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Role of Plant Parasitic Nematodes in Pulse Crops

ABBASI

Department of Botany, Shia P.G. College Lucknow, India

E-mail: abbasisyed223@gmail.com

ABSTRACT

Leguminous pulses occupy an important position in human dietary and very good source of vegetable proteins and supplement to cereal based diet. A large number of phytophagous nematodes viz; *Meloidogyne* spp. *Heterodera* spp. *Pratylenchus* spp. *Hoplolaimus* spp. *Helicotylenchus* spp. and *Rotylenchulus reniformis* have been found potent parasites causing potential damage to pulse crops of India viz; gram, black gram, moth, urd, lentil, pea, cowpea, soybean and pigeon pea etc.

Key words: Leguminous pulses, vegetable proteins, Phytophagous nematodes

INTRODUCTION

Nematodes constitute the largest and most ubiquitous groups of animal kingdom. Infact by number they 80-90% of all the multicellular animals. In soil, they are the most common of all the soil fauna numbering 1.8-120 millions per square meter of soil. The plant parasitic nematodes play a vital role in the production of crops, rarely there is any crop free from their attack whether in the field, orchards kitchen garden or green house. Nematodes cause severe yield losses to agricultural crops all over the world (Sasser and Frackman 1987). On the world basis yield losses for most legumes range 10-15%. Extensive reports on nematodes of food legumes are already published (Greco and Di Vito 1988; Sikora and Greco 1990, Sharma et al. 1992).

RANGE OF NEMATODE INFECTION IN LEGUMES

The most wide spread, and probably causing the greatest yield loss, on a world basis, are the root lesions nematodes, *Pratylenchus* spp. and root-knot nematodes, *Meloidogyne* spp. In the Mediterranean basin and in Europe *Ditylenchus dipsaci* affects broad bean and posses serious quarantine problems. Severe damage is also caused by *Heterodera cajani* on pigeon pea in

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India, *H. goettingiana* on broad bean and pea in Mediterranean basin and in Europe, *H. ciceri* on chickpea in Syria. *Meloidogyne artiellia*, *M. arenaria*, *M. incognita*, *M. javanica* are the main root- knot nematodes affecting legumes. Reniform nematode, *Rotylenchulus reniformis* affects chick pea in India and Ghana, Haricot bean in India, USA, and tropical America, mung bean in Philippines, soybean and pigeon pea in several countries (Sikora and Greco 1990; Sharma et al. 1992).

CONTROL MEASURES

Management strategies for the control of plant nematodes should consider the economics of the different legume crops and the means of control. Some legumes, such as broad bean, haricot bean, cowpea, and pea are used as fresh, cunned or frozen vegetables and provide high economic benefits for the farmer. Some legumes are cultivated on marginal lands where most of the available control methods are uneconomical. Generally the management of these nematodes should be based on control measures that are easy to apply, safe, cheap nonpolluting, and which do not require substantial change in the farm cropping system. The most suitable control methods are discussed here.

CHEMICAL CONTROL

Plant parasitic nematodes may be controlled by applying nematicidal chemicals to the soil or to the potential host plant. Generally yield increases following treatment with nematicides are very impressive and therefore this method of control is usually preferred by farmers. However nematicides are costly, hazardous and cumbersome to apply.

Some systemic and non-fumigant nematicides available as granular formulations and required to be applied in smaller quantities (0.5-10 kg ai/ha). The ease of application, low phytotoxicity and systemic action made them replaced the fumigants greatly. Oximecarbamates like, aldicarb, carbofuran, oxamyl, methomyl etc. organophosphates such as fensulphothion, thionazin, fenamiphos etc. have shown great promise as nematicides.

Crop	Nematode	Chemical	Dosage
Broad bean	*Ditylenchus dipsaci*	Methyl bromide	1000mg/ hr

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Cow pea	*Meloidogyne* spp.	Carbofuran	seed treatment @ 0.3 g a.i./m2
Pigeon pea	*Heterodera cajani*	Carbofuran	seed treatment with 0.02% solution or soil @ 1kg a.i./ ha
Soybean,cowpea, pigeon pea	*Radopholus* sp.	Carbofuran, forate	2g a.i./plant
Pigeon pea, Black gram, cow pea, Green gram	*Rotylenchulus* sp.	carbofuran, fensulphothion, oxamyl	seed coating with carbofuran @ 3% w/w, fen-Sulfothion 2% or Oxamyl 2%
chickpea, pigeonpea, pea	Tylenchorhynchus sp.	carbofuran or forate	1kg a.i/ha

SOIL SOLARIZATION

This method of control has shown promise for the control of several nematodes and other soil borne pathogens in warm areas, such as the tropics and subtropics (Lamberti and Greco 1990). Investigations in India (Sharma and Nene 1990) and Syria (Di Vito et al. 1991) have demonstrated good control of *Heterodera ciceri* and *Pratylenchus thornei* and chickpea and of *H. cajani*, *Rotylenchulus reniformis*, and other nematodes on pigeonpea and chickpea with significant yield increases of these crops. Efficiency of this method can be enhanced by polythene mulching.

BIOLOGICAL CONTROL

Biological control is the reduction of the amount of inoculum or disease- producing activity of a pathogen accomplished by or through one or more organisms other than man. This

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method is environmentally safe and has no harmful effect on non-target organisms. The fungus *Pacilomyces lilacinus* and a bacterium, *Pasteuria penetrance* have been reported as promising bio-control agents of root- knot nematodes.

CULTURAL METHODS

This method requires no special skills, low cast and has no toxicity or residual problem. Cultural methods include fallowing, flooding, summer ploughing, crop rotation.

Fallowing: keeping the land free of all vegetation, crops and weeds, by frequent tilling, turning, herbicide application, desiccation, solar heat, etc., nematodes are killed due to starvation. Because of their obligate nature, plant parasitic nematodes cannot survive in the soil in the absence of their hosts.

Flooding: Plant parasitic nematodes which are normally associated with dry culture crops, do not survive under flooding conditions and may die of oxygen deficiency. To get a soil rid of the root knot nematodes, 12-22 months of flooding up to 10 cm is necessary.

Summer ploughing: summer ploughing may be helpful in reducing the nematodes particularly in the tropical countries. It also exposes nematodes to solar heat and desiccation, accentuates effects of fallowing, kills at least a good part of population of soilborne insect pests, pathogens and weeds, and fits well into tropical and subtropical agriculture.

Crop rotation: control with crop rotation is easy with nematodes that have a narrow host range and thus all cyst forming nematodes can be effectively controlled. Usually a three-five year term rotation should be effective to reduce nematode soil population densities to the economic threshold as has been observed for *Heterodera cajani* (Sharma et al. 1992).

ORGANIC AMENDMENTS

The addition of organic materials to soil infested with plant parasitic nematodes has been clearly demonstrated as a satisfactory control method against many phytoparasitic nematodes, because of the cheapness and easy availability of materials. Amendments of soil with some oil cakes viz: Kranz, Mahuwa and Neem @ 2.5 tons/ha is found effective to control *Meloidogyne* spp.

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CONCLUSION

Pulse crops have been the backbone of Indian Agriculture enabling the land to have reasonable output. Besides, a rich source of protein, pulses are considered to be excellent and grain concentrates in the feed for the large cattle population of the country and some of them serve as a green manuring crops which add needed humus and major plant nutrients to the soil. Unfortunately, pulse crops suffer several constraints of which pests and diseases have their leading role. There is ample evidence that nematodes besides causing direct damage to plants may also increase the severity of many other soil borne pathogens and decrease the beneficial effects of others such as mycorrhiza and *Rhizobium* spp. which are of great importance especially in marginal lands that are frequently used for pulses. It is ingenuous to believe that these problems will be solved entirely by scientists located outside the area where the pulse crops are grown. Therefore, to cope with nematode problems, a joint effort, involving national and international research institutes should be strengthened and supported.

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