Vol. 24, No. 2, pp. 149-152 International Journal of Nematology December, 2014

Efficacy of several soil amendments for the control of *Xiphinema index* and *Meloidogyne javanica* on grapevine seedlings in Pakistan

Aly Khan*, S. Shahid Shaukat and Zafar A. Handoo*****

***Crop Diseases Research Institute, PARC, University of Karachi, Karachi 75270, Pakistan**

****Institute of Environmental Studies, University of Karachi, Karachi 75270, Pakistan**

*****USDA ARS Nematology Laboratory, BARC-West, Beltsville, MD 20705, USA**

E-mail: zafar.handoo@ars.usda.gov

Abstract. The effect of four soil amendments, applied individually or in several combinations, and a chemical nematicide (carbofuran) on plant-parasitic nematodes associated with the rhizosphere of grapevine (*Vitis vinifera* var. Shundokhani) seedlings was investigated in pot experiments. The most effective control of both *Xiphinema index* and *Meloidogyne javanica* was obtained with carbofuran at 0.2 g/litre. Populations of *Xiphinema index* and *Meloidogyne javanica* juveniles were highly susceptible to amendments composed of neem powder (at 4.08 g/pot)+ Fertinemakil fertiliser (at 2.5g/pot) as well as marigold + Fertinemakil. The least but significant control was achieved with sugarcane bagasse for *Xiphinema index* and sugarcane bagasse + fertinemakil for *Meloidogyne javanica* juveniles.

Keywords. Balochistan, grapevine, *Meloidogyne javanica*, soil amendment, *Vitis vinifera* var. Shundokhani, *Xiphinema index*.

INTRODUCTION

Balochistan province of Pakistan is well known as producing the best varieties of grapes in the Indian subcontinent. Grapes in Pakistan, as in other grape-producing areas, are severely damaged by several nematodes and pests. Nayba *et al.* (2012) have reported 100% prevalence level of *Xiphinema* in Faisalabad, Pakistan. In earlier studies, Amici (1965) recorded occurrence of *Xiphinema index* on grapevine in Italy. Magunacelaya *et al.* (2004) reported the association of *Xiphinema index* with grapevines in Chile.

Meloidogyne ethiopica was considered a major widespread parasite in the main grape growing areas of Chile (Carneiro *et al.*, 2007). Di Vito *et al.* (2009) studied the effect of initial populations of *Meloidogyne ethiopica* on the growth of grape (*Vitis vinifera* L. cv. Merlot Noir) in a greenhouse experiment. Téliz *et al.* (2007) reported the following percentage of occurrence of nematodes in vineyards of southern Spain: *Mesocriconema xenoplax* (34.4%), *Meloidogyne incognita* (26.6%), *M. javanica* (14.1%), *Xiphinema index* (12.5%), *X. italiae* (10.9%), *Pratylenchus vulnus* (6.3%) and *Meloidogyne arenaria* (1.6%). Kepenekcï *et al.* (2014) reported 22 species belonging to 16 genera of the Orders Tylenchida, Aphelenchida, Dorylaimida and Triplonchida from soil and root samples of *V. vinifera* in the central Anatolia region of Turkey. The species most frequently found were *Xiphinema pachtaicum* and *Helicotylenchus crenacauda*.

Raski (1955) reported the following species of significance to grape production in British Columbia, Canada: ring nematodes (*Mesocriconema xenoplax*), dagger nematodes (*Xiphinema* spp.), root-knot nematodes (*Meloidogyne* spp.) and root-lesion nematode (*Pratylenchus penetrans*). At first, nematode damage symptoms are often overlooked because the aboveground symptoms are non-specific and difficult to distinguish due to the effect of other factors. Nematode populations usually exist in patches of high population densities and rarely is an entire field affected. Thus, typical symptoms include poor vine vigour in patches of one to a dozen vines.

Applications of chemicals for control of nematodes in fields is expensive because high doses are required, moreover, nematicide usage is associated with environmental risks (Perveen and Shehzad, 2013). Accordingly, these reasons warrant eco-friendly methods for management of nematodes associated with grapevine (*Vitis vinifera* var.

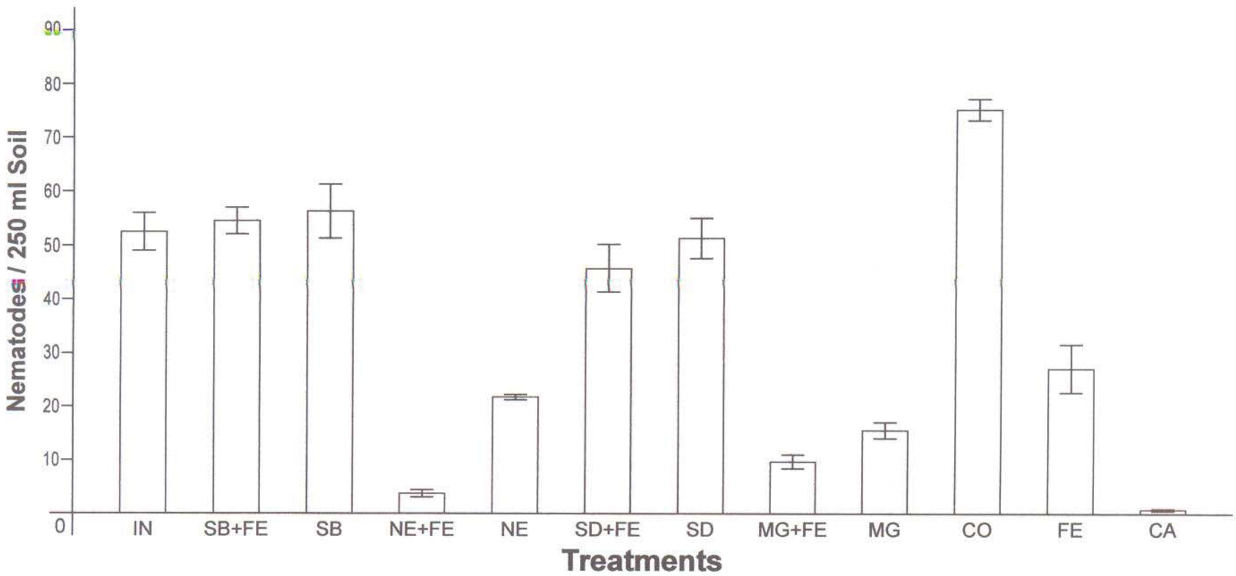

Figure 1. Effect of different treatments on *Xiphinema index* associated with grapevine seedlings. (IN = Initial, SB = Sugarcane bagasse, FE = Fertinemakil, NE = Neem leaf powder, SD = Sawdust, MG = Marigold flower powder, CO = Control, CA = Carbofuran).

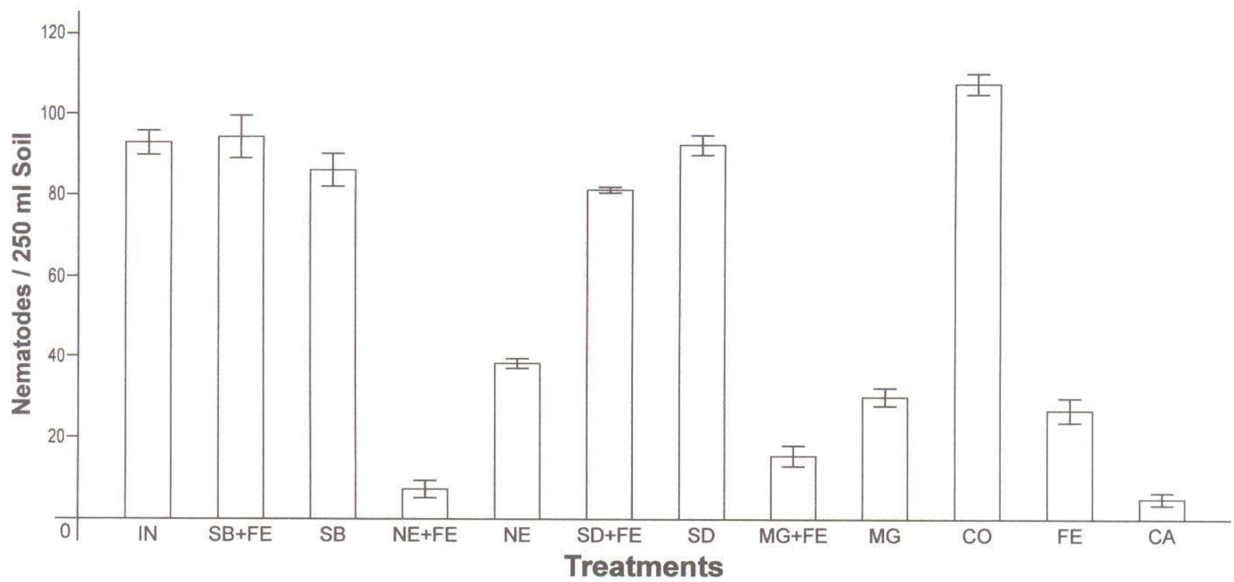

Figure 2. Effect of different treatments on *Meloidogyne javanica* associated with grapevine seedlings. (IN = Initial, SB = Sugarcane bagasse, FE = Fertinemakil, NE = Neem leaf powder, SD = Sawdust, MG = Marigold flower powder, CO = Control, CA = Carbofuran).

Shundokhani) seedlings before planting them in the fields. The objective of this investigation was to study the efficacy of several amendments for the control of *Xiphinema index* and *Meloidogyne javanica* juveniles on grapevine seedlings.

MATERIALS AND METHODS

The experiment was conducted at a Kalat nursery, Balochistan, Pakistan in plastic pots filled with 250 g of sandy loam soil. Six samples were taken from soil associated with uneven plant growth located 10 km from the nursery, and nematode populations present in the soil were determined (Cobb, 1918) as 52.50 ± 7.0 for *Xiphinema index* and 92.57 ± 6.12 for *Meloidogyne javanica* larvae per 250 g of soil. These two nematodes comprised 84 percent of the total plant-parasitic nematodes. One week later grapevine (*V. vinifera* L. var. Shundokhani) seedlings were transplanted in pots.

Amendments including sugarcane bagasse, neem (*Azadirachta indica*) leaf powder, sawdust and marigold (*Tagetes erecta*) flower powder were used alone and in combination with Fertinemakil (a pesticide containing neem cake (97.5 %) and a fungicide (Captan 2.5 %) produced by the Pakistan Council of Scientific and Industrial Research Laboratories Complex in collaboration with CDRI, PARC, University of Karachi). Neem leaves and marigold flowers obtained from Karachi University were air dried for six weeks and powdered using a Wiley mill (Thomas Scientific). Untreated pots were kept as control.

For comparison the chemical nematicide carbofuran (a.i. 44%, Agricultural Products Group of FMC Corporation, Philadelphia, PA, USA) belonging to the carbamate group of pesticides was used. The treatments and control were replicated four times each. The dose for Fertinemakil was 2.5 g/pot, for the other four amendments 4.08 g/pot and carbofuran was applied at 0.2 g/l (from this 250 ml solution poured in each pot). Pots were irrigated regularly with distilled water to avoid any contamination with fungi or nematodes. Eight weeks after treatment the soil in pots was collected for nematode population enumeration and was placed in polythene bags until the nematodes were extracted. Each sample was processed using a modified Cobb (1918) decanting and selective sieving method. The nematode populations were counted under a stereoscopic binocular microscope by shaking the nematode-containing suspension thoroughly and transferring 2.0 ml aliquots to a counting dish. Four aliquots were counted. Data were subjected to a factorial analysis of variance (ANOVA), followed by least significant difference (LSD) at $p = 0.05$ (Zar, 1999).

RESULTS AND DISCUSSION

The result of factorial ANOVA showed that all the treatments were significant ($p < 0.001$), while the two nematodes (*X. index* and *M. javanica*) were also significant ($p < 0.001$). The interaction of treatments × nematodes was also significant ($p < 0.05$). The most effective control was achieved by carbofuran. For *X. index* the extent of control was obtained in the order: neem powder + Fertinemakil > marigold + Fertinemakil. The least but significant control was achieved in sugarcane bagasse-treated pots (Fig. 1). With respect to nematode *Meloidogyne javanica* larvae, the best control was recorded with neem powder + Fertinemakil, followed by marigold + Fertinemakil while the least but significant control was shown by sugarcane bagasse + Fertinemakil (Fig. 2).

Patchy uneven growth was observed in a number of fields of Kalat district, Balochistan, Pakistan; these symptoms may be caused by the nematodes present, although these nematode densities were not analysed.

Al-Banna and Gardner (1996) studied (from 1990 through 1992) the nematodes extracted from the rhizosphere of native grape species in California, USA. For comparison, domestic grape as well as putative hybrids of *Vitis californica* and *V. vinifera* were also sampled. Taxonomic and trophic diversity was much higher in nematodes from samples of native grape than in those from grapes maintained in vineyard situations. Collected data showed that nematode communities with high trophic and taxonomic diversity have a lower numerical density of plant nematodes.

Nematodes may stunt the grapevine; the leaves of the vines produced may be misshapen, puckered or smaller than usual due to nematodes (*Xiphinema*) which act as vectors for viruses. Nematodes (*Meloidogyne*) that embed part or entire of their bodies, results in swelling of root-ends and complete destruction of root tissue which becomes dark-brown or black (Anwar and McKenry, 2002; Khan *et al.*, 2009a).

A number of approaches have been made to manage plant parasitic nematodes using soil amendments such as sawdust (Kimpinski *et al.*, 2003), sugarcane bagasse (Tabarant *et al.*, 2001) marigold (Lehman, 1979), neem (Colin and Pussemier, 1992) and Fertinemakil (Khan *et al.*, 2009).

Nematode control at the seedling stage is manageable and relatively inexpensive as suggested by Sethi and Gaur (1986). Moreover, uninfected seedlings transplanted into fields may exhibit greater tolerance and adaptability to changed habitat condition and survival in greater proportion compared to infected seedlings of untreated nurseries.

Acknowledgement. The authors thank Joseph Mowery of the USDA, ARS, Nematology Laboratory for excellent technical assistance. The first author (A.K) is thankful to the Pakistan Science Foundation, Islamabad for funding. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

LITERATURE CITED

Al Banna, L. and S. L. Gardner 1992. Nematode diversity of native species of *Vitis* in California. *Canadian Journal of Zoology* **74,** 971-982.

Amici, A. 1965. Research on the occurrence of *Xiphinema index* and other nematodes in some grapevine districts of Italy. *Proceeding s, International Conferences on Virus and Vectors on Perennial Hosts*, Davis, California.

Anwar, S. A. and M. V. McKenry 2002. Development response of a resistance-breaking population of *Meloidogyne arenaria* on *Vitis* sp. *Journal of Nematology* **34,** 28-33.

Carneiro, R. M. D. G., M. R. A. Almeida, E. T. Cofcewicz, J. C. Magunacelaya and E. Aballay 2007. *Meloidogyne ethiopica,* a major root-knot nematode parasitizing *Vitis vinifera* and other crops in Chile. *Nematology* **9,** 633-639.

Cobb, N. A. 1918. Estimating the nema population of soil. *Agricultural Technology Circular* 1, U.S. Department of Agriculture **1,** 48 pp.

Colin, J. E. and L. D. Pussemier, 1992. The neem *Azadirachta indica* as a means to control soil nematodes and its application in vegetable cultures in Benin. *Tropiculture* **10,** 89-92.

Di Vito, M., J. C. Magunacelaya, T. Ahumada and F. Catalona 2009. Relationship between initial populations' densities of *Meloidogyne ethiopica* and growth of vinifera grape in pots. *Nematologia Mediterranea* **37,** 105-108.

Kepenekcï, I., H. Toktay and E. Elvico 2014. Plant parasitic and virus vector nematodes associated with vineyards in central Anatolia region of Turkey (S.C.). *Pakistan Journal of Zoology* **46,** 866-869.

Khan, A., F. M. Bilqees and N. Khatoon 2009. Histopathology of grapevines roots infected with root-knot nematode *Meloidogyne incognita*. *Pakistan Journal of Nematology* **27,** 155-158.

Khan, A., S. S. Shaukat, B. Nawab, K. A. Khanzada and M. S. Solangi 2009a. Management of nematodes associated with maize using organic and inorganic amendments. *Pakistan Journal of Agricultural Research* **22,** 165-167.

Kimpinski, J., C. E. Gallant, R. Henry, J. A. Macleod, J. B. Sanderson and A. V. Stuz 2003. Effect of compost and manure soil amendments on nematodes and on yield of potato and barley: A 7-year study. *Journal of Nematology* **35,** 289-293.

Lehman, P. S. 1979. Factors influencing nematode control with marigold. Florida Department of Agriculture Conservation Service, *Nematology Circular No. 50*.

Magunacelaya, J. C., F. Lamberti and M. T. Ahumada 2004. On the occurrence of *Xiphinema index* Thorne and Allen in Chile. *Nematologia Mediterranea* **32,** 235-236.

Nayba, N. Javed, S. A. Khan, Z. Ullah and H. U. Khan 2012. Estimation and prevalence of plant parasitic nematodes associated with twelve fruit trees in Pakistan. *Pakistan Journal of Phytopathology* **24,** 63-68.

Perveen, Z. and S. Shahzad 2013. A comparative study of efficacy of *Paecilomyces* species against root-knot nematode *Meloidogyne incognita*. *Pakistan Journal of Nematology* **31,** 125-131.

Raski, D. J. 1955. Control of nematodes on grapes soil fumigation with crop rotation tested as a way to protect grape replants against root parasites. *California Agriculture* **9,** 9-15.

Sethi, C. L. and H. S. Gaur 1986. Nematode management: An overview. In: *Plant parasitic nematodes of India: Problems and Progress*, pp 424-445 (eds G. Swarup and D. R. Dasgupta). Indian Agricultural Research Institute, New Delhi India

Tabarant, P., C. Villenave, J-M. Risede, J. Roger-Estrade, L. Thurics and M. Dorel 2011. Effect of four organic amendments on banana parasitic nematodes and soil communities. *Applied Soil Ecology* **49,** 59-67.

Téliz, D., B. B. Landa, H. F. Rapoport, F. P. Camacho, R. M. Jimenez-Diaz and P. Castillo 2007. Plant parasitic nematodes infecting grapevine in southern Spain and susceptible reaction to root-knot nematodes of rootstocks reported as moderately resistant. *Plant Disease* **91,** 1147-1154.

Zar, J. H. 1999. *Biostatistical Analysis,* 4th ed., 929 pp. Englewood Cliffs, NJ, USA: Prentice-Hall.