



Research Article

# Analysis and Management of Phytonematodes Associated with Walnut (*Juglans regia* L.) in Hazara Division, Pakistan

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## Authors' Contributions

NS conducted the research. MSK provided lab facilities and guided in research. HA supervised the research activities. MS analysed the data and wrote the manuscript.

## Keywords

Plant parasitic nematodes, walnut, *Helicotylenchus* sp., Carbofuran, Poultry manure

**Abstract** | A survey was conducted to estimate the ratio of plant parasitic nematodes associated with Walnut (*Juglans regia* L.) in different areas of Hazara Division, KP, Pakistan. Soil samples collected from walnut trees showed that Abbottabad and Mansehra had both parasitic and saprophytic nematodes whereas Kohistan had only saprophytic nematodes. *Helicotylenchus* sp. was found in abundance from Abbottabad and Mansehra alongwith other parasitic nematodes including *Aphelenchus avenae*, *Tylenchus* species, *Pratylenchus* species, *Psilenchus* species, *Meloidogyne* species and *Trichodorus* species. Carbofuran (inorganic) and poultry manure (organic) in recommended amounts were used for management and results showed that both were effective against phytonematodes. Value of P for the effect of Carbofuran in Mansehra and Abbottabad was 0.0001 and 0.0001 whereas for poultry manure it was 0.0001 and 0.0009 respectively.

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## Introduction

Walnut (*Juglans regia* L.) is one of the most widespread nut tree found worldwide. In Pakistan it is widely domesticated in the areas such as Galliat, Abbottabad, Swat, Dir, Shangla, Buner, Chitral. They are found in many localities in Hazara Division which include Havelian, Abbottabad, Mansehra, Kohistan, KP, Pakistan. Some are under domestic conditions while some are in wild habitat (Hugot *et al.*, 2001). A spadeful of soil can contain more

than million nematodes because nematodes are so numerous and occur in so many habitats. Plant parasitic nematodes are destructive to plants and agricultural crops, and may results in countable yield losses (Bang *et al.*, 2016). A number of workers have reported nematodes associated with walnut causing yield losses from various parts of the world (Mangan, 2015; Taheri *et al.*, 2013; Askary *et al.*, 2012; Zari *et al.*, 2011; Zarina *et al.*, 2010; Britton *et al.*, 2009; Westerdahl *et al.*, 2006; Mazdosh *et al.*, 2005; Khan *et al.*, 2002; Tarihi, 2001; Lorrain, 2000; Liskova *et al.*, 1998; Ciancio *et al.*, 1996; Khan *et al.*, 1993; Kaul *et al.*, 1989). The management of the plant parasitic nematodes is very important economically. Organic and inorganic compounds have been used for management of

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these parasites throughout the world and some of these have been found promising. In this study carbofuran (a nematicide, inorganic amendment) and poultry manure (organic amendment) was used against plant parasitic nematodes in Mansehra and Abbottabad.

## Materials and Methods

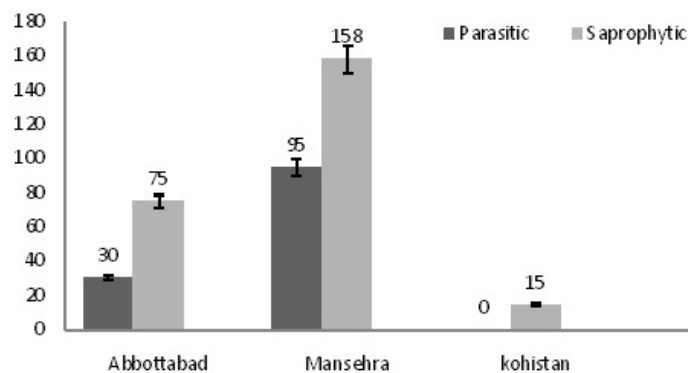
Walnut trees were surveyed for plant parasitic nematodes in different localities of Hazara Division. About 300 gram of soil sample was collected around the tree trunk by digging up to 2 feet deep. Collected samples were stored in a cool place and then processed by using Bearmann funnel technique (Southey, 1970). After 24 hours, each sample was studied under Watson Barnet stereoscope at 4X power for plant parasitic nematode population. Parasitic nematodes were isolated with the help of Pasteur pipette in cavity block. Nematode population was counted and data was recorded.

For the management of plant parasitic nematodes, nematicide carbofuran and poultry manure was applied around walnut trees affected by nematodes. Recommended rate of Carbofuran is 250 g/ tree and of poultry manure is 8kg/ tree. Soil around the tree trunk was dug with the help of spade for treatment with carbofuran and poultry manure. Both amendments were applied and thoroughly mixed in soil with the help of spade. Normal watering was done and avoids use of any other pesticide or agricultural sprays. Trees were marked as treated and untreated (controlled group) trees. Soil samples were collected after 3, 6 and 12 months from both treated and untreated trees and processed through Bearmann funnel technique. Nematode population was quantitatively analyzed under stereoscope microscope. Data collected was subjected to ANOVA analysis.

## Results and Discussion

Quantitative analysis showed that nematode population comprised of both parasitic and saprophytic species. Some localities in the studied area were found completely saprophytic while some showed both saprophytic and plant parasitic nematode species. Most common plant parasitic nematodes were *Helicotylenchus* species which are fungal feeders in their mode of life. Nematode population of different localities of district Abbottabad and Mansehra were compared and it was concluded that 40% of nematode population of Abbottabad and 60% of Mansehra (Fig. 1). It was confirmed that plant parasitic nematode population comprising of different species were damaging walnut trees in the studied area including *Helicotylenchus* species, *Aphelenchus avenae*, *Tylenchus* species, *Pratylenchus* species, *Psilenchus* species, *Meloidogyne* species and *Trichodorus* species. This result was similar to the observations of

Bahmani *et al.* (2013), he reported different plant parasitic nematode species associated with walnut trees in Sanandej region of Kurdistan province in western Iran in a survey.



**Figure 1: Parasitic and saprophytic nematode population in Abbottabad, Mansehra and Kohistan.**

Phytonematodes cause great damage to the host plant including walnut trees therefore resulted in economic loss. Phytonematodes can parasitize more than 2000 plants throughout the world. Hugot *et al.* (2001) also stated that phytonematodes consist of numerous groups resulting in severe crop losses as observed in this study. Most commonly identified nematode in the studied area was *Helicotylenchus* species which has a wide range of hosts and can parasitized host species from advanced one to most primitive families and even some can comprise gymnosperms in their host range (Rathore and Tiwari, 2016). Other nematode species are also of great importance as root knot (*Meloidogyne* species) and Root lesion (*Pratylenchus* species) were also observed. Root knot nematodes are obligate parasites of host plant and therefore cause severe damage to the whole tree. Rehman *et al.*, 2014 from India observed that root-knot nematode (*Meloidogyne incognita*) is a disastrous plant parasitic nematode causing great loss to both wild and cultivated crops worldwide. *Trichodorus* (stubby root nematode), *Aphelenchus* species, *Psilenchus* species and *Tylenchus* species are also fungal feeders.

The current results clearly showed that application of both nematicide Carbofuran (Inorganic amendment) and Poultry manure (as an organic amendment) for the control of plant parasitic nematodes associated with walnut trees gave positive results. Both Carbofuran and poultry manure reduced the nematode population associated with walnut trees in Mansehra and Abbottabad. It was observed that phytonematode population was declined after the application of both amendments. Plant parasitic nematode population was risk to the associated plant and therefore both amendments effects were of great concern. Difference can be easily observed between initial population and 3 Month population of the treated trees. It was same as to the findings of Khan *et al.*, 2001. They observed that carbofuran and poultry manure were effective against plant parasitic nematodes with other organic amendments.

Carbofuran was found effective as 12 month samples of the treated trees of both Mansehra and Abbottabad were found saprophytic therefore nematode population was totally eradicated (Figs. 2 and 3). The findings for Carbofuran were similar to Adegbite and Agbaje (2007) in which they found that Carbofuran was effective in eradicating parasitic nematodes especially root-knot nematode. Dtsanzo (1973) explained that carbofuran had positive response in eradicating parasitic nematodes completely. Results show that poultry manure was effective in controlling phytonematodes in Mansehra and Abbottabad (Figs. 4 and 5). Histogram graph bars with S.D showed the effect very clearly.

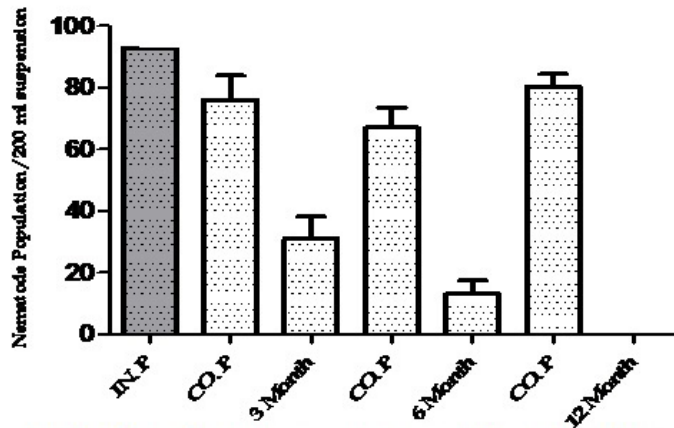


Figure 2: Effect of Carbofuran on phytonematodes in Mansehra. IN. P: Initial population; CO: Controlled population.

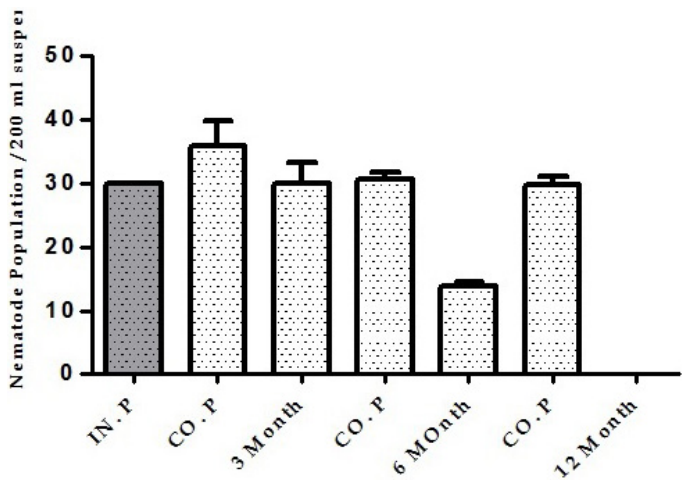


Figure 3: Effect of Carbofuran on phytonematodes in Abbottabad. IN. P: Initial population; CO: Controlled population.

Poultry manure is organic in nature and is a natural waste of poultry. Results also showed that nematode population was reduced to a noticeable extent with the application of poultry manure. Month wise results showed the difference between the initial and 12 month nematode population were not totally eradicated but declined to a significant level. Same results of Sivakumar and Marimuthu (1986) work showed 40.9% declined

in nematode population by the use of poultry manure. Therefore, Poultry manure is also a source of many nutrients for the plant and eco-friendly in nature (Nicholson *et al.*, 1996) that poultry manures contain phosphorus, nitrogen, sulfur, magnesium and potassium. Nitrogen in poultry manure is present in the form of Ammonia and Uric acid. McSorley (2011) observed that organic amendments are effective against plant parasitic nematodes. ANOVA showed that the p values for effect of Carbofuran and Poultry manure on phytonematodes were significant. Therefore, it was clear that both have profound effects on the nematode population and variation can be easily noticed on treated and untreated trees. Ismail and Youssef (1997), also observed that organic amendments including poultry manure were significantly effective in declining nematode population as ( $p < -0.01$ ).

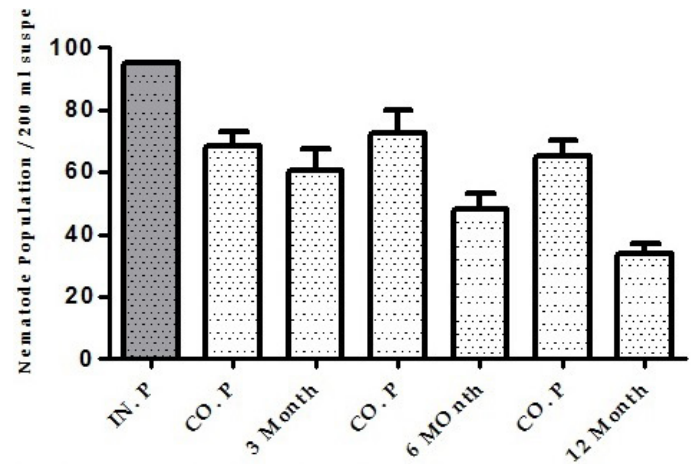


Figure 4: Effect of Poultry Manure on phytonematodes in Mansehra. IN. P: Initial population; CO: Controlled population.

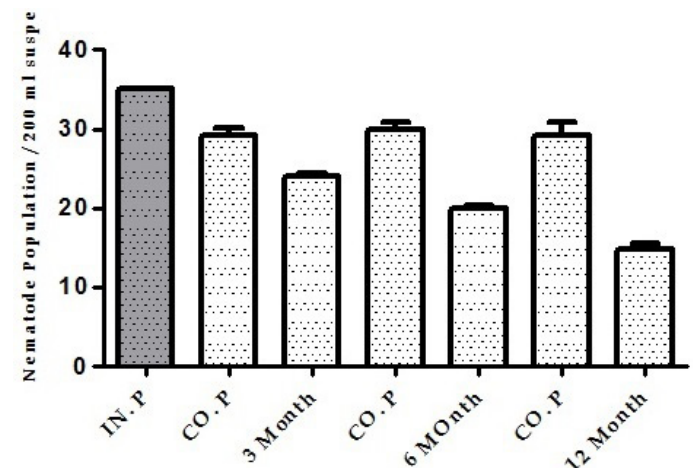


Figure 5: Effect of Poultry Manure on phytonematodes in Abbottabad. P: Initial population; CO: Controlled population.

## Conclusion

After this survey it was concluded that plant parasitic nematode population was present in different localities

of Hazara Division of Pakistan. Both saprophytic and parasitic species were present. It was also concluded that plant parasitic nematodes were causing damage to the walnut trees in the surveyed localities. Inorganic amendment comprising of Carbofuran (Nematicide) and organic amendment including Poultry Manure reduced the plant parasitic nematode population. Carbofuran totally eradicate the population while Poultry Manure reduced to a noticeable extend. But as Poultry Manure is not toxic in nature therefore it is more suitable as compared to nematicide which is toxic in nature.

#### Conflict of interest

Authors have no conflict of interest.

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