Management of Nematodes through Eco-Friendly Botanicals

Alka Vyas*and Shashi Bala**
**Asstt. Prof., Deptt. of Zoology, M.M.H. College Ghaziabad ,*
***Asstt. Prof., Deptt. of Zoology, R.G. P.G. College Meerut*

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Abstract

Plant parasitic nematodes are soil inhibiting microscopic creatures and are world-wide in distribution. They adversely affect the plant and cause great loss to agricultural forestry as well as horticulture production. They enter to the plant through root, stem, leaf, flower even fruit and causing various disease bacterial, fungal ultimately causing death of plant so facing deal with the above discussing situation we need to control of plant nematodes by using eco-friendly approach cost effective competent to other biochemical agent and agrochemicals.The antinemic properties of plants and their process in nematode management are being discussed in this paper.

Keywords: *Parasitic, Horticulture, Nematodes, Antinemic, Management*

Introduction

Phytonematodes are ubiquitous and microscopic in nature. They are silent enemies to mankind because they cause globally crop loss more than 100 billion annually (Khan, 2008). They infect plant roots, bulbs, rhizomes, stems, leavesbuds, flowers etc. and cause damage to the plant directly or indirectly. Nematodes are worldwide in distribution, their abundance depends on many factors such as soil type (Chirchir*et al*., 2008) and vegetation type (Sahu*et al*., 2011). Nematode infestation is mainly noticed in developing countries than in developed countries (Sasser and Freckman, 1986).

Since nematodes are generally soil inhabitants and attack underground parts of plant, damage caused by them cannot be diagnosed by symptoms alone, general symptoms sometimes resemble with those of some nutrient deficiency (Khan, 2008).

Now a days for the management of nematodes various chemicals are used which are not only contaminated ground and surface water but has also disturbed the balance among soil, plant and microbial population (Bahadur *et al.,* 2006).That is why Researchers have to develop eco-friendly approach for controlling nematodes because it is safe for environment, cost effective, easy to handling by farmers and degrade within few days.

Botanicals are the natural plant products when applied in the field leaves no residues in the field and is eco-friendly. In India, many plants are available which have nematicidal properties. Different scientists have been tested different plant extracts for their nematicidal properties. (Netscher and Sikora, 1990; Akhtar, 1999)

The plant products like leaf extracts (Netscher and Sikora, 1990; Akhtar, 1999), oil cakes (Yadav, 2006) and plant latex (Siddiqui and Alam, 1990) have been used in the management of nematodes.

Now-a-days botanicals like *Azadirachta, Eucalyptus,Sidaacutu* and *Tagetes* have been very popular in nematode control(Umar *et al*.,2010)

Methods For Nematodes Management

Botanical can be used in different ways to control nematodes—

- Using the parts of botanicals directly.
- Using the extracts of parts of botanicals.
- Using compounds of botanicals.
- Using plants as organic amendments.

Using the parts of botanicals directly—

Many botanicals have antinemic properties in their roots,shoots,leaves,flowers,seeds etc.(Cannayane, Rajendran G, 2003); Sundararaju *et al*., 2003). Fresh leaves of *Azadirachtaindica* and *water hyacinth*@60kgN/ha were found to be very useful for controlling the population of *Hirschmanniellaoryzae* and increasing productivity of rice (Prasad et al, 2004). Mexican marigold leaf, Bitter leaf, Lantana

leaf and Baker tree seeds were very effective in nematode control which recorded about 95% inhibition of nematode eggs. These botanicals also reduced the formation of galls in tomato (Taye*et al*., 2013).Seed soaked in aqueous extracts of neem and karnaj seed kernel at 20% proved to be very effective among many plant products tested in improving plant growth of cowpea and minimizing infection of *R.reniformis* (Ram and Batheli, 2003).

Water soluble fractions of neem exhibit toxic properties against root-knot nematodes and reduces their ability to infect host roots (Khanna,1991; Kathirvel*et al*.,1992; Mojumder and Mishra,1991).Seed and leaf extracts of neem(*Azadirachtaindica*) reduced juvenile mortality of the root knot nematodes on potato(Akhtar and Alam,1991; Khurma and sing 1997; Upadhyay*et al*.,2003).

This antinemic property of neem is mainly due to presence of Azadirachtin compound. When the soil is amended with neem leaves there is reduction of 77% nemic population(Verma and Khan, 2004). The application of neem cake, *Cymbopogonflexuosus* leaves, *Cymbopogonwinterianus* leaves, *Costusspecious* shoots and rhizomes dried powder reduces the growth of root-knot nematode (*Meloidogyne incognita*) (Pandey, 2002).

Another treatment to reduce the nematode fecundity and improved plant growth is green chopped leaves of neem, datura (*Datura stramonium*) eucalyptus (*Eucalyptus citriodora*), tulsi (*Ocimumcanum*), madar (*Calotropisprocera*) and mint (*Menthaarvensis*).It has been observed that the presence of neem seedlings inhibited the growth of second stage nematode juveniles (Wani and Alam, 2000)in chickpea roots.The aqueous extracts of neem leaf,neem seed kernel, futuka leaf (*Melastomamalabathricum*), germany bon leaf (*Ageratum conyzoides*) were tested for their toxicity against *Meloidogynegraminicola* stop the growth of *T.semipenetrans*on *C.jambhiri*(Deka et al,2002). Neem cake, neem seed and neem seed kernel reduced more than 75% in the no. of cysts(Mojumder and Mittal A,2003).

2) Plant extracts used as botanicals—

For nematode management many workers used plant extracts and testing these extracts both in *vitro* and *invivo on* nematodes (Sharma and Trivedi PC,2002). Aqueous extracts of leaves of Moringa (*Moringaoleifera*), African basil (*Ocimumgratissium*) and neem (*Azadirachtaindica*) exhibited pathogenicity effect on second stage juveniles of *M.incognita* (Vijayalakshmi andPrasad SK,1979).

Aqueous extracts of Baker tree (*Milletiaferruginea*), Bitter leaf(*Vernoniaamygodalina*), Mexican marigold (*Tagetesminuta*), Mexican tea

(*Chenopodiumambrosioides*) and Neem (*Azadirachta*) at 5% concentration controlled nematicidal properties against *M.incognita* in *vitro*.

Latex of *Calotropisgigantea*caused 100 percent inhibition of egg hatching at 10.0 concentration (Pandey and Kalra, 2003). Aqueous extracts of tubers of yam(*Dioscorea floribunda*) reduced the egg hatching of *M.incognita*(Nath and Mukerjee, 2000). Similarly extract of Datura was found to be powerful on the second stage juveniles of *M.javanica*in tomato plants (Al-Saba*et al*., 2001).

During the time of harvesting in tomato plants leaf extracts of *Calotropisgigantea* reduced the growth of root knot nematode (Saranavanapriya and Sivakumar, 2005).Garlic extract had more potential than neem leaf extract in the control of root-knot infection of tomato in *vivo* (Agbenin *et al*., 2005).Neem extract was useful for infestation of *M.incognita* and showed the highest juvenile mortality (82.8%) (Nelaballe and Mukkara, 2013).

The efficiency of leaf mulches from *A.indica*, *Acaciamangium*, *Calotropis gigantea* on root knot nematode (*M.incognita*) and kacholam were studied in Vellayani. These mulches reduced 60% nematode population *A.indica* and *chromolaena* mulches reduced gall index (Nisha and Sheela MS, 2002).

Shoot extracts of *Euphorbiahelioscopia*, *Erucasativa* and *P.lanceolata*inhibited the root galls in tomato plants and increased fruit yield of the plant(Hoseinpoor and Kargar,2012).Flower extract of Marigold,*Tageteserecta* reduced the hatching of *M.incognita*eggs and increased the mortality of juvenile up to100% when treated in *vitro* (Meena*et al*.,2010). Higher dose of botanicals increased their effectiveness and also improved the plant growth characters with reducing root knot index (Singh *et al*., 2012).

Dipping of roots in neem seed cake extract with carbofuran for 120 minutes was very effective for the inhibition of nematodes growth (Das and Deka BC, 2002). Powered neem seed kernel and neem cake extracts were effectively stopped the nematode population (Mojumder and Mittal A, 1999).Salannin at 1000ppm was the most effective botanical causing 76to 86% immobility (Mojumder V, 2002).

3) Botanical oil —

Botanicals oil was very effective against *M.incognita* in vegetables (Sivakumar and Gunasekaran, 2011).Clove oil has significant effect against root knot nematode, *M.incognita* in *vitro* (Meyer *et al*.,2008).Various oils from different plants like caraway, fennel, spearmint and oregano had compounds like caravacrol and thymol with antinemic property. At the concentrations of 100 micrograms/litre, these oils immobilized the juveniles of root knot nematodes and also reduced their hatching (Oka et al., 2000).Chinaberry and castor bean oil reduced the population of

M.incognita juveniles.

4) Dry powder of Botanicals—

Dry powder of botanicals also had significant role in the control of nematodes in soil. Dry powder extracts of *Newbouldialaevis* reduced the galls of *M.incognita* in African yam bean plant.(Ugwuoke*et al*.,2011).Low concentration of leaf powder of rock fleabane reduced the juvenile growth of *M.javanica* and *Tylenchulussemipenetrans* but it had no effect on stem and bulb nematode (Oka *et al*., 2001).

Dry leaf powders of *Vitextrifolia*, *Phlogacanthusthyrsiflorus* and *Parkiajavanica* had potential nematicidal properties(Mohilal andDhanachand , 2003).Neem seed powder significantly decreased the disease severity of *Fusarium* and root-knot in both green house and field (Agbenin *et al*.,2005).Tobacco dust had nematicidal activity when it was tested in tea plantations and used as a beneficialbiopesticide for root knot nematode management in tobacco.Tobacco plant had many toxic compounds include nicotine, germacreneanabasine, piperidine and alkaloids which may exhibit the nematicidal properties(Panter*et al*., 1990).

5) Botanicals as Organic amendments—

Use of various botanicals as organic amendments is less hazard and pollution free for farmers. This application also improves the nutrient status of soil and soil structure. Generally amendments of oil seed cakes in soil decreased the population of nematodes through toxic decomposed products like phenolics and ammonia.

Among various organic materials,neem cake(Alam*et al*.,1978) and mustard cake(Gul *et al*.,1990) have shown good result in the control of phytonematodes. Powder of cocoabeantestaand oil palm fruit fiber as mulches also reduced population of nematodes in the tomato plant (Ojo and Umar, 2013).Ground neem seed, tobacco waste dust (Mothaet *al*., 2010) and Mustard cake (Khan *etal*.,1996) also reduced the root knot nematodes population.Neem cake provides nitrogen in a slow-release form and protecting the plants against phytonematodes.Dry leaves of *Azadirachtaindica*, *Calotropisprocera*, *Datura stramonium*, *Crotolarzajuneca* and *Vitexnegunda* were play significant role against phytonematodes.Central Insecticides Board of India has approved the registration of 300ppm oil based and 1500 ppm kernel based neem formulations which can be used against phytonematodes (Akhtar, 2000).Application of N coated neem cake reduced the population of nematode, *Pratylenchuscoffeae* in banana tree (Sundararaju and Kumar, 2000). Crop rotation with *C.juncea* increased sugarcane production due to the advantages of green manuring (Dinardo Miranda LL & Gill MA, 2005).

A study of field experiment at Bundaverg, Queen land, sugar cane trash was in corporate into soil with or without nitrogen supplied as either soyabean residue

or ammonium nitrate in soil were reduced population of *P.zeae* and *Tylenchorhyndous* 85% and 71% respectively (Stirling GR ,Wilson *et al.*, 2005).

Nematicidal Princplesof Botanical

Different types of botanicals have different compounds to show nematicidal property.Azadirachtin is the major nontoxic compound present in neem plant. This compound is released through volatiation and decomposing of the different parts of plants (Akhtar, 2000 and Ntalli*et al*., 2009). Toxic principle of Marigold is due to presence of terthienyl and bithienylcompounds (Uhlenbroek and Bijloo, 1958 &1959). Marigold suppress the growth of galls produced by *M. incognita* on vegetable crops (Yen *et al*., 1998).*Alliumsativum* (garlic) produced Allicin which exhibited nematicidal activity against the phytonematodes. (Gupta and Sharma, 1993).Nicotine presents in Tobacco plant that is very harmful to insects (Panter*et al*., 1990).

Phenyl isothicyanate presents in crucifers contains antinemic property against root knot nematodes. (Morgan, 1925; Stahmann*et al*., 1943). The neem-based products effectively reduced gall number, egg mass and nematodes population in soil. 8% Econeemresulted in the longest shoots and roots of different plants. That is why Indian farmers without the knowledge of the chemical composition, have been using neem products as a traditional method of nematodes control for centuries.

Neem products are cheap, safer and eco-friendly.Recently many insecticides are available in India which contain azadirachtinviz,Achook, Nemin, Jawan, Repelin, Sunneem etc. Azadirachtin suppressed the growth of root – knot nematode on cucumber (Lynn *et al*., 2010).Margosan –O, Azatin,Superneem 4.5,Neemix and Triact are some potential insecticides and fungicides.

Neem Jeevan, Neemark, Neem Gold, Achook and Kranti were tested at 1% , 0.5% and 0.25% concentration against *M. incognita* reduced the egg hatch (24-70%) and root gall-index (20-50%) at all the tested levels(Sharma 2000).

Conclusion

Botanicals areCheap and eco-friendly being the only alternative to chemicals and expected to fulfil all requirements of the farmers. They are economically viable to the farmers. Concerning the environmental safety, they are gaining much importance in the integrated nematode management (INM) practices. For the conversation of biodiversity botanicals are the most promising source of bio-active products of plant origin. Moreover application of botanicals to the crops will yield healthy fruits and vegetables without harmful chemicals which results in healthier human generation.

Refrences

Agbenin N.O., Emechebe, A. M., Marley, P.S and Akpal, A.D. (2005) Evaluation of nematicidal action of some botanicals on Meloidogyne incognita in vivo and in vitro. *J. of Agrl. and Rural Devpt. in Tropics and Subtropics*. **106, 29- 39.**

Akhtar, M. &Alam, M.M. (1991) Integrated control of plan- parasitic nematodes on potato with organic amendments, nematicide and mixed cropping with mustard. *Nematol. Medit. 19, 169-171.*

Akhtar, M. (1999) Plant growth and nematode dynamics in response to soil amendments with neem products, urea and compost. Bioresource Tech.69, 181–183. Akhtar, M. (2000) Nematicidal potential of the tree Azadirachtaindica (A. Juss.). *Interated Pest Mangt. Rev.* **5, 57–66.**

Akhtar, M. (2000) Nematicidalpotencial of the neem tree *Azadirachtaindica* (A.Juss). *InteratedPest Mangt Rev.* **5, 55-66.**

Al Saba, R.F., Ammi, S.N., Al Zarry& Abdul Jawad, B. (2001) Effect of Datura stramonium extracts on root-knot nematodes M. javanica in tomato plant. *Dirasat Agrl. Sci.* **28, 219-226**.

Alam, M.M., Khan, A.M. and Sexena, S.K. (1978) Mechanism of control of plant parasitic nematodes as a result of the application of organic amendments to the soil, and role of formaldehyde and acetone. *Indian J. Nematol*. **8, 172-174.**

Bahadur, A., Singh, J., Singh, K.P., Upadhyay, A.K. and Rai, M. (2006) Effect of organic amendments and biofertilizers on growth, yield and quality attributes of Chinese cabbage (Brassica pekinensis). *Indian J. Agrl Sci.* **76, 596–598**.

Cannayane I, Rajendran G (2003) Penetration of *Meloidogyne incognita* (race3) in tomato and brinjal roots treated with botanical extracts, *Indian J Plant Protection* **31: 84-86.**

Chirchir, A.K., J.W. Kimenju, F.M. Olubayo and G.K. Mutua, 2008. Abundance and distribution of plant parasitic nematodes associated with sugarcane in Western Kenya. *Asian J. Plant Pathol.*, **2: 48-53.**

Das P, Deka BC (2002) Efficacy of neem-based pesticides against *Meloidogynegraminicola*on rice as seed treatment. *Indian J Nematol.* **32:204-205.**

Deka R, Sinha AK, Neog PP (2002) Effect of *Peecilomyceslilacinus* and botanicals against *Tylenchulussemipenotrans* on Citursjambhiri. *Indian J Nematol* **32: 230-232.**

Dinardo Miranda LL, Gill MA (2005) Effect of crop rotation with *Crotolariajuncea* on sugarcane yield, treated or not with nematicides at planting. Nematologia Brasileira **29: 63-66.**

Gul, A., Saifullah, S. & Shah, F.A. (1990) Control of root- knot nematodes in tomato through organic amendments and NPK. Sarhad J. Agrl. **6, 95-97.**

Gupta, R. & Sharma, N.K. (1993) A study of the nematicidal activity of allicin-an active principle in garlic, Allium sativum L., against Root-knot nematode, Meloidogyne incognita (Kofoid and White, 1919) Chitwood, 1949. *International J. Pest Mangt.* **39, 390-392.**

Hoseinpoor, R. &Kargar, A. (2012) Evaluation of the effect powder and aqueous extracts of some plant species on tomato yield and reproduction of Meloidogyne incognita. *International J. Agrl. Sci*. **2, 964-968.**

Kathirvel, M., Balasubramanian, G., Gopolan, M. &Sivakmar, C.V. (1992) Effect of seed treatment with botanical and chemicals for the control of root knot nematodes, M. incognita infesting okra. *Indian J. Plant Protec*. **20, 191-194.**

Khan, A.M., Adhami, A., Siddiqui, Z.A. and Saxana, S.K. (1996) Effect of different oil cakes on hatching of larvae and on development of root-knot caused by M. incognita. Pl. Dis. Proc. **528-588**.

Khan, I.A., Sayed, M., Shaukat, S.S. and Handoo, Z.A. (2008) Efficacy of four plant extracts on nematodes associated with papaya in Sindh, Pakistan. *Nematol. Meditt*. **36, 93 - 98.**

Khanna, A. S. (1991) In vitro studies on some plants extract as nematicides against M. incognita. Current Nematol. **2, 199-200.**

Khurma, U.R. & Singh, A. (1997) Nematicidal potential of seed extracts: in vitro effects on juvenile mortality and egg hatch of Meloidogyne incognita and M. javanica. Nematol. Meditt. **25, 49-54.**

Lynn, O.M., Song, W., Shim, J., Kim, J. and Lee, K. (2010) Effects of azadirachtin and neem-based formulations for the control of sweet potato whitefly and root-knot nematode. *J of Korean Society for Applied Biol. Chem*. **53, 598-604.**

Meyer, S.L.F., Lakshman, D.K., Zasada, I.A., Vinyard, B.T. &Chitwood, D.J. (2008) Doseresponse effects of clove oil from Syzygiumaromaticum on the root knot nematode Meloidogyne incognita, *Pest Mgt. Sci*. **64, 223–229**.

Mohilal N, Dhanachand C (2003) Management of root knot nematode using some botanicals as soil amendment. *J. Applied Zoological Researches* **14: 161-164.**

Mojumder V (2002) Effect of neem seedlings on major phytoparasitic nematodes associated with chickpea on crop yield. *Pesticide Research J* **14: 150-152**.

Mojumder, V. and Mishra, S.D. (1991) Effect of aqueous extracts of neem seeds on hatchability of eggs and penetrability of hatched juveniles of Meloidogyne incognita into roots of mungbean. *Current Nematol.* **2, 117-120.**

Mojumder V, Mittal A (1999) Effect of storage after seed coating of cowpea with neem products against Heteroderacajani. *Pesticide Research Journal* **11: 189-190.**

Mojumder V, Mittal A (2003) Effect of neem products as seed coating against Heteroderacajani in cowpea. *Legume Research* **26: 231-232**.

Morgan, D.O. (1925) Control of potato root eelworm, Heteroderarostochiensis through mustard plants. J. Helminthol. 3,185. Motha, K.F., Abeysekara, R. &Kottearachchi, N.S. (2010) Effect of biological agents and botanicals in controlling root- knot nematodes, Meloidogyne spp., in Nicotianatabacum. Tropical Agrl Res and Extn. **13, 1-5.**

Motha, K.F., Abeysekara, R. &Kottearachchi, N.S. (2010) Effect of biological agents and botanicals in controlling root- knot nematodes, Meloidogyne spp., in Nicotianatabacum. *Tropical Agrl Res and Extn.* **13, 1-5.**

Nath, R.C. & Mukherjee, B. (2000) Dioscorea floribunda, a potential source of nematicides of plant origin. *Nematol. Meditt*. **28, 145-149**.

Netscher, C. &Sikora, R.A. (1990) Nematode parasites of vegetables; in Plant parasitic nematode in subtropical and tropical agriculture. M. Luc, R. A. Sikora and J. bridge (eds.), pp.**237-283**, CAB International, Wallingford, Oxon, UK.

Nisha MS, Sheela MS (2002) Effect of green leaf mulching for the management of root-knot nematode in Kacholam. *Indian J Nematol* **32: 211-212.**

Ntalli, N.G., Menkissoglu-Spiroudi, U., Giannakou, I.O. and Prpphetou-Athanasiadou, D.A. (2009) Efficacy evaluation of neem (Azadirachtaindica A. Juss) formulation against Root- knot nematode, Meloidogyne incognita. *J. Crop Protec.* **28, 489 -494.**

Ojo, G.T. & Umar, I. (2013) Evaluation of Some Botanicals on Root – Knot Nematode (Meloidogynejavanica) in Tomato (Lycopersiconesculentum, Mill) in Yola Adamawa State, Nigeria. Biological Forum – *An International Journal* **5, 31- 36.**

Oka, Y., Ben-Daniel, B. and Cohen, Y. (2001) Nematicidal activity of powder and extracts of Inula viscose. *Nematologica* **3, 735-742.**

Oka, Y., Nacar, S., Putieusky, E., Ravid, U., Zohara, Y. and Spiegal, Y. (2000) Nematicidal activity of essential oils and their components against the root knot nematode. *Phytopathol*. **90, 710 -715**.

Pandey R (2002) Application of botanicals for management of root-knot nematode disease of Ammi majus.L. *Indian J. Nematol* **32: 198-200.**

Pandey R, Kalra A (2003) Root-knot disease of Ashwagandha*Withaniasomnifera* and its eco-friendly cost effective management. *J. Mycology and Plant Pathology* **33: 240-245.**

Panter, K.E., Keeler, R.F., Bunch, T.D. and Callen, R.J. (1990) Congenitical skeletal malformations and cleft pal-ate induced in goats by digestion of Lupinus, Conium and Nicotina species. Toxin. **28, 1377-1385.**

Prasad JS, Kumar RM, Rao LVS (2004) Role of manures and fertilizers in the management of the root nematode (*Hirschmanniellaoryzae*) in rice (*Orzyasativa L*). *Indian J Nematol* **34: 1-4.**

Ram B, Baheli BL (2003) Management of reniform nematode, *Rotylenchulusreniforms*on cowpea through seed treatment with botanicals. *Current Nematology* **14: 27-30.**

Sahu, R., P. Chandra and A.N. Poddar, 2011. Community analysis of plant parasitic nematodes prevalent in vegetable crops in district drug of Chhattisgarh, *India. Res. J. Parasitol*., **6: 83-89**

SankariMeena, K., Sivakumar, M., Jonathan, E. I., Devrajan, K. and Boopathi, T. (2010) Management

of Meloidogyne incognita in tomato through dry powder and aqueous extracts of Tageteserecta cv. Indian yellow. **Pestology 34, 28-30.**

Saranavanapriya, B. and Sivakumar, M. (2005) Management of root knot nematode, Meloidogyne incognita on tomato with botanicals. Nat. product radiance **4, 158-161**.

Sasser, J.N. and Freckman, D.W. (1986) A world perspective on Nematology; in Vistas on Nematology. Veech, J. A. and Dickson, D.W. (eds.), pp: **7-14**, Society of Nematologist. Maryland.

Sharma GC (2000) Efficacy of neem based formulation against the root-knot nematode *Meloidogyne incognita*. *Pesticide Research Journal* **12: 183-187**.

Sharma N, Trivedi PC (2002) Screening of leaf extracts of some plants for their nematicidal and fungicidal properties against *Meloidogyneincognita* and *Furasiumoxysporum*. *Asian J ExpSci* **16: 21-28.**

Siddiqui, M. A. and Alam, M. M. (1990) Potential of plant latex as botanical nematicide. Integrated Pest Mangt. *Practitioner* (USA) **12, 6-8.**

Sivakumar, M. &Gunasekaran, K. (2011) Management of root knot nematodes in tomato, chilli and brinjal by neem oil formulations. *J. Biopest.* **4, 198-200.**

Stahmann, M. A., Link, K.P. and Walker, J.C. (1943) Presence of antinemic phenyl isothiocyanate in roots of cruciferous plants. *J. Agrl Res*. **67, 49**.

Stirling G.R Wilson EJ, Striling AM, Pankhurst C.E, Moody PW, etal. 2005 Amendments of sugar cane trash indulsuppressiveness to plant parasitic nematode in sugar cane soil Australian Plant Pathology **34:203-211**.

Sundararaju, P. and Kumar, V. (2000) Effect of organics and inorganics on population build up of root-lesion nematode, Pratylenchuscoffeae on six banana cultivars. National Nematology Symposium on Integrated Nematode Management Held at OUAT, Bhubaneswar, Orissa, India. 23rd – 24th November.

Sundararaju P, Padmanaban B, Sathiamoorthy S (2003) Efficacy of certain botanicals against root-lesion nematode, *Pratylenchuscoffeae* in banana Nematologia Mediterranea **31: 201-205**.

Tulika Singh, B., Patel, A. and Thumar, R. K. (2012) Management of Root-knot Nematode (Meloidogyne incognita) in Bottle gourd using Botanicals in Pots. *Indian J. Nematol*. **42, 180-183.**

Ugwuoke K.I., Ukwueze, B.O. and Ogwulumba1, S.I. (2011) Powdery leaf extracts for control of Root knot nematode in African yam bean. *African Crop Sci. J*. **19,131 – 136.**

Uhlenbroek, J.H. &Bijloo, J.D. (1958) Investigation on nematicides. Isolation and structure of a nematicidal principle occurring in Tagetes roots. Recueil des TravauxChimiques des Pays-Ba. **77, 1004-1008.**

Uhlenbroek, J.H. &Bijloo, J.D. (1959) Investigation on nematicides. Structure of a second nematicidal principle isolated from Tagetes roots. Recueil des TravauxChimiques des Pays-Bas. **78,382-390**.

Umar, I., Muhammad, Z. &Okusanya, B.A.O. (2010) Effect of organic amendments on the control of Meloidogynejavanica (Kofoid and White, 1919) Chitwood, 1949) on Tomato (Lycopersiconlycopersicum, Mill). Agrl, *Business and Tech. J*. **8, 63-77.**

Upadhyay, K.D., Dwivedi, K. and Uttam, S.K. (2003) Effect of some plant extracts on the mortality and hatching of Meloidogyne incognita and Heteroderacajani infesting pigeon pea. Nematol. Meditt. **31, 28-32.**

Verma AC, Khan MN (2004) Potentially of botanicals for managing *Meloidogyne incognita* in *Ocimumcanum*. *Annals of Plant Protection Sciences* **12: 464-465.**

VijayaKumariNelaballe& Lakshmi Devi Mukkara (2013) A Preliminary Study on The Nematicidal Effect of some local flora on Meloidogyne Incognita Chitwood infesting mulberry. *Intn. J*. *Chemical, Envt. and Biol. Sci.* **1, 2320–4087.**

Vijayalakshmi K, Mishra SD, Prasad SK (1979) Nematicidal properties of some indigenous plant materials against second stage juveniles of *Meloidogyne incognita* (Kofoid and White) Chitwood. *Indian J Entomology* **41: 326-331.**

Wani AH, Alam MM (2000) Nematode control with antagonistic plants. *Current Nematology* **11: 45-54.**

WondimenehTaye, Sakhuja, P.K. and Tadele Tefera. (2013) Root-knot nematode (Meloidogyne incognita) management using botanicals in tomato (Lycopersiconesculentum). *Academia J. Agrl. Res.* **1, 9-16.**

Yadav, Y.S., Siddiqui, A.U. and Parihar, A. (2006) Efficacy of oil cakes as seed dressing treatments for the management of root-knot nematode, Meloidogyne incognita affecting chickpea. *Indian J. Nematol*. **36, 151-152.**

Yen, J. H., Lin, C. Y., Chen, D.Y., Lee, M. D. and Tsay, T. T. (1998) The study of antagonistic plants in the control of south root-knot nematode, Meloidogyne incognita. Plant Pathol. *Bulletin* **7, 94-104.**