Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7711

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(4), 80-85

Research Article

Indian Journal of Pure & Applied Biosciences

Management of Cotton Nematodes through Different Management Strategies

Muhammad Ramzan[1*], Unsar Naeem-Ullah[1], Ghulam Murtaza[2], Umair Rasool Azmi[3], Abdullah Arshad[2], Muhammad Shaheryar[4], Armghan Afzal[2]

[1]Department of Entomology, Muhammad Nawaz Shareef University of Agriculture Multan, Punjab Pakistan

[2]Department of Entomology, University of Agriculture Faisalabad, Punjab Pakistan

[3]Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, Punjab Pakistan

[4]Department of Agronomy, University of Agriculture Faisalabad, Punjab Pakistan

*Corresponding Author E-mail: ramzan.mnsua@gmail.com

Received: 25.06.2019 | Revised: 28.07.2019 | Accepted: 4.08.2019

ABSTRACT

Cotton (Gossypium hirsutum) is one of the most important textile fibre crops in the world, and cotton seeds are also fed to animals and made into oil. Plant Parasitic nematodes known as Phyto-nematodes; a threat for the agricultural crops such as cotton. Nematodes are very small, worm-like, multicellular animals adapted to living in water and soil. Some species of nematode are plant feeder and aerial feeder. Different methods such as cultural, biological, botanical etc. are used for the management of nematodes globally. The aim of present review is to evaluate the best method for controlling the nematodes. Botanicals nematicides are the best method for nematodes management because botanical have no harmful impact on human, animals and environment. New, more efficient and ecofriendly nematicides are needed along with machineries for more effective application.

Keywords: *Cotton, Nematode, Management Tactics, Botanicals*

INTRODUCTION

Cotton (*Gossypium hirsutum*) is the most important fiber crop in the world. Most of the nematodes species are found in warmers regions of the world (Dropkin, Victor, 1980). These are found in groups. Plant Parasitic nematodes; a threat for the agricultural crops also called as Phyto-nematodes. The world losses in cotton yield by the nematodes has been documented to be 10.7 % (Sasser, & Freckman, 1987). These nematodes prefer to live in soils or within the plant parts like tissues. Nematodes can't move to great distances as wings are absent in them thus, can crawl only. But for dispersion, use of different products most likely machinery, plant materials, soil and the transportation of organic materials. Most of the Phyto-nematodes are plant feeders and feed on the plants while some of the members or species are the aerial feeders (Yepsen, Roger, 1984). Majority of plant-parasitic nematodes are root feeders, associated with plants, completing their life cycles in the root zone.

Cite this article: Ramzan, M., Naeem-Ullah, U., Murtaza, G., Azmi, U.R., Arshad, A., Shaheryar, M., & Afzal, A. (2019). Management of Cotton Nematodes through different management strategies, *Ind. J. Pure App. Biosci. 7*(4), 80-85. doi: http://dx.doi.org/10.18782/2320-7051.7711

Some are endoparasitic, living and feeding within the tissue of roots, tubers, buds, seeds, etc (Sasser, 1990). The endoparasitic nematodes are root-knot nematodes (*Meloidogyne species*), the root-lesion nematodes (*Pratylenchus species*) and the cyst nematodes (*Heterodera species*). However, beside attacking the plants, they also act as a transmitter of viruses to the crop thus possessing more damage to the crop. Spread of other microorganisms (fungus and bacteria) has also been reported by the nematodes (Powell, 1971). Within the crops, nematodes prefer to live in deep high in the soil where the roots are present. Also, it can survive in unfavorable conditions in soil when the host is not present (Sasser & Freckman, 1987). It can survive over a large range of hosts and because of microscopic size it can't be seen with naked eye. A total of 4 molts occur in it. The 1st molt occur in egg while the remaining three occur in nymphal stage. The emerging nymph will be motile and the effective stage causing damage to the plants. It is also called as vermiform, 0.30-0.4 mm in size and reserve the large amounts of lipid in it.

Sampling

Timing

It is one of the important factors to determine the exact population of nematodes. It has been noted that population of nematodes can be very low from the winter to early fall, but in some cases its population will increase to much extent in early fall. However, after harvesting of cotton crop its population will decline sharply thus time should be chosen with the much measure to detect the best population. For the cotton in America it is recommended to take sample from Oct. to Nov. at a 20 cm depth of cotton.

Sample collection

The population of nematode is distributed all over the crop. So, the sample should be taken with great care and thoroughly from the whole field. Rhizophere should be selected for sample recording. For the fields, where no crop is grown or in extreme temperature sample should be taken within the depth of 30 cm. To detect disease spread by nematodes, plant parts should be collected for possible identification and should be compared with the healthy plants to get the end results.

The best sample will provide the following benefits (1) Properly taken sample will protect farmers from extensive loss. (2) Improper sample will lead to increase in the inputs increasing costs. (3) Large and small areas should be sampled with a one way that is zigzag way. (4) As nematode do not survive in upper 1-2-inch layer so soil from the upper surface should be removed. (5) The minimum sample should be ½ liter of soil that will be obtained from the different samples (Jagdale & Cross, 2011).

Taxonomy

The nematodes; commonly called as the round worms belong to the phylum Nematoda. The general body appearance is un-segmented body, containing hundreds of neurons associated with other body parts for proper functioning. These are multicellular organisms. The nematodes possess a stylet through which the said insect penetrate the plant and get their nourishment. The stylet has a hole which serve as a transmission of bacterial pathogens. Based on its presence, Nematodes have been divided into 3 types. They are present in terrestrial, marine, and parasitic niches. All make up the 10, 000 species around the globe. It has been said that nematodes are present in every litter of the soil and the soil contains usually many with species diversity. This pest has been regarded as one of the ubiquitous one.

Species

***Meloidogyne incognita* Chitwood, 1949**

Distribution

Tropical, Subtropical regions and Warm Temperate soils throughout the world (Robinson & Jaffee, 1996).

***Rotylenchulus reniformis* Linford and Oliveira, 1940**

Distribution

The same distribution as *Meloidogyne incognita* (Robinson & Jaffee, 1996).

***Meloidogyne acronea* Coetzee, 1956**

Distribution

Africa (Robinson & Jaffee, 1996).

***Pratylenchus brachyurus* Filipjev & Schuurmans Stekhoven, 1941**

Distribution

Afghanistan, Brunei Darussalam, Georgia, India, Indonesia, Iran, Israel, Japan, Korea, Malaysia Oman, Pakistan, Philippines, Singapore, Sri Lanka, Turkey, Uzbekistan, Vietnam, Benin Botswana, Cameroon, Côte d'Ivoire, Egypt, Gambia, Ghana, Guinea, Kenya, Madagascar Malawi, Mauritius, Mozambique, Nigeria, Réunion Senegal, South Africa, Togo, Uganda Zambia, Zimbabwe, Canada, Mexico, USA, Belize, Costa Rica, Cuba, Guatemala, Honduras, Puerto Rico, Trinidad and Tobago, Bolivia, Brazil, Colombia, French Guiana, Guyana, Peru, Venezuela, Bulgaria, Cyprus, Italy, Russian Federation, Australia, Cook Islands, Fiji, Niue, Samoa, Tonga.

***Hoplolaimus galeatus* Thorne, 1935**

Distribution

USA, Canada, Sumatra, India, Tanzania, and Central and South America

***Hoplolaimus indicus* Sherl 1963**

Distribution

Bangladesh, China, Iran, Pakistan

***Hoplolaimus seinhorsti* Luc, 1958**

Distribution:

Africa, India, Philippines, Thailand, Indonesia http://nemaplex.ucdavis.edu/Taxadata/G063s5.aspx

***Hoplolaimus columbus* Sher**

Distribution

India, Pakistan, Africa, Egypt, North America, USA, Central America & Caribbean, Trinidad and Tobago

***Hoplolaimus indicus* Sherl 1963**

Distribution

China, Bangladesh, Iran, Pakistan, India

REVIEW OF LITERATURE

MANAGEMENT

Temperature

A study showed the role of temperature in managing the nematodes. If the temperature in an empty field of soil reach at 10 °C, the nematodes population have a good effect however as the temperature increases to 45 °C eggs or immature will be no more viable (Heald & Robinson, 1987).

Soil texture:

Sand and clays show opposite correlation in terms of encouraging population. Soil containing 10-90 % sand was harboring more nematodes (*M. incognita*) than the clays more than 60 % (Robinson et al., 1997, Starr et al., 1993).

Biological control

To manage the Nematodes biological control has not been used on the commercial basis however some of the studies has been conducted and evaluated in lab conditions on the *M. incognita.* The biological control includes the microscopic organisms (fungus or bacterial). One of the fungus was reported (Robinson & Jaffee, 1996) *i.e. Monacrosporiuni cionopagum* and *M ellipsosporuni*. Some other fungus are mycorrhizal fungi, egg parasitizing fungi, such as *Paecilomyces lilacinus,* the obligately parasitic bacterium *Pasteuria penetrans,* strains of *Gluconacetohacter diazotrophicus* and predaceous nematodes (Robinson, & Jaffee, 1996). *R. reniforniis* was controlled successful in the Texas by *Heterodera glvcine* (soybean cyst) (Wang, et al., 2005). Another microorganisms *Pochonia chlanvdosporia* did controlled *R. renifoemis* by 77% in the pots (Wang et al., 2005).

Cultural control

Deep tillage

Deep tillage is known to be one of the old methods however, this alone proves to be a good tool. It has been found that *M incognita* was greatly affected by the deep tillage at the 45 cm thus controlling the nematodes (Garber et al.,1996).

Organic soil amendments

The following amendments in soil will be beneficial to control the nematode population in cotton fields; *Hoplolaimus columbus* population was down by implanting poultry litter in soil (Koenning, & Barker, 2004). Shellfish waster and crop residues that contain chitin are found to be highly good (Thoden et al., 2009).

Crop rotation:

The best crop to be used after cotton is peanut or groundnut. As it has been documented in

southeastern America as different nematodes *M. incognita, R. renifrinis* and *H. columbus* population was found below the level (Wang et al., 2005). The population of peanut root-knot nematode *M. arenaria,* also reduces very effectively on the cotton (Starr et al., 1998).

Sanitation / Weed Management:

Meloidogyne incognita and *Rotylenchulus reniformis* do egg lay at a faster speed. The *Meloidogyne* can lay over 2000 plant species and also on the weeds. While the *Rotylenchulus* can lay eggs over the 350 species of plants. Thus, good weed management practices should be used to encounter the nematode population (Robinson, et al.,1997). In a study, two weeds were documented to the most problematic in controlling the nematodes these are the morning glory and sickle pod. Among the problematic weeds sickle pod becomes more challenging in managing the nematode population (Davis & Webster, 2005).

Host plant resistance

Among all nematode management strategies, host plant resistance is one of them which has potential to control (Ogallo et al., 1999). It is one of the best ways in managing the pest population (Starr et al., 2002). However, a very few verities had been registered and that few have not been adopted globally.

Solarization

Soil solarization is a method of pasteurization, effectively reduce nematode population. It is mostly effective in those regions where summers are predictably warm and sunny. The basic technique entails laying clear plastic over tilled, moistened soil for approximately six to eight weeks. Solar heat is trapped by the plastic, raising the soil temperature. The incorporation of poultry litter prior to solarization, or use of a second layer of clear plastic, can reduce effective solarization time to 30 days (Brown et al., 1989, Stevens et al., 1990).

Red Plastic Mulch

The wavelengths of light are reflected with red mulch that cause the plant to keep more growth above ground, greater yield. Through red plastic mulch, the plant is putting less energy into its root system, the very food the nematodes feed on. Reflection from the red mulch, in effect, tugs food away from the nematodes that are trying to draw nutrients from the roots (Adams, 1997).

Flooding

Flooding is also an important strategy to control pest population. It is done in those areas which have plenty of water. Soil is flood for seven to nine months, kills nematodes by reducing the amount of oxygen available for respiration while the concentrations of naturally occurring substances like methane, organic acids and hydrogen sulfide increase that are toxic to nematodes (MacGuidwin, 1993). Flooding is the long process; it may take two years to kill all the nematode egg masses. Flooding works best if both soil and air temperatures remain warm.

Use of Botanical Nematicides

There are various plant families which used for the control of nematodes. Marigolds belong to *Tagetes species* and family Asteraceae. It has polyacetylenes and polythienyls exhibiting nematicidal properties (Chitwood, 2001, Hooks et al., 2010, Thoden et al., 2009, Wat et al., 1981). Others species such as *Acacia gummifera* and *Tagetes patula* have nematicidal properties, also used against nematodes and gave 60-70% control (El Allagui et al., 2007).

Use of Nematicides

The most popular option for nematodes management are the nematicides and 40-75 percent cotton production increase by using nematicides against nematodes in cotton. There are several factors such as temperature, soil moisture, texture, timing of application, the selection of nematicide and conditions of the infested field as well as nematode population (Greer et al., 2009). Most of the nematicides applied during crop plantation. The nematicides are present in various forms such as granular, foliar and fumigants etc. Seed treatment with nematicides gave well results in the field. There are various methods for application of nematicides; prior to planting, Injection of soil fumigants, direct application of nematicides on seed in the form

of seed treatment and use of nematicides in granules form in the furrow (Greer et al., 2009).

Acknowledgement

Authors are highly thankful to Muhammad Nawaz Shareef University of Agriculture, Multan for providing suitable environment for manuscript writeup.

CONFLICT OF INTEREST

Authors have no conflict of interest.

CONCLUSION

We have reviewed and evaluated the different management tactics of nematodes. The quality and quantity of many economic crop losses due to nematode globally. Nematodes are the hot issue of present and future research. The present review indicate that we should pr0mote botanical pesticides with the combination of other pesticides against nematodes.

REFERENCES

Adams, Sean. (1997). Seeiní red: Colored mulch starves nematodes. *Agricultural Research. 18*.

Brown, J. E., Patterson, M.G., Osborn, & M.C. (1989). Effects of clear plastic solarization and chicken manure on weed control. Nat. Ag. Plastics Assoc., Peoria. 76-79.

Chitwood, D.J. (2001). Phytochemical based strategies for nematode control. Annu Rev Phytopathol. *40*, 221–249.

Davis, R. F., & Webster, T. M. (2005). Relative host status of selected weeds and crops for *Meloidogiie incognita* and *Roivienchulus reiigi.rmis. Journal of Cotton Science, 9*, 41-46.

Dropkin, Victor, H. (1980). Introduction to Plant Nematology. John Wiley & Sons, New York, NY. *256*, 42-246.

El Allagui, N., Tahrouch, S., Bourijate, M., & Hatimi, A. (2007). Action of plant extracts on root-knot nematods (Meloidogyne spp.) mortality 503. *Acta Bot Gallica 154*, 503–509.

Garber, R. H., DeVay, J. E., Goodel, P. B., & Roberts, P. A. (1996). Cotton diseases and nematodes. In S. J. Hake, T. A. Kerby & K. D. Hake (Eds.).

Greer, A., Wilson, G., & Kirkpatrick, T. L. (2009). Management of economically important nematodes of Arkansas cotton.

Heald, C. M., & Robinson, A. F. (1987). Effects of soil solarization on *Roty lenchulus reni/ormis* in the Lower Rio Grande Valley of Texas. *Journal of Nernatolog y, 19*, 93 103.

Hooks, C.R.R., Wang, K.H., Ploeg, A., & McSorley, R. (2010). Using marigold (Tagetes spp.) as a cover crop to protect crops from plant-parasitic nematodes. *Appl Soil Ecol 46*, 307–320.

Jagdale, G. B., & Cross, J. (2011). Sampling for plant-parasitic nematodes identification and diagnosis.

Koenning, S. R., & Barker, K. R. (2004). Influence of poultry litter applications on nematode communities in cotton agroecosystems. *Supplement to Journal o/Nematology*, *36*, 524-533.

MacGuidwin, A.E. (1993). Management of Nematodes. p. 159ñ166. In: Randell C. Rowe (ed.) Potato Health Management. APS Press, St. Paul, MN.

Ogallo, J. L., Goodell, P. B., Eckert, J., & Roberts, P. A. (1999). Management of root-know nematodes with resistant cotton cv. NemX. Crop Science *39*, 418–421.

Powell, N.T. (1971). Interaction of plant parasitic nematodes with other disease-causing agents. In: Zuckerman BM, Mai WF, Rohde RA (eds) Plant parasitic nematodes, Academic Press Inc., London, *2*, 119–136.

Robbins, R. T., Shipe, E. R., Rakes, L., Jackson, L. E., Gbur, E. E., & Dombek, D. G. (2001). Host suitability in soybean cultivars for the rcniform nematode, 2000 tests. *Supplement to Journal of Nemnatologv, 33*, 314-317.

Robinson, A. F., & Jaffee, B. A. (1996). Repulsion of *Meloidogvhne incognita* by alginate pellets *containing hyphae of Monacrosporium cionopagum, M. ellipsosporum,* or *Hirsutetella rhossiliensis. Journal of Nematology, 28*, 133-147.

Robinson, M., Jenkins, J. N., & McCarty. J. C. (1997). Root-knot nematode resistance of F2 cotton hybrids from crosses of resistant gemiplasm and commercial cultivars. *Crop Science, 31*, 1041-1046.

Sasser, J.N., & Freckman, D.W. (1987). A world perspective on nematology: the role of the society,

Sasser, J. N. (1990). Plant-parasitic Nematodes: The Farmerís Hidden Enemy. North Carolina State University Press, Raleigh, NC. 47-48.

Starr J. L., Heald, C. M., Robinson, A. F., Smith, R. G., & Krause, J. P. (1993). *Meloidogvne incognita* and *Rot ylenchulus reni/brinis* and associated soil textures from some cotton production areas of *Texas. Journal of Nematology, 25*, 252-256.

Starr, J. L., *Cotton.* In K. R. Barker, G. A. Pederson & G. L. (1998). Windham (Eds.), *Plant and nematode interactions.* American Society of Agronomy, Crop Science Society of America. Soil Science Society of America Publishers.359-379.

Starr, J. L., Bridge, J., & Cook, R. (2002). *Resistance to plant-parasitic nematodes: history, current use and future potential.* CABI Publishing. 1-22.

Stevens, C., Khan, V.A., & Tang, A.Y. (1990). Solar heating of soil with double plastic layers: a potential method of pest control. In: Proceedings of the 22nd National Agricultural Plastics Congress. *Nat. Ag. Plastics Assoc.*, Peoria, IL. 163-68.

Thoden, T.C., Boppre, M., & Hallmann, J. (2009). Effects of pyrrolizidine alkaloids on the performance of plant-parasitic and free-living nematodes. Pest Manag Sci *65*, 823–830.

Wang, K., Riggs, R. D., & Cnppen, D. (2005). Isolation, selection, and efficacy of *Pochonia chlarnydosporia* for control of *Rot 'lenehulus renforrnis* on cotton. *Phvtopatholog*, 95.

Wat, C.K., Prasad, S.K., Graham, E.A., Partington, S., Arnason, T., Towers, G.H.N., & Lam, J. (1981). Photosensitization of invertebrates by natural polyacetylenes. Biochem Syst Ecol. *9*, 59–62.

Yepsen, Roger, B. (1984). The Encyclopedia of Natural Insect & Disease Control. Rev. ed. Rodale Press, Emmaus, PA. 267-271.