Effect of amendments for the control of nematodes on peach seedlings

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Abstract

The effect of several amendments was evaluated against nematodes associated with peach (*Prunus persica* L. Batsch) seedlings. Three major nematode populations were found in the soils including *Helicotylenchus pseudorobustus*, *Xiphinema americanum* and *Pratylenchus thornei*. Soil containing nematodes was collected from peach orchards near Kalat, Balochistan and filled in pots and peach seedlings were transplanted. Various soil amendments were applied including sawdust, sugarcane bagasse, neem (*Azadirachta indica*) leaf powder and marigold (*Tagetes erecta*) flower powder used alone and in combination with Fertinemakil. Untreated pots were kept as control. Carbofuran a chemical nematicide was used for comparison. Subsequently after 8 weeks nematode populations were studied. The results showed that amendments significantly influenced the nematode population though the nematode populations themselves did not differ significantly. The effectiveness of various amendments was in the order Carbofuran > Fertinemakil > marigold + Fertinemakil > neem powder + Fertinemakil against *Helicotylenchus pseudorobustus*. With respect to *Xiphinema americanum*, Carbofuran > neem powder + Fertinemakil > marigold + Fertinemakil > neem powder. While, *Pratylenchus thornei* was best abated by Carbofuran > marigold + Fertinemakil > neem powder + Fertinemakil > marigold in that order. The role of different nematodes associated with peach is discussed.

Keywords: Organic amendments, nematodes, peach seedlings, Balochistan, Pakistan

Peach (*Prunus persica* L. Batsch) is a fruit tree cultivated in the temperate region and is considered the second most important fruit of temperate zone next to apple (Bailey & Bailey, 1976). Balochistan having four agro-ecological zones is endowed with a unique environment for the production of great variety of quality fruits including peach (Fazal-e-Haider, 2008). About 60% of peach is produced in Balochistan. The yield losses of peach were caused by different diseases including nematodes (Forer *et al.*, 1984). Feeding by *Meloidogyne* spp., can impair root functions such as uptake of nutrients and water. Nyczepir *et al.*, (1999) reported that Guardian peach rootstock was evaluated for susceptibility of *Meloidogyne incognita* (Georgia peach isolate) and *M. javanica* in a greenhouse. Both commercial guardian seed sources produced plants that were poor hosts to *M. incognita* and *M. javanica*. Results indicated that *M. incognita* J_2 penetrated guardian roots and formed galls, but the majority of nematodes failed to mature and reproduce. Root lesion nematode *Pratylenchus* spp., penetrated the peach root surfaces and can also enter roots; and cause damage as they feed and migrate through root tissues (Mountain & Boyce, 1958; Potter *et al.*, 1984). Filipjev (1969) studied the pathogenicity of *Pratylenchus* spp. on peach. Irrespective of its pathogenicity *Xiphinema americanum* is known to be a vector of peach rosette mosaic virus (PRMV), an economically important virus that causes diseases (Ramsdell & Myers, 1974; Ramsdell *et al.*, 1983). *Helicotylenchus* spp., are ectoparasites of roots (Niblack & Bernard, 1985) and may survive

without feeding for four months (Siddiqi, 1986). Keeping in view the importance of peach, this research was initiated with the objective to test the efficacy of various amendments against nematodes associated with peach cv. 8A seedlings in Kalat, Balochistan.

Materials and Methods

Six soil samples were taken from a peach orchard near Kalat town, Balochistan for nematode evaluation during February 2013. Plastic pots were filled with 250 g of sandy loam soil (52% sand; 40% silt, 4% clay; 2% organic matter; pH 6.7) having a population of 63 ± 2 *Helicotylenchus pseudorobustus*; 50.5 ± 2.5 *Xiphinema americanum* and 41 ± 0.3 *Pratylenchus thornei*. These three nematodes comprised 82% of the total plant-parasitic nematode populations. One week later peach (*Prunus persica* L. cv. 8A) seedlings were transplanted in pots. Amendments including sawdust, sugarcane bagasse, neem (*Azadirachta indica*) leaf powder and marigold (*Tagetes erecta*) flower powder were used alone and in combination with Fertinemakil (a pesticide containing neem cake (97.5%) product from Pakistan Council of Scientific and Industrial Research Complex in collaboration with Crop Diseases Research Institute, Karachi, Pakistan Agricultural Research Council, University of Karachi, Pakistan). Neem leaves and marigold obtained from Hub Chauki, Balochistan, were air dried for six weeks and powdered using a Willey mill (Thomas Scientific). Untreated pots were kept as control. For comparison the carbamate nematicide carbofuran (a.i. 44% Agricultural Product Group, Philadelphia, PA) 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). The pots were irrigated regularly with distilled water to avoid any contamination with fungi or nematodes. Eight weeks after treated soil in pots was collected for nematode populations and placed in polythene bags until nematodes were extracted. Each sample was processed using a modified Cobb's (1918) decanting and selective sieving method. The nematode population was counted under a stereoscopic binocular microscope by shaking the nematode-counting suspension thoroughly and transferring 2 ml aliquots to a counting dish. Four aliquots were counted. Data were subjected to a factorial analysis of variance (ANOVA) followed by least significant different (LSD) at $p = 0.05$ (Zar, 1996).

Results and Discussion

The treatment results were significant and nematodes non-significant ($p < 0.001$). However, treatments × nematode interaction (Table 1) was significant ($p < 0.05$). Among the non-conventional nematicides (soil amendments) Fertinemakil, marigold + Fertinemakil, neem powder + Fertinemakil was effective against nematode *Helicotylenchus pseudorobustus*. Although Carbofuran was the most effective in controlling all the three nematodes *Xiphinema americanum* was highly affected with neem powder + Fertinemakil followed by marigold + Fertinemakil and neem powder. On the other hand nematode *Pratylenchus thornei* was abated by marigold + Fertinemakil followed by neem powder + Fertinemakil and marigold (Fig. 1A-C).

The efficacy of different treatments varied for the three nematodes. The presence of population of *Xiphinema* in the orchards may be a potential for damage to the seedlings/plants with densities below the detection limit as reported earlier by (Kotcon, 1990) in West Virginia peach orchards. *Pratylenchus* also occurred in potentially damaging number which along with *Helicotylenchus pseudorobustus* could cause damage to the peach trees in general and seedlings in particular. The diversity and population of nematodes was high in Kalat in an earlier survey (Khan *et al.*, 2013) was unexpected.

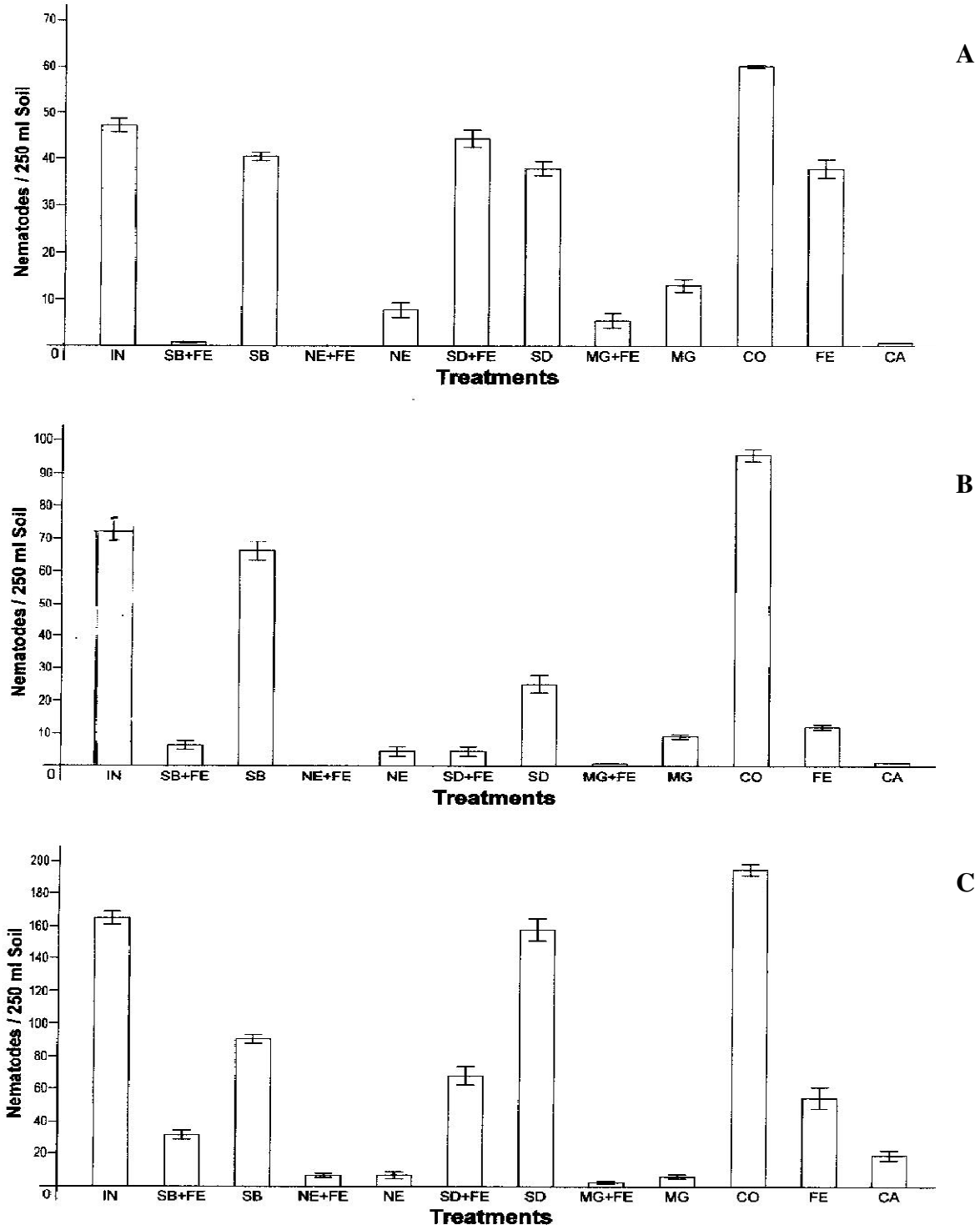

Fig. 1 (A–C). Effect of different treatments on nematodes associated with peach seedlings (IN = Initial; SB = Sugarcane bagasse; FE = Fertinemakil; NE = Neem leaf powder; SD = Sawdust; MG = Marigold flower powder; CO = Control; CA = Carbofuran (A = *Helicotylenchus pseudorobustus*; B = *Xiphinema americanum*; C = *Pratylenchus thornei*).

Most growers with high nematode densities tend to apply chemical nematicides regularly, but the nematicides are apparently not adequately reducing the nematode densities. Growers appear to have targeted their problem orchards for nematicide treatment, but once the nematodes are established in high frequency the orchards do not respond to nematicide treatment. These observations suggest a lack of success in nematode management problems in Balochistan orchards. These nematode together could affect the vigour among the seedlings to be transplanted in the orchards, thus nematode free seedlings are recommended which shall grow better once transplanted in the fields.

Table 1. Factorial ANOVA of various treatments and three nematode species associated with peach seedlings.

Source	SS	Df	MS	F	P
Blocks	344.67	3	114.95	0.805	n.s.
Treatments	49227.24	10	4922.72	34.477	< 0.001
Nematodes	23.227	2	11.61	0.081	n.s.
Treat. × Nematode	5287.433	20	264.371	1.851	< 0.05
Error	13706.878	96	142.779	-	-
Total	68589.659	131	-	-	-

Treatment $LSD_{0.05}$ = 9.683, Nematode $LSD_{0.05}$ = 5.056

Acknowledgment

The senior author is thankful to Pakistan Science Foundation, Islamabad for financial assistance to conduct this research.

References

Bailey, L.H. & Bailey, E.Z. 1976. *Hortus Third*. MacMillan Publishing Co. Inc., New York.

Cobb, N.A. 1918. Estimating the nema population of soil. U.S. Deptt. of Agriculture. *Bur. Plant Ind. Agriculture Technical Cir.*, 1: 1-48 pp.

Fazal-e-Haider, S. 2008. Fruit production in Balochistan. Dawn, English, 2008.

Filipjev, P. 1969. Population dynamics and pathogenicity of three species of *Pratylenchus* on peach. *Phytopathology* 59, 120-124.

Forer, L.B., Powell, C.A. & Stouffer, R.F. 1984. Transmission of tomato ring spot virus to apple rootstock cutting and to cherry and peach seedlings by *Xiphinema rivesi*. *Plant Diseases* 68, 1052-1054.

Khan, A., Shaukat, S.S. & Khatoon, N. 2013. Phytonematodes associated with peach (*Prunus persica* L.) seedlings in Balochistan. *Pakistan Journal of Nematology* 31, 153-156.

Kotcon, J.B. 1990. Distribution, frequency and population density of nematodes in West Virginia peach orchards. *Journal of Nematology* 22, 712-717.

Mountain, W.B. & Boyce, H.R. 1958. The peach replant problem in Ontario VI. The relation of *Pratylenchus penetrans* to the growth of young peach trees. *Canadian Journal of Botany* 36, 135-151.

Niblack, T.L. & Bernard, E.C. 1985. Plant parasitic nematode communities in dogwood, maple and peach nurseries in Tennessee. *Journal of Nematology* 17, 132-139.

Nyczepir, A.P., Beckmann, T.G. & Reighard, G.L. 1999. Reproduction and development of *Meloidogyne incognita* and *M. javanica* on guardian peach rootstock. *Journal of Nematology* 31, 334-340.

Potter, J.W., Dirks, V.A., Johnson, P.W., Olthof, T.H.A., Layne, R.E.C. & McDonnell, M.M. 1984. Response of peach seedlings to infection by the root-lesion nematode *Pratylenchus penetrans* under controlled conditions. *Journal of Nematology* 16, 317-322.

Ramsdell, D.C. & Myers, R.L. 1974. Peach rosette mosaic virus, symptomology and nematode associated with grapevine degeneration in Michigan. *Phytopathology* 64, 1174-1178.

Ramsdell, D.C., Bird, G.W., Giller, J.M. & Rose, L.M. 1983. Superimposed shallow and deep soil fumigation to control *Xiphinema americanum* and peach rosette mosaic virus re-infection in concord vineyard. *Plant Diseases* 67, 625-627.

Siddiqi, M.R. 1986. *Tylenchida. Parasites of plants and insects*. Commonwealth Agricultural Bureaux, U.K. 645 pp.

Zar, J.H. 1996. *Biostatistical Analysis* 4th Edition. Prentice-Hall, Englewood Cliffs, N.J.

(Accepted: September 15, 2014)