JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Nematodes Problem and their Control in Agriculture Crop

[1]Prity Ranjan and [2]Prof. (Dr.) Shiva Nand Singh

[1]Research Scholar, Department of Zoology, B.R.A.Bihar University, Muzaffarpur
[2]HOD & Professor, Univ. Department of Zoology, B.R.A.Bihar University, Muzaffarpur

Abstract : Plant parasitic nematodes are microscopic species belonging to a discrete class of animals. They possess stylets and live mostly in the soil. Interest in these animals has been greatly stimulated where they attack or cause injury to economic plants. Their effects on plants result in damage to plant parts or reduction in plant growth or crop yield. All over present in nature, phytoparasitic nematodes are associated with every important agricultural crop and represent a significant constraint on global food security. Root-knot nematodes (Meloidogyne spp.) cyst nematodes (Heterodera and Globodera spp.) and lesion nematodes (Pratylenchus spp.) rank at the top of list of the most economically and scientifically important species due to their intricate relationship with the host plants, wide host range, and the level of damage ensued by infection. In this paper we discuss about different types of prevention methods of crops from nematodes problems.

Keywords : Agriculture crop, Nematodes, Parasitic, Interaction, Control.

I. INTRODUCTION

Plant-parasitic nematodes are important pests in agriculture all over the world. In India, along with continuous land and agriculture development, the implementation of agricultural intensification projects, and the introduction of various plant materials and agricultural products from other countries to the island, nematode damage is becoming increasingly conspicuous in many crops and districts. Plant-parasitic nematodes are a costly burden in agricultural crop production. Of all the important plant-parasitic nematodes, the most successful species are the sedentary groups which establish a permanent feeding site within the plant host and obtain nutrients while completing their lifecycles. Sedentary nematodes have a natural advantage over their migratory relatives due to a fascinating and complex method of host cell transformation resulting in the development a sustainable feeding structure. Interestingly, with over 4000 described plant-parasitic nematodes, only a small amount produce significant economic losses in crops. A assessment of crop losses caused by nematodes to crops and periodic update of the same are useful to fix research priorities, besides serving as a benchmark for policy planners/funding agencies for research support and public/private sector to make appropriate investments for developing nematode management products. Based on data generated through AICRP on Nematodes over the years, a critical analysis has been made on losses in different crops. Overall, plant-parasitic nematodes cause 21.3% crop losses amounting to Rs. 102,039.79 million (1.58 billion USD) annually; the losses in 19 horticultural crops were assessed at Rs. 50,224.98 million, while for 11 field crops it was estimated at Rs. 51,814.81 million. Rice root-knot nematode, Meloidogyne graminicola, was economically most important causing yield loss of Rs. 23,272.32 million in rice. Citrus (Rs. 9828.22 million), banana (Rs. 9710.46 million) among fruit crops; and tomato (Rs. 6035.2 million), brinjal (Rs. 3499.12 million) and okra (2480.86 million) among the vegetable crops suffered comparatively more losses.

II. METHODS OF NEMATODES CONTROL

Plant nematodes can be controlled by several methods. The nematode control aims to improve growth, quality and yield by keeping the nematode population below the economical threshold level. The control measures to

be adopted should be profitable and cost effective. It is essential to calculate the cost benefit ratio before adopting control measures. The nematode control methods are

1. Regulatory (Legal) control
2. Cultural control
3. Physical control
4. Biological control
5. Chemical control.

1. Regulatory control

Regulatory control of pests and diseases is the legal enforcement of measures to prevent them from spreading or having spread, from multiplying sufficiently to become intolerably troublesome. The principle involved in enacting quarantine is exclusion of nematodes from entering into an area which is not infested, in order to avoid spread of the nematode. Quarantine principles are traditionally employed to restrict the movement of infected plant materials and contaminated soil into a state or country. Many countries maintain elaborate organizations to intercept plant shipments containing nematodes and other pests. Diseased and contaminated plant material may be treated to kill the nematodes or their entry may be avoided. Quarantine also prevent the movement of infected plant and soil to move out to other nematodes free areas.

Plant Quarantine in India

The Destructive Insects and Pests Act, 1914 (DIP) was passed by the Government of India which restricts introduction of exotic pests and disease into the country from abroad. The agricultural pests and disease acts of the various states prevent interstate spread of pests within the country. The rules permits the plant protection advisor to the government of India or any authorizes officer to undertake inspection and treatments. Strict regulations have been made against G. rostochiensis, the potato cyst nematode and Rhadinaphelenchus cocophilus, the red ring nematode of coconut. Domestic quarantine regulations have also been imposed to restrict the movement of potato both for seed and table purposes in order to present the spread of potato cyst nematode from Tamil Nadu to other states in India.

2. Cultural control

Cultural nematode control methods are agronomical practices employed in order to minimize nematode problem in the crops.

Selection of healthy seed material

In plants, propagated by vegetative means we can eliminate nematodes by selecting the vegetative part from healthy plants. The golden nematode of potato, the burrowing, spiral and lesion nematodes of banana can be eliminated by selecting nematode free plant materials. The wheat seed gall nematode and rice white tip nematode can be controlled by using nematode free seeds.

Adjusting the time of planting

Nematode life cycle depends on the climatic factors. Adjusting the time of planting helps to avoid nematode damage. In some cases crops may be planed in winter when soil temperature is low ad at that time the nematodes cannot be active at low temperature. Early potatoes and sugar beets grow in soil during cold season and escapes cyst nematode damage since the nematodes are not that much active, to cause damage to the crop during cold season.

Fallowing

Leaving the field without cultivation, preferably after ploughing helps to expose the nematodes to sunlight and the nematodes die due to starvation without host plant. This method is not economical.

Deep summer ploughing

During the onset of summer, the infested field is ploughed with disc plough and exposed to hot sun, which in turn enhances the soil temperature and kills the nematodes. For raising small nursery beds for vegetable crops like tomato and brinjal seed beds can be prepared during summer, covered with polythene sheets which enhances soil temperature by 5 to 10˚C which kills the nematodes in the seed bed. This method is very effective and nematode free seedling can be raised by soil solarization using polythene sheets.

Manuring

Raising green manure crops and addition of more amount of farm yard manure, oil cakes of neem and castor, pressmud and poultry manure etc enriches the soil and further encourages the development of predacious

nematodes like mononchus spp. and also other nematode antagonistic microbs in the soil which checks the parasitic nematodes in the filed.

Flooding

Flooding can be adopted where there is an enormous availability of water. Under submerged conditions, anaerobic condition develops in the soil which kills the nematodes by asphyxiation. Chemicals lethal to nematodes such as hydrogen sulphide and ammonia are released in flooded condition which kills the nematodes.

Trap cropping

Two crops are grown in the field, out of which one crops is highly susceptible to the nematode. The nematode attacks the susceptible crop. By careful planning, the susceptible crop can be grown first and then removed and burnt. Thus the main crop escapes from the nematode damage. Cowpea is highly susceptible crop can be grown first and then removed and burnt. Cowpea is highly susceptible to root – knot nematode and the crop can be destroyed before the nematodes mature.

Antagonistic crops

- Certain crops like mustard, marigold and neem etc have chemicals or alkaloids as root exudates which repell or suppress the plant parasitic nematodes.
- In marigold (Tagetes spp.) plants the α – terthinyl and bithinyl compounds are present throughout the plant from root to shoot tips. This chemical kills the nematodes.
- In mustard allyl isothiocyanate and in pangola grase pyrocaterchol are present which kills the nematodes.
- Such enemy plants can be grown along with main crop or included in crop rotation.

Removal and destruction of infected plants

Early detection of infested plants and removal helps to educe nematode spread. After harvest the stubbles of infested plants are to be removed. In tobacco, the root system is left in the field after harvest. This will serve as a inoculum or the next season crops. Similarly in D. angstus the nematode remains in the left out stubbles in the field after harvest of rice grains. Such stubbles are to be removed and destroyed and land needs to be ploughed to expose the soil.

Use of resistant varieties

Nematode resistant varieties have been reported from time to time in different crops. Use of resistant varieties is a very effective method to avoid nematode damage. Nemared, Nematex, Hisar Lalit and Atkinson are tomato varieties resistant to M. incogntia . The potato variety Kufri swarna is resistant to G. rostochiensis.

3. Physical control

It is very easy to kill the nematodes in laboratory by exposing the nematodes to heat, irradiation and osmotic pressure etc., but it is extremely difficult to adopt these methods in field conditions. These physical treatments maybe hazardous to plant or the men working with the treatments and the radiation treatments may have residual effects.

Heat treatment of soil

Sterilization of soil by allowing steam is a practice in soil used in green house, seed beds and also for small area cultivation. Insects, weed seeds, nematodes, bacteria and fungi are killed by steam sterilization. In such cases steam is introduced into the lower level of soil by means of perforated iron pipes buried in the soil. The soil surface needs to be covered during steaming operation. Plastic sheets are used for covering. In the laboratory and for pot culture experiments autoclaves are used to sterilize the soil.

Hot water treatment of planting material

Hot water treatment is commonly used for controlling nematodes. Prior to planting the seed materials such as banana corms, onion bulbs, tubers seeds and roots of seedlings can be dipped in hot water at 50 – 55 ˚C for 10 minutes and then planted.

Irradiation

Irradiation also kills the nematode. Cysts of G. rostochiensis exposed to 20,000 Ɣ contained only dead eggs and at 40, 000 Ɣ exposure, the eggs lost their contents. Ditylenchus

4. Biological control

With increasing demands in organic agriculture and concerns for environmental welfare, the use of chemical pesticides has decreased. Alternative means of pest management such as the use of biological controls are of great interest for crop producers. The efficacy of nematophagous bacteria and fungi in the control some nematode pests, including cyst and root-knot nematodes has been well-documented. Parasitic bacteria of *Pasteuria spp.* have been reported to infect 323 nematode species including both plant-parasitic nematodes and free-living nematodes. Three methods of application for *P. penetrans* were evaluated for nematode control including seed, transplant, and post-plant treatments. In greenhouse studies involving cucumber, all three *Pasteuria* treatments were shown to reduce galling caused by *M. incognita* as well as soil nematode numbers and nematode reproduction. Nematophagous fungi *Pochonia chlamydosporia* has potential as a biological control agent for *M. incognita* in vegetable crops. Along with crop rotational methods, *P. chlamydosporia* was shown to reduce nematode levels in soil previously used for root-knot nematode susceptible tomato. Nematophagous fungal products including chitinases show great potential for the development of biopesticides.

5. Chemical control.

Chemical nematicides are often used in the management of root-knot nematodes however; EPA restrictions in some soil fumigants due to increased environmental toxicity coupled with the expensive costs associated new nematicide development limit their availability. The very nature of these mammalian pesticides poses a significant risk to humans. Plant-parasitic nematodes often reside in plant tissue which makes soil delivery applications of the chemical challenging. The incorporation of plant varieties that harbor multiple resistance to an array of plant pathogens is an attractive and practical approach for plant breeders.

III. Conclusion

It may be concluded that the nematode had a very detrimental effect on growth, and development of plant. However, the conserved use of specific genotypes of disease resistant cultivars may contribute to increased pathogen aggressiveness resulting in epiphytotic conditions; therefore the identification of additional resistant varieties becomes increasingly necessary for long term control.

References

[1] Bridge J, Luc M, Plowright RA, Peng D. Nematode parasites of rice. In: Luc, M., Sicora, R.A., Bridge, J. (Eds.), Plant parasitic nematodes in tropical and subtropical agriculture. CABI, UK, 2005, 87-130.

[2] Pokharel RR, Abawi GS, Duxbury JM, Smat CD, Wang X, Brito JA. Variability and the recognition of two races in Meloidogyne graminicola. Australasian Plant Pathology. 2010; 39:326-333.

[3] De Waele D, Elsen A. Challenges in tropical plant nematology. Ann. Rev. Phytopathol., 2007; 45:457-485.

[4] Jain RK, Khan MR, Vinod Kumar. Rice root-knot nematode (Meloidogyne graminicola) infestation in rice. Archives of Phytopathology and Plant Protection. 2012; 45(6):635-645

[5] Chantanao A. Nematodes of rice and some other plants in Thail. Entomol. Plant Pathol. Bull. Thail. 1962; 1:1-15.

[6] Rao YS, Israel P. Life history and binomics of Meloidigyne graminicola, the rice root-knot nematode. Ind. Phytopath. 1973; 26:333-340.

[7] Narasimhamurthy HB, Ravindra H. Invasion studies and symptomatology of rice root-knot nematode, Meloidogyne graminicola, Advances in Life Sciences. 2016; 5(22):10408-10411.

[8] Kiontke K, Fitch D. Nematodes. Current Biology. 2013;23:862-864. DOI: http://dx.doi.org/10.1016/j.cub.2013.08.0095.Poinar GO. 1983. The Natural History of Nematodes. Prentice Hall, Englewood Cliffs, NJ

[9] Quentin M, Abad P, Favery B. Plant parasitic nematode effectors target host defense and nuclear functions to establish feeding cells. Frontiers in Plant Science. 2013;4:1-7. DOI: 10.3389/fpls.2013.00053

[10] Davis EL, Hussey RS, Mitchum MG and Baum TJ. Parasitism proteins in nematode-plant interactions. Current Opinion in Plant Biology. 2008;11:360-366. DOI: 10.1016/j.pbi.2008.04.003

[11] Khan A, Mian MM, ZAHID MI. Post penetration development of Meloidogyne graminicola in rice root, Thailand Journal of Agricuilture Science. 1995; 28:311-320.

[12] Rao YS, Israel P. Life history and binomics of Meloidigyne graminicola, the rice root-knot nematode. Indian Phytopathology. 1973; 26(2):333-340.

[13] Halbrendt J. Root Knot Nematodes: An IPM CRSP pest profile, In update integrated pest management, collaborative research support program, Virginia Polytechnic Institute and State University, USA, 1997; 3(2).

[14] Dabur KR, Taya AS, Bajaj HK. Life cycle of Meloidogyne graminicola on paddy and its host range studies, Indian Journal of Nematology. 2004; 34:80-84.

[15] Singh KP, Jaiswal RK, Kumar N, Kumar D. Biomass of nematodes and associated roots: A determinant of symptom production in root-knot disease of rice (Oryza sativa L.). J Phytopathol. 2006; 154:676-682.