Control of root-knot disease of brinjal (*Solanum melongena* L.) by the application of leaf extracts of certain medicinal plants

Naseer Hussain Shah, Abdul Rashid Dar*, Irfana Amin Qureshi, Afroza Akhter, Mohammad Rafiq Wani and Lubna Andleeb1

Department of Botany, Abdul Ahad Azad Memorial Degree College, Bemina-190 018, Srinagar, Jammu and Kashmir, India.

Received: 09-04-2018 Accepted: 29-05-2018 DOI: 10.18805/IJARe.A-5016

ABSTRACT

Microscopic plant parasitic nematodes are round worms that feed on plants and damage them. The most common and serious amongst the nematodes is the root-knot nematode found throughout the country with a very wide host range of cultivated crops. Brinjal (*Solanum melongena*) crop yield is considerably reduced by root-knot nematodes particularly *Meloidogyne incognita*. Root-galls of brinjal caused by *Meloidogyne incognita* can be controlled effectively by using the bio-agents and botanicals which in turn increases the yield and plant growth. Present study explored the effect of leaf extracts of certain plants on the root-knot development, plant growth and nematode multiplication in pot experiments. Extract treated and nematode inoculated plants showed improvement on growth over untreated inoculated plants and reduced the disease development. Five (viz., margosa, marigold, datura, hemp and tobacco) leaf extracts, irrespective of concentration, apparently induced tolerance in inoculated plants as evidenced by better plant growth in comparison to control and suppressed the multiplication of nematode which resulted in low root-knot index. Margosa (*Azadirachta indica*) leaf extract suppressed the nematode multiplication, reduced root galling and improved the plant growth of inoculated plants. Margosa and marigold (*Tagetes erecta*) leaf extracts were found more effective in controlling the root-knot development than the leaf extracts of hemp (*Cannabis sativa*), datura (*Datura metel*) and tobacco (*Nicotiana tabacum*). Higher concentrations (20 ml/plant) of leaf extracts were found to be more effective in controlling the root knot development. Based on our observations, it may be concluded that margosa or marigold extract treatment of brinjal seedlings prior to transplantation can avoid severe damage by suppressing the nematode multiplication and inducing the tolerance in treated inoculated plants.

Key words: Brinjal, Leaf extracts, *Meloidogyne incognita*, Medicinal plants.

INTRODUCTION

One of the limiting factors affecting crop growth and production of good quality fruits in *Solanum melongena* an important vegetable crop of India is the root knot nematode, *Meloidogyne incognita*. It causes substantial reduction in plant height, root length, fresh and dry weights of shoots and roots and hence considerable reduction in yield. A variety of management strategies are being adopted to manage root-knot nematode *Meloidogyne incognita*, one of the most difficult pests of agricultural crops. Plant pathologists and nematologists have been involved in integrating biological control agents and organic amendments in nematode management strategies (Jatala, 1986). In recent past, biological management of plant nematodes has emerged as one of the frontier research areas in view of the environmental hazards caused by the application of chemical pesticides and nematicides (Nico et al., 2004; Hallmann et al., 2009; Huang et al., 2009; Siddiqui et al., 2009; Collange et al., 2011; Rajput and Lodha, 2014; Pandey et al., 2016).

Organic farming has emerged as an important priority area with regard to the growing demand for safe and healthy food and long-term sustainability that addresses environmental pollution associated with indiscriminate use of agrochemicals. Amendment of soil with decomposable organic matter and biocontrol agents is recognised as most efficient method of changing soil and rhizosphere environments, thereby adversely affecting the life cycle of pathogens and enabling the plant to resist attack of pathogens through better vigour and altered root physiology. Amending soil with pesticides of botanical origin such as oil-cakes, chopped and dressed plant parts has now become the prime means to protect crops because of being safe, eco-friendly and bio-degradable in nature (Muller and Gooch, 1982; Tyagi and Ajaz, 2004).

Root exudates of certain plants (Oostenbrink et al., 1957; Alam et al., 1975), extracts of different parts of some medicinal and poisonous plants (Hussain and Maqsood, 1975 a, b; Mahmood et al., 1979, Hussain et al., 1984, Siddiqui

---

*Corresponding author’s e-mail: endemicrashid@gmail.com
1Department of Botany, Govt. Degree College, Ganderbal-191 201, Jammu and Kashmir, India.
In this backdrop, an investigation was carried out to study the effect of leaf extracts of certain plants on the root-knot development, plant growth and nematode multiplication in pot experiments in order to evaluate the alternative eco-friendly measures to manage root knot nematode infecting brinjal.

**MATERIALS AND METHODS**

50 gm fresh leaves each of margosa (*Azadirachta indica* Juss.), marigold (*Tagetes erecta* L.), datura (*Datura metel* L.), hemp (*Cannabis sativa* L.) and tobacco (*Nicotiana tabacum* L.) were separately macerated in 500ml distilled water. Each leaf extract was later filtered through muslin cloth to obtain the filtrates for use in the present studies.

Three week old seedlings of brinjal (*Solanum melongena* L.) var. Pusa Purple Long raised in autoclaved soil were carefully uprooted and singly transplanted in 6 inch clay pots containing 1 kg sterilized soil. Application of 10 and 20 ml leaf extracts of each plant was done after 3 days of transplanting by pouring it around the root zone separately and then each seedling was inoculated with 1000 freshly hatched larvae of *Meloidogyne incognita*.

The plants were uprooted after 60 days of inoculation and slowly washed to remove the adhering soil particles. Plant growth was measured in terms of its length and fresh weight of root and shoot. The nematodes from the soil were isolated by using Oostenbrink’s elutriator-cum-Baermann funnel technique and from roots by Warring blender. Data pertaining to nematode population in soil and root tissues was recorded.

The root-knot index was calculated using Taylor and Sasser (1978) method. Each treatment was replicated 5 times. Data was analyzed statistically and significance calculated at 5% level.

**RESULTS AND DISCUSSION**

Data presented in Table 1 clearly indicate that untreated inoculated plants showed a very significant growth reduction over untreated uninoculated plants. Extract treated and inoculated plants, on the other hand showed comparatively less growth reduction rather showed an improvement in plant growth over untreated inoculated plants. All leaf extracts, irrespective of concentration, apparently induced tolerance in inoculated plants as evidenced by better plant growth in comparison to control and suppressed the multiplication of nematode which resulted in low root-knot index.

Margosa leaf extract was found best to suppress the nematode multiplication (*R*=2.14 and 0.97 against 11.12 in control), reduced root galling (Root-knot index 1.3 and 0.6 against 4.7 in control) and improved the plant growth of

| Treatments               | Doses (ml) | Length (cm) | Fresh weight (gm) | No. of nematode larvae/pot | No. of female nematode root | Total no. of nematode population in soil & root tissues | R= Pf/Pi | Root-knot index |
|--------------------------|------------|-------------|-------------------|---------------------------|-----------------------------|----------------------------------------------------------|----------|----------------|
| Untreated uninoculated   | -          | 50.5        | 38.6              | 89.1                      | 16.8                        | 6.5                                                      | 23.3     | -              |
| Untreated inoculated     | -          | 32.1        | 26.4              | 58.5                      | 8.7                         | 3.6                                                      | 12.3     | 10537          | 585         | 11122         | 11.2        | 4.7          |
| Leaf Extracts            |            |             |                   |                           |                             |                                                          |          |                |
| Margosa                  | 10         | 39.2        | 34.9              | 74.1                      | 14.1                        | 5.5                                                      | 19.6     | 1849           | 275         | 2124          | 2.14        | 1.3          |
|                          | 20         | 45.4        | 37.7              | 83.1                      | 15.5                        | 6.0                                                      | 21.5     | 825            | 153         | 978           | 0.97        | 0.6          |
| Marigold                 | 10         | 37.5        | 29.3              | 66.8                      | 13.6                        | 4.9                                                      | 18.5     | 3306           | 302         | 3608          | 3.60        | 1.7          |
|                          | 20         | 40.3        | 33.4              | 73.7                      | 14.2                        | 5.3                                                      | 19.5     | 1310           | 187         | 1497          | 1.49        | 1.0          |
| Datura                   | 10         | 36.9        | 28.6              | 65.5                      | 12.5                        | 4.0                                                      | 16.5     | 4865           | 349         | 5214          | 5.12        | 2.4          |
|                          | 20         | 39.3        | 32.0              | 71.3                      | 13.1                        | 5.1                                                      | 18.2     | 1864           | 283         | 2147          | 2.14        | 1.6          |
| Hemp                     | 10         | 35.7        | 27.5              | 63.2                      | 11.9                        | 4.2                                                      | 16.1     | 6158           | 298         | 6556          | 6.55        | 2.9          |
|                          | 20         | 38.6        | 31.1              | 69.7                      | 12.7                        | 4.9                                                      | 17.6     | 2898           | 321         | 3219          | 3.21        | 1.9          |
| Tobacco                  | 10         | 33.8        | 27.1              | 60.9                      | 10.2                        | 4.5                                                      | 14.7     | 7785           | 426         | 8211          | 8.21        | 3.8          |
|                          | 20         | 35.4        | 29.9              | 65.3                      | 12.0                        | 4.0                                                      | 16.0     | 4307           | 373         | 4670          | 4.68        | 2.3          |
| C. D. @ 5%               | -          | -           | -                 | 2.35                      | -                           | -                                                        | 1.64     | -              | -           | -             | 0.39        | 0.72         |

*R*= Reproductive factor, *Pf*= Final population, *Pi*= Initial population
Each value is average of five replicates

*and Alam, 1985; Pandey and Haseeb, 1988; Salam and Sinha, 1990), and the water soluble extracts of plant products like *Asafoetida* (hing) have been reported to possess nematicidal properties (Hussain and Saxsena, 1969). Toxic chemicals present in such root exudates and plant extracts inhibit the larval emergence and cause mortality of plant parasitic nematodes.*
inoculated plants. This was followed by marigold, datura and hemp leaf extracts. Higher concentrations of leaf extracts were more effective, however efficacy of tobacco leaf extract was found to be the least.

The farmers have been using organic materials for improving soil fertility since the advent of agriculture. However, it is known fact that these organic additives are highly effective in suppressing many plant diseases including those caused by nematodes. Thus, successive phases of biochemical degradation and succession of microorganisms may guide the control of plant pathogens in the soil.

In present investigation, maximum root galls and egg masses were observed with the increasing levels of nematode Meloidogyne incognita inoculum. Highest level of nematode inoculum indicated inhibitory and damaging potential on plant growth parameters of brinjal. The leaf extracts may have acted against the nematode by way of changing root-conditions inimical to them or by means of some active principles absorbed by roots causing tolerance of cells against the invasion and development of the pathogens as also reported earlier (Bunt, 1975; Bell, 1981; Kast, 1985; Tiyagi et al., 1986; Siddiqui and Alam, 1989; Tiyagi and Alam, 1995).

Based on the observations of present study it may be concluded that margosa or marigold extract treatment of brinjal seedling prior to transplantation can avoid severe damage by suppressing nematode multiplication and induce tolerance in treated inoculated plants. This beneficial effect may be attributed to the bitter principles of nematode toxic chemicals such as nimbidin, thionimone and margosene present in margosa and thiophenes in the marigold leaf extracts (Khan et al. 1974). Further research may help in finding and developing new botanicals (biopesticides/nematicides) for eco-friendly management of root-knot nematode of brinjal.

REFERENCES
Alam, M.M., Masood, A., and Hussain, S.I. (1975). Effect of margosa and marigold root leachates on mortality and larval hatching of certain nematodes. Indian J. Expt. Biol., 13: 412-414.
Bell, A.A. (1981). Biochemical mechanisms of disease resistance. Annu. Rev. Plant Physiol., 32: 21-81.
Bunt, J.A. (1975). Effect and mode of action of some systemic nematicides. Meded Landb Hogesch Wageningen, 75: 1-128.
Collange, B., Navarrete, M., Peyre, G., Mateille, T., and Tchamitchian, M., (2011). Root-knot nematode (Meloidogyne) management in vegetable crop production: The challenge of an agronomic system analysis. Crop Protection, 30: 1251–1262.
Hallmann, J., Davies, K. G., and Sikora, R., (2009). Biological control induced by root-knot nematode, [Perry, R.N., M. Moens, and J.L. Starr, (eds)]. CABI Wallingford 380–411.
Huang, Y., Xu, C.K., Ma, L., Zhang, K.Q., Duan, C.Q., and Mo, M. H., (2009). Characterization of volatiles produced from Baccillus megaterium YFM 3.25 and their nematicidal activity against Meloidogyne incognita. European Journal of Plant Pathology, 126: 417–422.
Husain, S.I. and Masood, A., (1975a). Effect of some plant extracts on larval hatching of Meloidogyne incognita (Kofoid & White, 1919) Chitwood 1949. Acta Botanica Indica, 3: 142-146.
Husain, S.I. and Masood, A., (1975b). Nematicidal action of plant extracts on plant parasitic nematodes. Geobios, 2: 74-76.
Husain, S.I. and Saxena, S.K., (1969). Studies on nematicidal action of certainanthelmintic substances. Proc. All India Nematol. YMP IARI, New Delhi. P. 14.
Husain, S.I., Kumar, R., Khan, T.A. and Titov, A., (1984). Effect of root dip treatment of egg plant seedlings with plant extracts, nematicides, oil-cakes and antihelmintic drugs on plant growth and root-knot development. Pak. J. Nematol., 2: 79-83.
Jatala, P., (1986). Biological control of plant parasitic nematodes. Ann. Rev. Phytopathol., 24: 453-489.
Kast, W.K., (1985). Wirkung alternativer spritzfolgen auf pilzliche Schadetreger bei Reben 1984. Gesunde Pflanzen, 37: 494-501.
Khan, M.W., Alam, M.M., Khan, A.M., and Saxena, S.K., (1974). Effect of water soluble fractions of oil-cakes and bitter principles of neem on some fungi and nematodes. Acta Botanica Indica, 2: 120-128.
Mahmood, I.A., Masood, A., Saxena, S.K., and Hussain, S.I., (1979). Effect of some plant extracts on the mortality of Meloidogyne incognita and Rotylenchulus reiformis. Acta Botanica Indica, 7: 129-132.
Muller, R., and Gooch, P.S., (1982). Organic amendment in nematode control. An examination of the literature. Nematropica, 12: 319–326.
Nico, A.L., Jimenez-Díaz, R.M., and Castillo, P., (2004). Control of root-knot nematodes by composted agro-industrial wastes in potting mixtures. Crop Protection, 23: 581–587.
Oostenbrink, M., Kuiper, K., and S’Jacob, J.J., (1957). Tagetes als feindpflanzen von protylenchus Arten. Nematologica, 2: 424-433.
Pandey, R., and Haseeb, A., (1988). Studies on the toxicity of certain medicinal plants to root-knot nematode, M. incognita (Kofoid and White) Chitwood. Indian J. Plant Pathol., 6 (2): 184-185.
Pandey, R.K., Nayak, D.K., Lepcha R., and Kar, R.K., (2016). Biochemical changes in susceptible and resistant black gram cultivars induced by root-knot nematode, Meloidogyne incognita. Agricultural Science Digest, 36: 326-328.
Rajput, S., and Lodha, P., (2014). Screening of different sunflower varieties against root-knot nematode (Meloidogyne incognita) in Jaipur, Rajasthan. Agricultural Science Digest, 34: 226-228.
Salam, M.A., and Sinha, A.R.P., (1990). Effect of some plant extracts on the hatching of Meloidogyne incognita. Current Nematology, 1 (1): 1-6.
Siddiqui, M.A. and Alam, M.M., (1985). Evaluation of nematicidal properties of different parts of margosa and Persian lilac. *Neem Newslett.*, 2: 1-4.

Siddiqui, M.A., and Alam. M.M., (1989). Control of stunt nematode by bare-root dip in leaf extracts of margosa and Persian lilac. *Pak. J. Nematol.*, 7: 33-38.

Siddiqui, Z.A., Qureshi, A., and Akhtar, M.S., (2009). Biocontrol of root-knot nematode *Meloidogyne incognita* by *Pseudomonas* and *Bacillus* isolates on *Pisum sativum*. *Archives of Phytopathology and Plant Protection*, 42: 1154–1164.

Taylor, A.L., and Sasser, J.N., (1978). Biology, identification and control of root-knot nematodes (*Meloidogyne* spp.) Coop. Publ. Plant Pathol. North Carolina State Univ. and U. S. Agency int. Dev. Raleigh, N. C. 111 pp.

Tiyagi, S.A., and Ajaz, S., (2004). Biological control of plant parasitic nematodes associated with chickpea using oil cakes and *Paecilomyces lilacinus*. *Indian Journal of Nematology*, 34: 44–48.

Tiyagi, S.A., and Alam. M.M., (1995). Efficacy of oil seed cakes against plant-parasitic nematodes and soil inhabiting fungi on chickpea and mungbean. *Bioresour. Technol.*, 51: 233-239.

Tiyagi, S.A., Siddiqui, M.A., and Alam. M.M., (1986). Toxicity of an insect repellant plant to plant-parasitic nematodes. *Int. Nematol. Network News.*, 3: 16-17.