of plants, by burrowing the tissue of plants and causing damage on some parts of the plant like root, stem, folar and flowers. Other nematode species are endoparasites of plants and they can live inside the plants part and causing damage the whole plant parts. There are nematodes that used as bioindicators of the health of soil, the physical and chemical environment of the soil. The nematodes economic significance has been directly associated with the economic levels of crop damage. So that, it can cause economic damage of soil when the cereal crop yield losses exceeds a certain limit. Nematodes usually are introduced into new areas with infested soil or plants, can be prevent by using only nematode free plants purchased from reliable nurseries and prevent the spread of nematodes, avoid moving plants and soil from infested parts of the garden.

Future Directions

Free-living nematode species are most plentiful, including bacteria feeding nematodes, fungi feeding nematodes, and other nematodes feeding nematodes, up till now the majority of species are biologically poorly understood. The approaches of nematodes management can be used in combination methods with an integrated pest management system. The most commonly used practiced methods are crop rotation, developing resistant and tolerant cultivars, using chemicals and cultural practices. Large amount of production of food in many countries comes from small farming comparatively in small farm land and the loss of crops is due to pests and diseases in monoculture farm land with the help of pesticides and inorganic fertilizers. Nematodes are the most vulnerable when they are actively searching for host roots, surviving and growing seasons. There are techniques used to increase the temperature of soil by solarization value to control nematodes, develop required strategies via understanding the growth of host plant and nematode biology. In addition, in some climates planting the crop when slow of invasion of nematode. Therefore, new research will require multidisciplinary collaboration to enable the integration of traditional practices with new ideas created by the scientists and more research required on nematode biology and the environment, and nematologists must consider several possibilities regarding to how nematode life cycles can be interrupted, how microbial activity at the root soil interface nematode invasion can be promoted, identification of harmful nematodes, selection of resistant varieties, or tolerate nematode infestation, and that can produce acceptable yields and also developing biological control methods are some of the recommended information.

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