

**PLANT-PARASITIC NEMATODES ASSOCIATED WITH  
TOMATO AND OKRA FIELDS OF ALLAHABAD, UTTAR  
PRADESH, INDIA**

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**Abstract**

An extensive survey was carried out for the infestation of plant parasitic nematodes associated with vegetable growing fields i.e., tomato and okra. Soil and root samples were collected from 238 tomato fields represents 16 different locations (villages) where TSS-1 to TSS-238 varieties and 227 soil and root samples from the okra fields were collected (OSS-1 to OSS-227) represents 16 different locations (16 villages) to identify the hot spots of plant-parasitic nematodes of Allahabad, Uttar Pradesh, India. Results revealed that incidence of root-knot nematodes were found 60% and 55.9% in tomato and okra fields, respectively. Beraunji, Basahra, Mansoorahad and Urua villages were found most infested areas of okra and tomato crops. Root-knot nematode infestation was found to maximum i.e., 60%. Moreover, other plant-parasitic nematodes such as *Rotylenchulus reniformis*, *Longidorus* spp., *Hoplolaimus* spp., *Hemicriconemoides* spp., *Xiphinema* spp., *Helicotylenchus* spp., *Tylenchorhynchus* spp., *Paratylenchus* spp., and *Pratylenchus* spp., were also recorded.

The tomato, botanically known as *Lycopersicon esculentum* Mill., belongs to the family Solanaceae. The tomato is a warm-season crop and infested by plant-parasitic nematodes. Root-knot nematodes are serious and economically most important pest all over the world (Trifonova *et al.*, 2009). The crop losses due to nematodes are related to their population density and crop growth (Sehgal & Gaur, 1999). Also, they stated that the nematodes cause losses up to 80% in heavily infested field. In susceptible plants, the nematode population build up to a maximum usually as crop reach to ripe stage and in some cases the plants die even before reaching maturity (Singh & Khurma, 2007).

Root-knot nematodes (*Meloidogyne* spp.) are global menace to crop production. Vaish & Singh (2001) conducted a survey to investigate the incidence of root-knot nematode of tomato. They found that more than 50% of the fields were infested with *Meloidogyne* nematodes. Esfahani (2009) conducted

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a survey to assess the incidence of root-knot disease on tomato in 8 localities in and around Aligarh (India). He showed that in tomato, all the 8 localities were infested with root-knot nematodes.

Okra (*Abelmoschus esculentus* L.) is one of the important vegetable crops grown in tropical and subtropical countries including almost all parts of India mainly during summer and rainy seasons (Sardana *et al.*, 2011). It is cultivated in India with an average productivity of 8.5 t / ha. The crop suffers from many pests, weeds and disease problems resulting in low yield. Amongst pests, jassids, aphids, fruit borers, and root-knot nematodes are major constraints (Sardana *et al.*, 2011). The farmers are aware of all visible enemies of okra crop but are often not aware of nematodes.

### Materials and Methods

An extensive survey was carried out for the community analysis of plant parasitic nematodes associated with tomato and okra. Soil and root samples were collected from 238 tomato fields from 16 different locations (villages) where TSS-1 to TSS-238 varieties were grown by the farmers and 227 okra fields (OSS-1 to OSS-227) represent 16 different locations (16 villages) of Allahabad districts, Uttar Pradesh to identify the plant-parasitic nematode disease infestations. Since nematodes are distributed in patches, a large number of subsamples (i.e., cores which are combined together to make a single sample for analysis) were taken from tomato growing field (mix. of 5 different places of one field). All the samples were collected in polythene bags separately, sealed and brought to the laboratory. Each collected soil sample was thoroughly mixed to make homogenous before processing. Soil samples were processed for nematode extraction according to Cobb's sieving and decanting method (Cobb, 1913, 1918). Nematode species present in the suspension were identified and counted by taking known amount suspension in a counting disc under stereoscopic binocular microscope. Root gall index were determined according to Prot & Matias, 1995 (1=Root with no gall, 2= Root with 1-25% galls, 3=Root with 26-50% galls, 4=Root with 51-75% galls and 5=Root with 75% galls and above). The calculation on following parameters related to nematode infestation was computed as suggested by Norton (1978):

$$\text{Relative density (RD)} = \frac{\text{No. of individuals of a nematode genus}}{\text{Total No. of individuals of all the nematode genera}} \times 100$$

$$\text{Relative abundance (RA)} = \frac{\text{No. of samples in which the species occurred}}{\text{Total No. of samples examined}} \times 100$$



$$\text{Relative Frequency (RF)} = \frac{\text{Relative abundance of species}}{\text{Relative abundance of all the species}} \times 100$$

$$\text{Dominance value index (DVI)} = \frac{\text{RD} + \text{RA} + \text{RF}}{3}$$

$$\text{Reproduction factor (R)} = \frac{\text{Final population (Pf)}}{\text{initial population (Pi)}}$$

$$\text{Disease Prevalence (DP)} = \frac{\text{No. of fields infected}}{\text{No. of fields inspected}} \times 100$$

$$\text{Inoculum Density (ID)} = \frac{\text{No. of individuals of a nematode genus}}{\text{Weight of soil sample (g)}}$$

### Results and Discussion

**Disease prevalence, relative abundance, relative density, relative frequency, dominance value index and inoculums density of the root-knot nematode associated with tomato fields:** Results revealed that root-knot nematode infestation were sustained the maximum incidence (60%) in tomato fields. Panasa, Tiwaripur, Bhagautipur, Balkaranpur, Rajapur and Dighia villages were found most infested areas growing tomato crop. Other different plant parasitic nematodes viz., *Rotylenchulus reniformis*, *Helicotylenchus* spp., *Hoplolaimus* spp., *Longidorus* spp., *Pratylenchus* spp., *Xiphinema* spp., *Tylenchorhynchus* spp., *Hemicriconemoides* spp., and *Filenchus* spp., were found associated but in few numbers with the tomato fields (Table 1 a, b).

Disease prevalence (DP) of root-knot nematode (*Meloidogyne incognita*) in tomato fields ranged from 86.6% to 5% at Panasa village and Haziganj village, respectively (Table 1). So, the disease prevalence was recorded descending at Panasa (86.6%) followed by Chakdecha (85.7%), Bhagautipur (83.3%), Tiwaripur (80%), Rajapur (68.7%), Balkaranpur (66.6) Dighia (60%), Gorapur (56.2%), Decha (45.4%), Babuganj (42.1%), Tharwai (38.8%), Nauaa (38.4%), Kaandi (33.3%), Ismaelpur (28.5%), Majhua (11.7%) and Haziganj village (5%).

Relative abundance (RA) of root-knot nematode attained the highest abundance (100%) at three villages namely Chakdecha, Tiwaripur, Ismaelpur, Haziganj followed by Bhagautipur (93.7), Rajapur (91.6%), Balkaranpur (90.9%), Panasa (86.6%), Dighia (85.7%), Gorapur (81.8%), Babuganj an

Kaandi (80%), Tharwai (77.7%), Deeha (71.4%), Nauaa (62.5%) and then the lowest abundance at Majhua village (46.3%) (Table 1c).

Also, relative density (RD) of root-knot nematode associated with tomato fields ranged from 77.7% to 21.1% at Kaandi village and Tharwai village, respectively. So the relative density was recorded descending as follows: (77.7%) at Kaandi followed by Gorapur (75.7%), Babuganj (72.8%), Deeha (68%), Dighia and Ismaelpur (65.2%), Nauaa (56.9%), Majhua (49.1%), Bhagautipur (44.6%), Chakdeeha (39.1%), Panasa (36.7%), Tiwaripur (35.5%), Rajapur (29%), Balkaranpur (28%) and minimum value (21.1%) at Tharwai village (Table 1c).

**Table 1a. Number of surveyed locations of tomato fields with positive samples of RKN.**

| Location    | No. of surveyed field | No. of infected field | No. of +ve samples of RKN |      |
|-------------|-----------------------|-----------------------|---------------------------|------|
|             |                       |                       | M. i                      | M. j |
| Rajapur     | 16                    | 12                    | 11                        | 9    |
| Chakdeeha   | 14                    | 12                    | 12                        | 10   |
| Dighia      | 10                    | 7                     | 6                         | -    |
| Tharwai     | 18                    | 9                     | 7                         | 8    |
| Deeha       | 11                    | 7                     | 5                         | -    |
| Majhua      | 17                    | 7                     | 2                         | -    |
| Nauaa       | 13                    | 8                     | 5                         | -    |
| Panasa      | 15                    | 15                    | 13                        | 13   |
| Babuganj    | 19                    | 10                    | 8                         | -    |
| Tiwaripur   | 10                    | 8                     | 8                         | 8    |
| Gorapur     | 16                    | 11                    | 9                         | -    |
| Kaandi      | 12                    | 5                     | 4                         | -    |
| Bhagautipur | 18                    | 16                    | 15                        | 12   |
| Ismaelpur   | 14                    | 4                     | 4                         | -    |
| Haziganj    | 20                    | 1                     | 1                         | -    |
| Balkaranpur | 15                    | 11                    | 10                        | 10   |
| Total       | 238                   | 143                   | 120                       | 70   |

Table 1b. Plant parasitic nematodes associated with tomato and their population in Allahabad district.

| Location    | Meloidogyne species* |     | Rot.** | Lon. | Hop. | Hem. | Xi. | Hel. | Ty. | Ap. | Het. | Dy. | Pr. | Total nematode population |
|-------------|----------------------|-----|--------|------|------|------|-----|------|-----|-----|------|-----|-----|---------------------------|
|             | M.i                  | M.j |        |      |      |      |     |      |     |     |      |     |     |                           |
| Rajapur     | 94                   | 78  | 56     | 26   | 9    | -    | -   | 14   | -   | 24  | 10   | 13  | -   | 324                       |
| Chakdecha   | 122                  | 114 | 46     | -    | -    | 6    | 2   | -    | 9   | -   | 4    | -   | 9   | 312                       |
| Dighia      | 144                  | -   | 20     | 18   | 9    | -    | 4   | -    | 4   | 15  | -    | -   | -   | 214                       |
| Tharwai     | 36                   | 86  | 4      | -    | 6    | -    | -   | 16   | -   | -   | 6    | 16  | -   | 170                       |
| Decha       | 96                   | -   | 15     | -    | -    | 5    | -   | 6    | -   | 12  | -    | -   | 7   | 141                       |
| Majhua      | 28                   | -   | -      | 14   | -    | 5    | -   | -    | 6   | -   | 4    | -   | -   | 57                        |
| Nauaa       | 110                  | -   | 28     | -    | 8    | 4    | 3   | 17   | -   | 2   | 7    | 18  | -   | 193                       |
| Panasa      | 158                  | 212 | 12     | 16   | -    | -    | -   | -    | -   | 15  | -    | -   | 17  | 430                       |
| Babuganj    | 78                   | -   | -      | -    | 9    | -    | 5   | -    | 6   | -   | 9    | -   | -   | 107                       |
| Tiwaripur   | 126                  | 118 | 60     | -    | -    | 4    | -   | 13   | -   | 8   | -    | 20  | 5   | 354                       |
| Gorapur     | 156                  | -   | -      | 28   | -    | -    | -   | 6    | -   | 14  | -    | -   | -   | 206                       |
| Kaandi      | 124                  | -   | 6      | -    | 10   | -    | -   | -    | 5   | -   | 5    | -   | 12  | 162                       |
| Bhagautipur | 205                  | 140 | 45     | 25   | -    | 3    | 6   | 22   | -   | -   | -    | 13  | -   | 459                       |
| Ismaelpur   | 92                   | -   | 13     | -    | 4    | 8    | -   | -    | 7   | -   | 9    | -   | 8   | 141                       |
| Haziganj    | 80                   | -   | 10     | -    | 4    | -    | 6   | -    | 4   | 17  | -    | -   | -   | 119                       |
| Balkarapur  | 125                  | 172 | 48     | 34   | -    | 5    | -   | 19   | -   | -   | 14   | 22  | 7   | 445                       |
| Total       | 1774                 | 929 | 363    | 161  | 59   | 40   | 26  | 113  | 41  | 107 | 68   | 102 | 65  | 3834                      |

\*M. i = *M. incognita*, M. j = *M. javanica*, \*\*Rot. = *Rotylenchulus*, Lon. = *Longidorus*, Hop. = *Hoplotannus*, Hem. = *Hemicriconemoides*, Xi = *Xiphinema*, Hel. = *Helicotylenchus*, Ty. = *Tylenchorynchus*, Ap. = *Aphelenchoides*, Het. = *Heterodera*, Dy. = *Ditylenchus*, Pr. = *Pratylenchus*.



**Table 1c. Community analysis of RKN associated with tomato in Allahabad district**

| Localities  | RKN species* | RD** | RA   | RF   | DVI  | DP   | ID   | GI |
|-------------|--------------|------|------|------|------|------|------|----|
| Rajapur     | Mi           | 29.0 | 91.6 | 34.3 | 51.6 | 68.7 | 0.18 | 2  |
|             | Mj           | 24.0 | 75.0 | 28.1 | 42.3 | 56.2 | 0.15 | 2  |
| Chakdecha   | Mi           | 39.1 | 100  | 40   | 59.6 | 85.7 | 0.24 | 3  |
|             | Mj           | 36.5 | 83.3 | 33.3 | 51.0 | 71.4 | 0.22 | 3  |
| Dighia      | Mi           | 67.2 | 85.7 | 37.5 | 63.4 | 60.0 | 0.28 | 4  |
|             | Mi           | 21.1 | 77.7 | 25.9 | 41.5 | 38.8 | 0.07 | 2  |
| Tharwai     | Mj           | 50.5 | 88.8 | 29.6 | 56.3 | 44.4 | 0.17 | 2  |
|             | Mi           | 68.0 | 71.4 | 41.7 | 60.3 | 45.4 | 0.19 | 3  |
| Decha       | Mi           | 49.1 | 46.3 | 44.9 | 46.7 | 11.7 | 0.05 | 1  |
| Majhua      | Mi           | 56.9 | 62.5 | 33.3 | 50.9 | 38.4 | 0.22 | 3  |
| Nauaa       | Mi           | 36.7 | 86.6 | 34.4 | 52.5 | 86.6 | 0.42 | 4  |
| Panasa      | Mj           | 49.3 | 86.6 | 34.4 | 56.7 | 86.6 | 0.42 | 3  |
|             | Mi           | 72.8 | 80   | 61.5 | 71.4 | 42.1 | 0.15 | 2  |
| Babuganj    | Mi           | 35.5 | 100  | 33.3 | 56.2 | 80.0 | 0.25 | 3  |
|             | Mj           | 33.3 | 100  | 33.3 | 55.5 | 80.0 | 0.23 | 3  |
| Tiwariapur  | Mi           | 75.7 | 81.8 | 45   | 67.5 | 56.2 | 0.31 | 4  |
|             | Mj           | 77.7 | 80   | 36.3 | 64.4 | 33.3 | 0.24 | 3  |
| Gorapur     | Mi           | 44.6 | 93.7 | 33.3 | 57.2 | 83.3 | 0.41 | 5  |
| Kaandi      | Mi           | 44.6 | 93.7 | 33.3 | 57.2 | 83.3 | 0.41 | 5  |
|             | Mj           | 30.5 | 75   | 26.6 | 44   | 66.6 | 0.28 | 4  |
| Bhagautipur | Mi           | 65.2 | 100  | 36.3 | 67.1 | 28.5 | 0.18 | 2  |
| Ismaelpur   | Mi           | 67.2 | 100  | 12.5 | 59.9 | 5.0  | 0.16 | 2  |
| Haziganj    | Mi           | 28.0 | 90.9 | 27.8 | 48.9 | 66.6 | 0.25 | 3  |
|             | Mj           | 38.6 | 90.9 | 27.8 | 52.4 | 66.6 | 0.34 | 4  |

\*Mi= *M. incognita*, Mj = *M. javanica*; \*\*RD= Relative density, RA=Relative abundance, RF=Relative frequency, DP=Disease prevalence, ID=Inoculum density, DVI= Dominance value index, GI=Gall index according to Prot & Matias, 1995.

As for relative frequency (RF) of root-knot nematode, its rated descending as follows: 61.5% at Babuganj village followed by Gorapur (45%), Majhua (44.9%), Decha (41.7%), Chakdecha (40%), Dighia (37.5%), Ismaelpur and Kaandi (36.3%), Panasa (34.4%), Rajapur (34.3%), Tiwariapur, Bhagautipur and Nauaa (33.3%), Balkaranpur (27.8%), Tharwai (25.9%) and minimum value (12.5%) at Haziganj village (Table 1c).

Dominance value index (DVI) was recorded maximum (71.4%) at Babuganj village followed by Gorapur (67.5%), Ismaelpur (67.1%), Kaandi (64.4%), Dighia (63.4%), Decha (60.3%), Haziganj (59.9%), Chakdecha (59.6%), Bhagautipur (57.2%), Tiwariapur (56.2%), Panasa (52.5%), Rajapur (51.6%), Nauaa (50.9%), Balkaranpur (48.9%), Majhua (46.7%) and minimum (41.5%) at Tharwai village (Table 1c).

Inoculum density (ID) of root-knot nematode associated with tomato fields was recorded as maximum value (0.42) at Panasa village followed by Bhagautipur (0.41), Gorapur (0.31), Dighia (0.28), Balkaranpur and Tiwariapur (0.25), Kaandi and Chakdecha (0.24), Nauaa (0.22), Decha (0.19), Rajapur and Ismaelpur (0.18), Haziganj (0.16), Babuganj (0.15), Tharwai (0.07) and minimum value (0.05) at Majhua (Table 1c).

Maximum population of other associated nematodes viz., *Rotylenchulus* sp., occurred in Rajapur (56), *Longidorus* spp., in Balkaranpur (34), *Hemicriconemoides* in Ismaelpur (8), *Xiphinema* spp., in Bhagauipur and Haziganj (6), *Helicotylenchus* spp., in Bhagautipur (22), *Tylenchorhynchus* spp., in Chakdecha (9), *Aphelenchoides* spp., in Rajapur (24), *Heterodera* spp., in Balkaranpur (14), *Ditylenchus* spp., in Tiwaripur (20) and *Pratylenchus* spp., in Panasa (17) (Table 1c).

**Disease prevalence, relative abundance, relative frequency, dominance value index and inoculum density of the root-knot nematode associated with okra fields:** Different plant parasitic nematodes viz., *Meloidogyne*, *Rotylenchulus*, *Helicotylenchus*, *Hoplolaimus*, *Aphelenchoides*, *Longidorus*, *Ditylenchus*, *Pratylenchus*, *Xiphinema*, *Heterodera*, *Tylenchorhynchus*, *Hemicriconemoides*, *Filenchus* and *Radopholus* were found associated with okra fields. The population of root-knot nematodes (*Meloidogyne* spp.) was achieved the maximum value among all (Table 2 a, b),

**Table 2a. Number of surveyed locations of okra fields with positive samples of RKN.**

| Village      | No. of surveyed field | No. of infected field | No. of + ve samples of RKN |      |
|--------------|-----------------------|-----------------------|----------------------------|------|
|              |                       |                       | M. i                       | M. j |
| Tikri        | 15                    | 6                     | 4                          | -    |
| Urua         | 18                    | 14                    | 12                         | 10   |
| Basahra      | 20                    | 16                    | 16                         | 12   |
| Degurpur     | 14                    | 10                    | 8                          | -    |
| Rampur       | 16                    | 9                     | 7                          | -    |
| Khai         | 12                    | 8                     | 4                          | -    |
| Harrai       | 14                    | 10                    | 7                          | 8    |
| Bardaha      | 11                    | 2                     | 2                          | -    |
| Devnahrai    | 22                    | 7                     | 5                          | -    |
| Kaserua      | 15                    | 10                    | 9                          | 8    |
| Beraunji     | 9                     | 1                     | 1                          | -    |
| Medua        | 13                    | 7                     | 5                          | -    |
| Gohri        | 12                    | 4                     | 3                          | 3    |
| Saraygopal   | 8                     | 3                     | 3                          | -    |
| Mansoorabaad | 16                    | 11                    | 10                         | -    |
| Aanapur      | 12                    | 9                     | 8                          | 9    |
| Total        | 227                   | 127                   | 104                        | 50   |

The maximum disease prevalence (DP) of root-knot nematode (*M. incognita*) was recorded (80%) at Basahara village followed by Aanapur and Urua (66.6%), Mansoorabad (62.5%), Kaserua (60%), Degurpur (57.1%), Harrai (50%), Rampur (43.7%), Medua (38.4%), Saraygopal (37.5%), Khai (33.3%), Tikri (26.6%), Gohri (25%), Devnahai (22.7%), Bardaha (18.1%) and minimum (11.1%) at Beraunji village (Table 2c).

Table 2b. Plant parasitic nematodes associated with okra and their population in Allahabad district.

| Village      | <i>Meloidogyne</i> species* |     |     |      |     |     |      |      |      |     |     |      |      |     | Total nematode population |     |
|--------------|-----------------------------|-----|-----|------|-----|-----|------|------|------|-----|-----|------|------|-----|---------------------------|-----|
|              | M.j                         |     | M.j | Hem. | Ty. | Xi. | Hop. | Rot. | Lon. | Pr. | Ap. | Hel. | Par. | Dy. |                           | Fi. |
|              | M.j                         | M.j |     |      |     |     |      |      |      |     |     |      |      |     |                           |     |
| Tikri        | 90                          | -   | 4   | -    | -   | 11  | -    | 22   | -    | 11  | -   | 2    | 9    | 23  | 172                       |     |
| Urna         | 92                          | 94  | -   | 3    | 6   | -   | 9    | -    | 8    | -   | 18  | -    | -    | 3   | 233                       |     |
| Basahra      | 126                         | 84  | 12  | -    | 10  | -   | 4    | 13   | -    | -   | 7   | 5    | -    | 16  | 277                       |     |
| Degurpur     | 156                         | -   | -   | -    | -   | 17  | -    | 9    | 17   | -   | 13  | -    | 5    | -   | 217                       |     |
| Rampur       | 112                         | -   | 2   | -    | 13  | -   | 8    | -    | 12   | -   | -   | -    | 14   | -   | 161                       |     |
| Khai         | 88                          | -   | -   | 2    | 4   | -   | -    | 10   | 16   | -   | -   | 4    | -    | 14  | 138                       |     |
| Hairai       | 56                          | 88  | 6   | -    | -   | -   | 15   | -    | -    | 4   | 6   | -    | 6    | -   | 181                       |     |
| Bardaha      | 72                          | -   | -   | -    | 9   | 8   | -    | 10   | -    | 5   | -   | -    | 2    | 7   | 113                       |     |
| Devnabrai    | 96                          | -   | -   | 6    | -   | 22  | -    | -    | 6    | -   | -   | -    | 4    | -   | 134                       |     |
| Kaserua      | 126                         | 124 | 8   | -    | 15  | -   | 14   | 13   | -    | 14  | 16  | 17   | -    | -   | 337                       |     |
| Beraunji     | 40                          | -   | -   | 5    | -   | -   | -    | -    | 2    | -   | -   | 4    | -    | 3   | 54                        |     |
| Medua        | 92                          | -   | 2   | -    | 5   | 4   | -    | 17   | -    | -   | 6   | -    | 23   | 9   | 158                       |     |
| Gohri        | 47                          | 39  | -   | 11   | -   | 18  | 8    | 2    | -    | 5   | -   | -    | -    | -   | 130                       |     |
| Saraygopal   | 80                          | -   | -   | -    | 3   | -   | -    | 5    | 4    | -   | 12  | -    | -    | 4   | 108                       |     |
| Mansoorabaad | 175                         | -   | 3   | -    | -   | -   | 11   | 6    | -    | -   | -   | 6    | -    | -   | 201                       |     |
| Aanapur      | 78                          | 142 | 13  | 3    | 5   | 4   | -    | 17   | -    | 9   | -   | -    | 18   | 3   | 292                       |     |

\*M.j = *M. incognita*, M.j = *M. javanica*; Hem. = *Hemicriconemoides*, Ty. = *Tylenchorhynchus*, Xi. = *Xiphinema*, Hop. = *Hoplostaimus*, Rot. = *Rotylenchus*, Lon = *Longidorus*, Pr. = *Pratylenchus*, Ap. = *Aphelenchoides*, Hel. = *Helicotylenchus*, Par. = *Paratylenchus*, Dy. = *Ditylenchus*, Fi. = *Filenchus*.



Table 2c. Community analysis of RKN associated with okra in Allahabad district.

| Village      | RKN species* | RD** | RA   | RF   | DVI  | DP   | ID   | GI |
|--------------|--------------|------|------|------|------|------|------|----|
| Tikri        | Mi           | 52.3 | 66.6 | 28.5 | 49.1 | 26.6 | 0.18 | 4  |
| Urua         | Mi           | 39.4 | 85.7 | 35.3 | 53.4 | 66.6 | 0.18 | 3  |
|              | Mj           | 40.3 | 71.4 | 29.4 | 47   | 55.5 | 0.18 | 3  |
| Basahra      | Mi           | 45.4 | 100  | 36.3 | 60.5 | 80   | 0.25 | 3  |
|              | Mj           | 30.3 | 75   | 27.2 | 44.1 | 60   | 0.16 | 2  |
| Degurpur     | Mi           | 71.8 | 80   | 53.3 | 68.3 | 57.1 | 0.31 | 3  |
| Rampur       | Mi           | 69.5 | 77.7 | 41.7 | 62.9 | 43.7 | 0.22 | 3  |
| Khai         | Mi           | 63.7 | 50   | 25   | 46.2 | 33.3 | 0.17 | 2  |
| Harrai       | Mi           | 30.9 | 70   | 33.3 | 44.7 | 50   | 0.11 | 1  |
|              | Mj           | 48.6 | 80   | 38   | 55.5 | 57.1 | 0.17 | 2  |
| Bardaha      | Mi           | 63.7 | 100  | 18.1 | 60.6 | 18.1 | 0.14 | 2  |
| Devnahrai    | Mi           | 71.6 | 71.4 | 35.7 | 59.5 | 22.7 | 0.19 | 1  |
| Kaserua      | Mi           | 37.3 | 90   | 31   | 52.7 | 60   | 0.25 | 4  |
|              | Mj           | 33.8 | 80   | 27.5 | 47.1 | 53.3 | 0.22 | 4  |
| Beraunji     | Mi           | 74   | 100  | 20   | 64.6 | 11.1 | 0.08 | 3  |
| Medua        | Mi           | 58.2 | 71.4 | 25   | 51.5 | 38.4 | 0.18 | 2  |
|              | Mj           | 30   | 75   | 25   | 43.3 | 25   | 0.07 | 2  |
| Gohri        | Mi           | 36.1 | 75   | 25   | 45.3 | 25   | 0.09 | 1  |
|              | Mj           | 30   | 75   | 25   | 43.3 | 25   | 0.07 | 2  |
| Saraygopal   | Mi           | 74   | 100  | 33.3 | 69.1 | 37.5 | 0.16 | 1  |
| Mansoorabaad | Mi           | 87   | 90.9 | 52.7 | 76.8 | 62.5 | 0.35 | 4  |
| Aanapur      | Mi           | 26.7 | 88.8 | 50   | 55.1 | 66.6 | 0.15 | 3  |
|              | Mj           | 48.6 | 100  | 56.3 | 68.3 | 75   | 0.28 | 4  |

\*Mi= *M. incognita*, Mj= *M. javanica*; \*\*RD= Relative density, RA= Relative abundance, RF= Relative frequency, DVI= Dominance value index, DP= Disease prevalence, ID= Inoculum density, GI= Gall index according to Prot & Matias, 1995.

Relative abundance (RA) of root-knot nematode was recorded maximum (100%) at Saraygopal, Basahra and Beraunji villages followed by Mansoorabad (90.9%), Kaserua (90%), Aanapur (88.8%), Urua (85.7%), Degurpur (80%), Rampur (77.7%), Gohri (75%), Medua and Devnahrai (71.4%), Harrai (70%), Tikri (66.6%) and minimum value (50%) at Khai village (Table 2c).

Relative frequency (RF) of root-knot nematode was recorded maximum (53.3%) at Degurpur village followed by Mansoorabad (52.7%), Aanapur (50%), Rampur (41.7%), Basahra (36.3%), Devnahrai (35.7%), Urua (35.3%), Saraygopal and Harrai (33.3%), Kaserua (31%), Tikri (28.5%), Gohri, Medua and Khai (25%), Beraunji (20%) and minimum (18.1%) at Bardaha village (Table 2).

Dominance value index (DVI) was recorded maximum (76.8%) at Mansoorabad village followed by Saraygopal (69.1%), Degurpur (68.3%), Beraunji (64.6%), Rampur (62.9%), Aanapur (61.7%), Bardaha (60.6%), Basahra (60.5%), Devnahrai (59.5%), Aanapur (55.1) Urua (53.4%), Kaserua (52.7%), Medua (51.5%), Tikri (49.1%), Khai (46.2%), Gohri (45.3%) and minimum (44.7%) at Harrai village (Table 2c).

The maximum value of the inoculum density (ID) was recorded (0.35) at Mansoorabad village followed by Degurpur (0.31), Kaserua and Basahra (0.25), Rampur (0.22), Devnahrai (0.19), Urua, Medua and Tikri (0.18), Khai (0.17), Saraygopal (0.16), Aanapur (0.15), Bardaha (0.14), Harrai (0.11), Gohri (0.09) and minimum (0.08) at Beraunji (Table 2).

Clearly, the study concluded that Panasa, Tiwaripur, Bhagautipur, Balkaranpur, Rajapur and Dighia villages were found most root-knot nematode infested areas growing tomato crop while Beraunji, Basahra, Mansoorabad and Urua villages were found most infected areas growing okra crop.

Maximum population of other associated nematodes viz., *Hemicriconemoides* spp., occurred in Aanapur (13) *Tylenchorhynchus* spp., in Gohri (11), *Xiphinema* spp., in Kaserua (15), *Hoplolaimus* spp., in Devnahrai (22), *Rotylenchulus* spp., in Harrai (15), *Longidorus* spp., in Tikri (22), *Pratylenchus* spp., Degurpur (17), *Aphelenchoides* spp., in Rampur (12), *Helicotylenchus* spp., in Urua (18), *Paratylenchus* spp., in Kaserua (17), *Ditylenchu* spp., in Medua (23) and *Filenchus* spp., in Tikri (23) (Table 2c).

Our findings agree with earlier workers. Sant *et al.*, (2003) conducted a survey from fourteen different locations and found that more than 70% fields were infested with *Meloidogyne* species. Saeed *et al.*, (1976) reported that 20 genera of plant parasitic nematodes were found around the roots of *Solanum melongena* and *Lycopersicon esculentum*. Vaish & Singh (2001) also conducted a survey to investigate the incidence of root-knot disease of tomato and found that more than 50% fields were infested with *Meloidogyne* species.

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