

Screening of plant parasitic Nematodes associated with Tomato crops in Madhepura district

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ABSTRACT

A survey was conducted in 14 plots of five villages under Madhepura district to examine PPN infection in tomato crops. Out of 14 plots, 10 plots were positive for PPN. *Meloidegyne* dominated among all six genera of PPN. The six genera isolated from tomato plants were *Meloidegyne*, *Helicotylenchus*, *Aphelenchus*, *Pratylenchus*, *Tylenchus* and *Longidorus*. The average frequency of occurrence was recorded as 0.642 for *Meloidegyne* and *Helicotylenchus*, 0.571 for *Aphelenchus*, 0.357 for *Pratylenchus* and *Tylenchus*, 0.428 for *Longidorus*. Average absolute frequency was observed as 0.409% for *Meloidegyne*, 0.204% for *Helicotylenchus*, 0.227% for *Aphelenchus*, 0.200 for *Pratylenchus*, 0.190 for *Tylenchus* and 0.068% for *Longidorus*. Population density of each PPN genera was examined in soil and root of Tomato plants. Maximum population density was recorded both in soil and root for *Meloidegyne* in all plots where it occurred.

Key Words - Plant parasitic nematodes, Tomato, Population density, Frequency, Absolute frequency

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INTRODUCTION

Tomato is one of the most consume vegetable in India. It is the key source of β -carotene and lycopene which are antioxidant. Antioxidants protect DNA damage of cell and thus minimize the risk of cancer. Consumption of tomato also prevent cardiac problems and decrease high blood pressure. Tomato contain cellulose, hemicellulose and pectine fibres so its consumption decreases constipation. It is also a rich source of vitamin A, E and C. The major loss of tomato crop occurs due to infection of plant parasitic nematodes (Bongers, 1990). Parasitic nemtodes interact with pathogens and produces disease complex due to which resistance of plant decreases against pathogen (Begum *et al.*, 2012). Root-know nematode cause serious loss in tomato crops. Root-knot nematode, *Meloidegyne* infect a large number of crops

including tomato, cucumber, onion, carrot, rice, pea, bean and cotton (He Qiong, 2020). *Meloidegyne* causes heavy loss in yield of tomato crops. The symptoms of infection are galled root, chlorosis, wilting, stunted growth and eventually death of plant. Root-knot nematodes causes great loss in tomato crops worldwide (Fuller *et al.*, 2008). Infection of *Meloidegyne* incognita causes increase in root weight and decrease in shoot weight (Fortnum *et al.*, 1991). Abundance of plant parasitic nemtodes is related with soil properties. Krif *et al.*, (2020) observed high abundance of *Meloidegyne* in sandy soil in Turkey. Chirchir *et al.*, (2008) also reported high abundance of *Meloidegyne* in sandy soil in Kenya. Nicol *et al.*, (2011) observed high abundance of *Meloidegyne* in sandy soil of Spain.

MATERIAL & METHODS

Extensive survey was carried out in Tomato fields of five villages: Chikni, Lalpur, Jitapur, Bihariganj and Kumarkhand of Madhepura district to find the occurrence of plant pathogenic nematodes. In each village, five plots of tomato crop was selected and infected plants and soil were collected. Soil was collected from 15-20 cm deep in zig-zag pattern and brought to laboratory in polybags.

Extraction of Nematodes from plant root: Infected plant roots were cut into small pieces and grinded in a grinder and nematodes were extracted using Baermann method. Nematodes were extracted from 10gm root of each sample.

Extraction of Nematodes from soil: Nematodes were extracted from soil using Baermann method. 100gm soil samples were placed in a funnel that hold a sieve and filter paper. Funnel end was covered with rubber tube and a clamp was set at the end of rubber tube. Water was added on the soil sample in funnel. Nematodes were collected after 48 hours in a petridish by removing clamp from rubber tube. Isolated nematodes were identified microscopically by staining with $KMMnO_4$. Identification of Nematodes was done up to genus using standard literature (Bogale *et al.*, 2020). Nematode were counted on Haemocytometer.

Nematode, population density, relative abundance, frequency of occurrence were calculated by the formula:

Population density (PD): Population density was calculated as the maximum number of individual of a particular gene.

Frequency of occurrence (FO) was calculated by the formula:

$$FO = \frac{\text{No. of plot with a particular genus}}{\text{No. of plot examined}}$$

Frequency and Absolute frequency was calculated by the formula:

Frequency = Total no. of samples in which a particular genus was present

$$AF = \frac{\text{No. of sample with a genus}}{\text{Total no. of samples}} \times 100$$

RESULTS

A survey was carried out in five villages of Madhepura district namely Chikni, Lalpur, Jitapur, Bihariganj and Kumarkhand to isolate plant parasitic Nematodes (PPN) associated with tomato crops. Altogether 6 genera of PPN including *Meloidegyne*, *Helicotylenchus*, *Aphelenchus*, *Pratylenchus*, *Tylenchus* and *Longidorus* were identified in different tomato fields of surveyed villages. The average frequency of occurrence was recorded as 0.642 for *Meloidegyne* and *Helicotylenchus*, 0.571 for *Aphelenchus*, 0.357 for *Pratylenchus* and *Tylenchus*, 0.428 for *Longidorus* (Fig. 1).

Average absolute frequency was observed as 0.409% for *Meloidegyne*, 0.204% for *Helicotylenchus*, 0.227% for *Aphelenchus*, 0.200 for *Pratylenchus*, 0.190 for *Tylenchus* and 0.068% for *Longidorus* (Fig.2).

Population density of each PPN genera was examined in soil and root of Tomato plants. Maximum population density was recorded both in soil and root for *Meloidegyne* in all plots where it occurred. This genus was absent in soil and root samples from one plot of Lalpur, Jitapur, Bihariganj and Kumarkhand, while present in all plots of Chikni. *Helicotylenchus* was absent in all plots of

Table 1: Population density of plant parasitic nematode in 100ml soil

| Village | Plot No. | Melo | Heli | Aphe | Praty | Tyle | Long |
|------------|----------|------|------|------|-------|------|------|
| Chikni | 1 | 213 | 85 | 35 | 00 | 00 | 00 |
| | 2 | 183 | 72 | 43 | 00 | 08 | 00 |
| | 3 | 65 | 00 | 00 | 22 | 00 | 00 |
| Lalpur | 1 | 00 | 00 | 07 | 00 | 17 | 08 |
| | 2 | 120 | 00 | 00 | 11 | 00 | 00 |
| Jitapur | 1 | 217 | 23 | 05 | 00 | 12 | 00 |
| | 2 | 00 | 17 | 08 | 05 | 00 | 07 |
| Bihariganj | 1 | 116 | 62 | 00 | 00 | 05 | 13 |
| | 2 | 107 | 27 | 00 | 00 | 00 | 00 |
| | 3 | 00 | 00 | 00 | 09 | 04 | 17 |
| Kumarkhand | 1 | 53 | 21 | 16 | 00 | 00 | 00 |
| | 2 | 123 | 13 | 28 | 00 | 00 | 05 |
| | 3 | 78 | 00 | 00 | 18 | 00 | 11 |
| | 4 | 00 | 00 | 11 | 00 | 00 | 00 |

Melo = *Meloidegyne*

Aphe = *Aphelenchus*

Tyle = *Tylenchus*

Heli = *Helicotylenchus*

Praty = *Pratylenchus*

Long = *Longidorus*

Lalpur, one plot of Bihariganj and two plots of Kumarkhand. *Aphelenchus* was not recorded from any plot of Bihariganj and one plot of all other villages. *Pratylenchus* was absent in two plots of Chikni and Bihariganj, 3 plots of Kumarkhand and one plot of Jitapur and Lalpur. *Tylenchus* was absent in all plots of Kumarkhand and *Longidorus* was totally absent in Chikni (Table 1 & 2).

Maximum frequency and absolute frequency was recorded for *Meloidegynae* in a plot of Chikni and minimum in a plot of Bihariganj (Table 3).

Table 2: Population density of PPN in 10 gm root of Tomato plants from different plots

| Village | Plot No. | Melo | Heli | Aphe | Praty | Tyle | Long |
|------------|----------|------|------|------|-------|------|------|
| Chikni | 1 | 312 | 182 | 190 | -- | -- | -- |
| | 2 | 218 | 192 | 88 | -- | 21 | -- |
| | 3 | 92 | 87 | -- | 89 | -- | -- |
| Lalpur | 1 | -- | -- | 38 | -- | 63 | 23 |
| | 2 | 244 | -- | -- | 28 | -- | -- |
| Jitapur | 1 | 88 | 312 | 35 | -- | 41 | -- |
| | 2 | -- | 98 | 48 | 22 | -- | 18 |
| Bihariganj | 1 | 215 | 118 | -- | -- | 18 | 37 |
| | 2 | 217 | 105 | -- | -- | -- | -- |
| | 3 | -- | -- | -- | 36 | 22 | 42 |
| Kumarkhand | 1 | 165 | 93 | 42 | -- | -- | -- |
| | 2 | 208 | 67 | 71 | -- | -- | 25 |
| | 3 | 144 | -- | -- | 52 | -- | 43 |
| | 4 | -- | -- | 31 | -- | -- | -- |

Table 3: Details of PPN in different plots of selected villages, Frequency of Occurrence (FO), Frequency (F) & Absolute frequency (AF)

| Village | PPN | Plot examine | Plot with PPN | FO | No. of sample | Positive | F | AF% |
|------------|-------|--------------|---------------|------|---------------|----------|----|------|
| Chikni | Melo | 3 | 03 | 01 | 50 | 33 | 33 | 0.66 |
| | Heli | 3 | 03 | 01 | 50 | 21 | 21 | 0.42 |
| | Aphe | 3 | 02 | 0.6 | 50 | 17 | 17 | 0.54 |
| | Praty | 3 | 01 | 0.3 | 50 | 23 | 23 | 0.46 |
| | Tyle | 3 | 01 | 0.3 | 50 | 22 | 22 | 0.44 |
| | Long | 3 | 00 | 00 | 50 | 00 | 00 | 00 |
| Lalpur | Melo | 2 | 01 | 0.5 | 30 | 12 | 12 | 0.40 |
| | Heli | 2 | 00 | 00 | 30 | 00 | 00 | 00 |
| | Aphe | 2 | 01 | 0.5 | 30 | 13 | 13 | 0.43 |
| | Praty | 2 | 01 | 0.5 | 30 | 11 | 11 | 0.36 |
| | Tyle | 2 | 01 | 0.5 | 30 | 09 | 09 | 0.30 |
| | Long | 2 | 01 | 0.5 | 30 | 07 | 07 | 0.23 |
| Jitapur | Melo | 2 | 01 | 0.5 | 30 | 14 | 14 | 0.46 |
| | Heli | 2 | 02 | 01 | 30 | 08 | 08 | 0.26 |
| | Aphe | 2 | 02 | 01 | 30 | 06 | 06 | 0.20 |
| | Praty | 2 | 01 | 0.5 | 30 | 03 | 03 | 0.10 |
| | Tyle | 2 | 01 | 0.5 | 30 | 05 | 05 | 0.16 |
| | Long | 2 | 01 | 0.5 | 30 | 04 | 04 | 0.13 |
| Bihariganj | Melo | 3 | 02 | 0.6 | 50 | 13 | 13 | 0.26 |
| | Heli | 3 | 02 | 0.6 | 50 | 07 | 07 | 0.14 |
| | Aphe | 3 | 00 | 00 | 50 | 00 | 00 | 00 |
| | Praty | 3 | 01 | 0.3 | 50 | 05 | 05 | 0.10 |
| | Tyle | 3 | 02 | 0.6 | 50 | 03 | 03 | 0.06 |
| | Long | 3 | 02 | 0.6 | 50 | 02 | 02 | 0.04 |
| Kumarkhand | Melo | 4 | 03 | 0.75 | 60 | 18 | 18 | 0.30 |
| | Heli | 4 | 02 | 0.5 | 60 | 09 | 09 | 0.15 |
| | Aphe | 4 | 03 | 0.75 | 60 | 04 | 04 | 0.06 |
| | Praty | 4 | 01 | 0.25 | 60 | 02 | 02 | 0.03 |
| | Tyle | 4 | 00 | 00 | 60 | 03 | 03 | 0.05 |
| | Long | 4 | 02 | 0.5 | 60 | 02 | 02 | 0.03 |

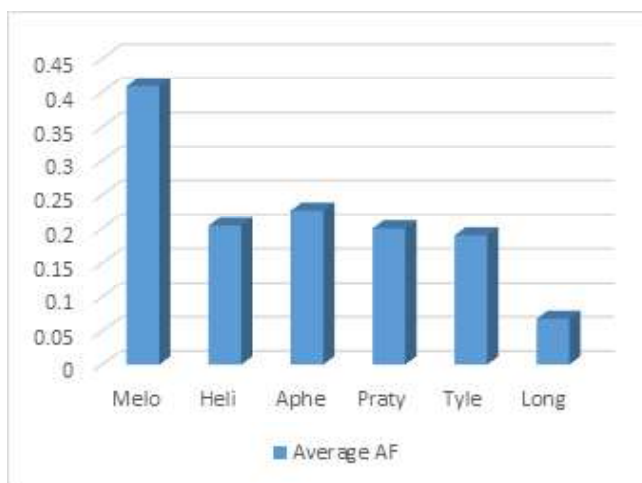


Fig. 1: Graph showing average absolute frequency of identified PPN

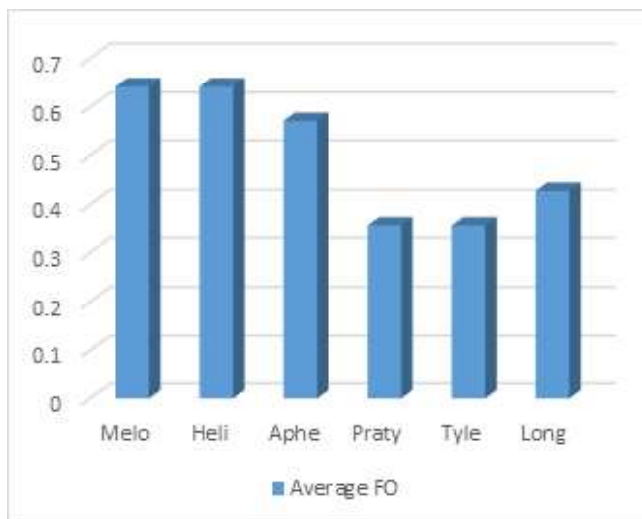


Fig. 2: Graph showing average frequency of occurrence (FO) of identified PPN.

DISCUSSION

Tomato is the most favourable host crop for plant parasitic nematodes (Hussain *et al.*, 2011). In the present study also it was observed that PPN were present in almost all plots of tomato crops. The root-knot PPN *Meloidegynae* was observed in 10 plots of tomato crops, out of total surveyed 14 plots. Similar result was reported by Nono-Womdim *et al.*, (2002). Taylor *et al.*, (1982) and Lambarti *et al.*, (1979) also reported that *Meloidegynae* is the largest dominant PPN distributed all over the world. Altogether 6 genera of PPN including *Meloidegynae*, *Helicotylenchus*, *Aphelenchus*, *Pratylenchus*, *Tylenchus* and *Longidorus* were identified in

different tomato fields of surveyed villages. The average frequency of occurrence was recorded as 0.642 for *Meloidegyne* and *Helicotylenchus*, 0.571 for *Aphelenchus*, 0.357 for *Pratylenchus* and *Tylenchus*, 0.428 for *Longidorus* (Fig. 1).

Average absolute frequency was observed as 0.409% for *Meloidegyne*, 0.204% for *Helicotylenchus*, 0.227% for *Aphelenchus*, 0.200 for *Pratylenchus*, 0.190 for *Tylenchus* and 0.068% for *Longidorus* (Fig.2).

Population density of each PPN genera was examined in soil and root of Tomato plants. Maximum population density was recorded both in soil and root for *Meloidegyne* in all plots where it occurred.

CONCLUSION

Tomato is the most favorable host for plant parasitic nematodes. In the present study, a survey was conducted in 14 tomato crop plots of five villages under Madhepura district. Out of 14 plots, 10 plots were infected with plant parasitic nematodes (PPN). Further maximum population density frequency and absolute frequency was recorded for *Meloidegyne*. Altogether six genera of PPN recorded from different plots of Chikni, Lalpur, Jitapur, Bihariganj and Kumarkhand villages under Madhepura district including *Meloidegyne*, *Helicotylenchus*, *Aphelenchus*, *Pratylenchus*, *Tylenchus* and *Longidorus*. The average frequency of occurrence was recorded as 0.642 for *Meloidegyne* and *Helicotylenchus*, 0.571 for *Aphelenchus*, 0.357 for *Pratylenchus* and *Tylenchus*, 0.428 for *Longidorus*.

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