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Bioecology of Phytonematoids of Intensive Gardens in Surkhandarya Conditions

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Abstract
This article discusses the global impact of phytonematodes on crop production and presents a recent assessment of crop losses caused by these tiny creatures. The habitat, taxonomy, biology, parasitism, sampling, spatial distribution, contribution in the soil food web and management of plant parasitic nematodes are described. Progress in molecular and biochemical studies on these nematodes is highlighted. The economically important plant parasitic nematodes worldwide, as well as the economic thresholds for damage by these nematodes, are also described. Future prospects are mentioned.

Keywords: assessment, parasitism, sampling, spatial, distribition

It is well known that the 2008 global financial crisis, considered by many economists to be the worst financial crisis since the Great Depression of the 1930s, has played a key role in hindering many small and large businesses, and causing a decline in consumer wealth and downturn in economic activity creating high unemployment, unfavourable conditions for new businesses, increase in prices of goods and services and low income per capita. In this context, agriculture, as a far-reaching activity in terms of both economy and sociology throughout world civilization in the history of mankind, has been adversely affected. Combined with applying intensive agriculture systems, usage of arable land for nonagricultural purposes and land degradation through erosion, salination, desertification and pesticides' contamination and/or other byproducts of civilization, one will realize that the arable land remaining to feed the growing population will be decreasing on both absolute hectares and hectares per capita (Thomason et al., 1983; DEFRA, 2010). In developing countries where hectares per capita is already less than that in developed ones, loss of land for such, or other, reasons will erode their production potential in the agricultural sector. Moreover, individuals and groups of mankind cannot save huge financial resources to continue the policy of securing reasonable development for other reasons widely known all over the world; economic losses due to war damage effected globally, new diseases which demand ample costs to overcome, and non-optimal utilization of available resources. All these in one way or another minimize such resources which could be directed to fill in the gap of agricultural produce. In addition, a continuous challenge is to face an ever-increasing world population with more and better food. Now, experts at almost all levels in developing and more developed countries recognize the seriousness of the world food problem. Given such a situation, in order to achieve more and better food, further research is required on how to make more ambitious goals or ends adequately meet with less resources or means. From the agricultural economic point of view, ends or objectives may target physical production tools, agricultural services, consumption or profits. Means are concerned with physical resources, funds or organizations that can be used in achieving the objectives. Therefore an economic problem arises only if there are many ends that need satisfying, and that the means to achieve these ends are limited. Hence, the central problem in economics is the problem of choice between alternatives. To resolve the problem of choosing

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between alternatives, economics deals with implementing the alternatives that can best maximize ends, such as physical output, consumer satisfaction and resource allocation and minimize means, like the use of land, labour, capital and organization; i.e. maximization of ends with the given means or minimization of used means for the given ends (Khan, 1972). In this context, nematodes have rarely been considered or recognized as major limiting factors until all other constraints on yield increase have been removed (Bridge, 1978). Therefore, it is essential that the full spectrum of crop production restrictions is fully and appropriately considered, including the often overlooked phytonematode constraints (Nicol et al., 2011) to maximize agriculture output. Some scientists could count more than 1 million kinds of nematodes, rating those next to insects in numbers. About 50% of the known nematodes are marine, 25% live in the soil or freshwater feeding on fungi, bacteria, other saprophytes, small invertebrates or organic matter. About 15% are animal-parasitic nematodes that range from small insects and other invertebrates up to domestic and wild animals and man. Only about 10% of nematodes are parasitic on plants (http://mrec.ifas.ufl.edu/lso/SCOUT/Nematodes.htm). A small percentage of about 3400 known species of plant-parasitic nematodes (Hodda, 2011) is widespread and causes significant losses to crop production (Sasser, 1988; Koenning et al., 1999; Nicol et al., 2011). Of the remainder, their importance as plant pathogens is unknown; some species have limited distributions and cause localized damage to plants, and some species are recorded only once from their type host and locality. Based on such distributions, their phytosanitary measures seem generally justifiable, depending on whether potential impacts outweigh costs. The latest statistics showed that 250 species from 43 genera satisfied one or more of the criteria to be believed to demonstrate a phytosanitary risk; yet, these species may not cover all species of phytosanitary importance (Singh et al., 2013). 1.2 The Nature of Phytonematodes 1.2.1 Habitat, taxonomy, biology, parasitism and injury Phytonematodes or plant-parasitic nematodes (PPN) live in the soil or in plant tissue, and typically do not move great distances. Anthropogenic movement of the nematodes over great distances may occur via nematodecontaminated materials such as planting material, soil, machinery and organic fertilizers. The majority of PPN affect crops through feeding on or in plant roots, whilst a minority are aerial feeders. Their role is mainly due to direct impact on economically important crop host damage, and ability to act as vectors of viruses or cause complex diseases when in association with other pathogens. The nematodes can damage plants not only through direct feeding and migration within plant tissues, but they also facilitate subsequent infestation by secondary pathogens, such as fungi and bacteria (Powell, 1971). Nematodes can cause significant damage to almost all kinds of crops but due to their subterranean habit and microscopic size they remain invisible to the naked eye (Ngangbam and Devi, 2012). They can occur deep in the soil, usually around the rhizosphere, and many have great capabilities to survive even in the absence of a host (Sasser and Freckman, 1987). Plant parasitic nematodes of the phylum Nematoda are divided into two orders: Tylenchida and Dorylaimida. All the genera belonging to Dorylaimida (Xiphinema, Longidorus, Paralongidorus, Trichodorus and Paratrichodorus) are migratory ectoparasites. They are known to attack trees and herbaceous crops, damaging the plants severely by transmitting phytopathogenic nepo- and tobra-viruses. Many economically important genera of migratory endoparasites (Pratylenchus, Radophulus, Anguina, Aorolaimus, Hirschmanniella, Hoplolaimus and Ditylenchus) belong to Tylenchida: they damage plants because their movement and feeding inside the roots causes cell death and tissue necrosis. Other phytonematode genera of the same order include Tylenchorhynchus, Helicotylenchus, Scutellonema, Rotylenchulus, Criconemella, Hemicriconemoides, Hemicycliophora, Tylenchulus, Rhadinaphelenchus and Aphelenchoides (Hunt et al., 2005). The most important nematode families of this order, either as models of plant–pathogen interaction or as crop pests, are constituted by sedentary endoparasitic nematodes

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(Heteroderidae, Nacobbidae). The family Heteroderidae includes the most diffused genera, such as Globodera, Heterodera and Meloidogyne, where the second-stage juvenile (J2), hatched from an egg, is the ‘infective’ stage. The J2 moves through the soil in order to locate new host roots and make entry into them. It penetrates the root tissue, enters into that and establishes a suitable feeding site there. The nematode injects growth-regulating substances into the cells near its head, and consequently some of those cells are enlarged. These ‘giant’ or ‘nurse’ cells are the specialized food sources for the nematode. The nematode continuously feeds on giant cells and during this period it starts assuming obesity, becomes immobile or sluggish and advances to maturity (adult stage). Globodera and Heterodera are cyst-forming nematodes; adult females of cyst-forming nematodes protrude from the roots with the majority of their body, and lay eggs inside the body. Late in the life cycle, the female’s external cuticle turns brown (from a whitish to yellowish colour when they are alive) and hardens. These hardened brown dead females are called cysts. The eggs are protected inside the cyst from environmental stresses. The cysts are the means for spreading the infestation. These cysts can be found attached to infested roots or dispersed in the soil. At the end of their life cycle, females of Meloidogyne spp., generally known as rootknot nematodes (RKNs), completely embed themselves into the roots and lay eggs in an external gelatinous matrix, which is fairly visible to the naked eye, outside the roots. Moreover, RKNs can usually induce hypertrophy and hyperplasia of the surrounding tissues, which lead to the formation of galls on roots. Nematodes that are sedentary endoparasitic do not kill parasitized cells and evolve very specialized and complex relationships with their hosts.

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