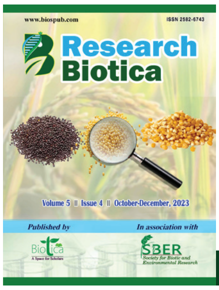

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Host Reaction of Some Local Tomato Varieties against Root Knot Nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood

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Abstract

An experiment was conducted for the investigations on screening on different local tomato varieties against RKN, *Meloidogyne incognita* under net house conditions during the year 2021-22. Out of thirty-five varieties only four (Abhimanyu, HY- Rocky, HY- 1276 and HY-Red Boar) were found to be moderately resistant to the nematode having root gall index between 2.1 to 3.0. Twenty-one varieties were found to be susceptible having root gall index between 3.1 to 4.0, but the remaining varieties were quite vulnerable to the nematode having root gall index between 4.1 to 5.0. Additionally, it was discovered that, in comparison to the other tomato types, Amlan and HY-3682 (Special) had the most gall infestation. All the varieties showed significant differences in their responses or reactions to root-knot nematodes from moderately resistant to vulnerable.

Keywords: Gall index, Resistant, Root knot nematode, Susceptible, Tomato, Varieties

Introduction

Vegetables are important elements of Indian agriculture because of their short growing season, high yield, nutritional value, economic viability and potential to produce on- and off-farm employment. Tomato (*Solanum lycopersicum* L.), a Solanaceae family member, is one of the most prominent vegetable crops produced worldwide. India is the world's second-largest tomato grower, behind China, with an annual yield of 18.7 tons over an area of over 8,08,500 hectares. In compared to developed nations, India's yield ha^{-1} remains low due to a multitude of challenges, including tomato infection by root-knot nematodes (*Meloidogyne* spp.). In warmer climes or those with shorter winters, they dwell in the soil. Their larvae infect plant roots, resulting in the formation of root-knot galls that starve the plant of nutrients. Numerous pathogens, such as bacteria, fungi, viruses and nematodes, attack tomatoes and cause a significant amount of damage. *Meloidogyne incognita* is a severe tomato pest that causes harm by feeding and producing huge galls or "knots" throughout infected plants root systems, which can interfere with water and nutrient intake and consequently photosynthetic translocation (Anwar and Mckenry, 2010). Additionally, it modifies the host's physiology and, in cases of severe infestation, can completely damage the tomato plant (Kamran *et al.*, 2010). The degree of root galling is influenced by the cultivar, host plant type and population density of *Meliodogyne*. Severe nematode infections impair tomato productivity and the quality of marketable products, causing tissue collapse, distortion, or discoloration. The root knot nematode, or *Meloidogyne incognita*, is the main pest causing a considerable reduction in yield over all of India. An estimated 27.24% of tomatoes are lost annually in India due to root knot nematode infestations (Jain *et al.*, 2007). In India, *Meloidogyne incognita* is the most often seen species of Meloidogyne on tomatoes. Appropriate management measures should be used on time to avoid root-knot nematode damage. Controlling root knot nematodes in tomatoes can be accomplished using cultural, biological, chemical or resistant techniques. However, each strategy is dependent on its compatibility to the cropping system and the farmers' scale of operation. Furthermore, several approaches for managing root knot nematode populations in the field may be incompatible with one another. As a result,

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for managing these soil-borne infections, such as root knot nematode, the use of resistant varieties is most practicable due to their lower production costs, as well as their environmental safety and compatibility with other control measures (Sikora and Fernandez, 2022). Many researchers believe that, when compared to nematicide, using resistant cultivars is one of the cheapest, most basic, economically practical and environmentally friendly ways to manage *M. incognita* infestation in tomato (Darban *et al*., 2003; Tariq *et al*., 2016; Sujatha *et al*., 2017). In a four-cropping-season study, crop rotation using resistant tomatoes reduced the nematode population by 90%. When the resistant tomato was grown for two years in a row, good yields were typically obtained (Talavera *et al.*, 2009). One well-known RKN resistance gene in tomatoes is a single dominant (Mi-1) resistance gene (Casteel *et al.*, 2006). Numerous breeding programmes use the Mi-1 gene to produce highly productive hybrid and resistant to root knot nematode tomato cultivars (Shrestha *et al.*, 2012). As a result, the purpose of this study was to assess some local tomato varieties for resistance to root-knot nematodes (*Meloidogyne incognita* race-2) so that the findings could be used to identify resistant tomato cultivars for future healthy seed production programs against root knot nematode.

Materials and Methods

Thirty-five local tomato varieties were screened in net house conditions at the Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, during Rabi 2021-22, to investigate resistance to root knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood race-2. The net house is located at 22°56′ N, 88°32′ E and 9.75 m above mean sea level. The varieties were purchased from the local market. As a test pathogen, *M. incognita* race-2 was chosen. In the net house, brinjal root seedlings were used to cultivate a pure culture of *M. incognita* race-2 for the experiment. The brinjal galled roots were used for extracting the egg masses, which were then cultured in Petri plates with distilled water. Using a multi-chambered microscope and stereoscopic binoculars, infectious juveniles of the second stage (J_2′) were extracted from Petri plates and inoculums were counted in a counting dish. Juveniles were extracted from infected roots using a modified Baermann tray method (Whitehead and Hemming, 1965). During this time, tomato cultivars were planted in earthen pots. Before sowing, potting medium was made in a 3:1:1 ratio of soil, sand and vermicompost. To ensure that the media was devoid of nematodes, the needed volume of media was sterilized with a 10% formaldehyde solution. After three weeks of sterilizing, the potting material was suitable for use. Tomato seeds were planted in clay pots (6") filled with sterilized soil @ 1000 cc pot^{-1}. After one week, after three seeds were placed in each pot, only one plant pot^{-1} was permitted to grow. At the 3-4 leaf stage (15 days after planting), inoculation was performed at a rate of one J_2 cc^{-1} of soil, *i.e.*, 1000 J_2 pot^{-1}. According to Coyne and Ross (2014), three to four holes were drilled near the rhizosphere to a depth of 3-5 cm for inoculation. *Meloidogyne incognita* second stage juveniles (J_2) were released using a 10 ml pipette at a rate of 1000 J_2 pot^{-1}. Following inoculation, holes were filled with soil and pots were watered. Forty-five days after inoculation, the tomato plants were carefully removed to prevent injury to the roots and adjacent plants. Measurements included shoot length, root length, egg masses plant^{-1}, fresh root weight, dried root weight, fresh shoot weight and root knot index (0-5). After the roots were uprooted, they were carefully cleaned with tap water and the shoot-root junction was cut. Then the weight (g) and length (cm) of the shoots and roots were measured. The roots were taken to the laboratory for a further examination. A stereoscopic binocular microscope was used in the laboratory to count galls and egg masses. Following the counting of the roots and shoots, they were placed in paper packets and dried for 4-5 days in a dry air oven at 45 °C before being weighed. The degree of resistance was calculated using the Taylor and Sasser (1978) scale (1-5) provided in table 1.

Table 1: Rating chart for evaluation of host response (Taylor and Sasser, 1978)

No. of Galls/ Eggmasses	Scale	Reactions
0	1	Highly resistant (HR)
1-10	2	Resistant (R)
11-30	3	Moderately resistant (MR)
31-100	4	Susceptible (S)
More than 100	5	Highly susceptible (HS)

[The critical difference (CD) at the 5% significance level was calculated from the data collected throughout the experiment and compared using Duncan's Multiple Range Test at the 5% probability level; the data was analyzed in CRD]

Results and Discussion

Table 2 displayed the results. In tomato accession HY-1276, the tomato variety Golchmelt and Tanuja achieved the largest plant height (43.6 cm) and the lowest plant height (27 cm). In terms of plant height, it was discovered that two kinds had no significant difference with Golchmelt and Tanuja, while three variations had no significant difference with HY-1276. The height of the other kinds varied greatly from the tallest and lowest. Tomato varieties Golchmelt and Tanuja had the highest fresh shoot weight of 14.53 g, while tomato variety HY-1276 had the lowest weight of 9.20 g. It was also discovered that neither variety had a significant difference in fresh shoot weight with Golchmelt and Tanuja, while the other two variants did not change significantly from HY-1276. The fresh shoot weight of the remaining types varied greatly from that of the heaviest. The tomato variety Golchmelt had the highest dry shoot weight of 1.63 g, while the tomato varieties NS-2535 and HY-1286 had the lowest weight of 0.27 g. It was also found that no variation was comparable to Golchmelt in terms of dry shoot weight, while no varieties differed significantly from NS-2535 and HY-1286. The dry

Table 2: Evaluation of different tomato varieties against root knot nematode *Meloidogyne incognita* race-2

Germplasm	Shoot Parameters			Root Parameters			Root knot index	No. of Egg mass per root system	Reaction
	Shoot length (cm)	Fresh shoot weight (g)	Dry shoot weight (g)	Root length (cm)	Fresh root weight (g)	Dry root weight (g)			
Golchmelt	43.6	14.53	1.63	16.3	2.13	0.27			
Tanuja	43.6	14.53	1.07	15.3	1.70	0.20	3.6	43	S
Lakshmi	37	12.33	0.60	14.3	1.37	0.13	3.8	52	S
Heemraj	32.3	10.77	0.60	11.3	1.57	0.17	4.2	67	HS
Nirupam	36.3	12.10	0.80	14.3	1.23	0.13	3.6	62	S
Villa	40.6	13.53	0.73	18.3	0.90	0.03	3.8	71	S
NS-562	39	13	0.90	18	1.63	0.17	4.6	85	HS
6242	36.6	11.53	0.67	14.6	1.53	0.17	3.6	49	S
Amlan	39.3	13.10	1.10	15	1.77	0.17	4.6	78	HS
Jumbo	33.3	11.10	0.33	12	0.53	0.03	4	63	S
Rossini	31.3	10.43	0.50	13.3	0.70	0.07	3.8	48	S
Heemsekhar	31	10.33	0.37	12.3	0.83	0.03	4	58	S
Heemsona	32.6	10.87	0.50	12.6	0.70	0.03	3.8	65	S
3605	36.6	12.20	0.57	12.6	1.10	0.10	3.4	56	S
NS-2535	32	10.67	0.27	14	0.60	0.03	4	72	S
1384	33.6	11.20	0.73	14.6	1.13	0.10	4.4	83	HS
Abhimanyu	28.3	9.43	0.33	11.3	0.63	0.03	3	64	MR
Akruthi	28	9.33	0.40	13.3	0.63	0.03	3.2	57	S
Mochomo	40.3	13.43	0.97	15.3	1.70	0.23	4.2	66	HS
Abhinav	41	13.67	0.83	19.3	1.60	0.17	4.4	85	HS
HY-2174	38	12.67	0.63	12	0.80	0.10	3.8	75	S
HY-Rocky	34.6	11.53	0.50	12	0.70	0.03	2.8	66	MR
HY-Odosh	32.3	10.77	0.40	11.6	0.70	0.03	3.8	73	S
HY-Abhilash	31	10.33	0.33	10	0.33	0.03	3.2	55	S
HY- 3682 (Special)	38	12.67	0.97	16	2.33	0.27	4.6	76	HS
HY-3682	34.6	11.53	0.43	13.3	0.90	0.03	4.4	82	HS
HY-Nell	30.3	10.10	0.60	14.6	0.70	0.03	4.2	79	HS
HY-1286	29	9.67	0.27	11	0.90	0.07	3.6	67	S
HY-1276	27.6	9.20	0.40	12.6	0.53	0.33	3	48	MR
HY-1217	29	9.67	0.47	19.3	1.03	0.07	3.6	49	S
HY-12063	31.3	10.43	0.53	15	1.47	0.10	4.4	89	HS
HY-4057	33.3	11.10	0.63	15	1.40	0.13	4	67	S
HY-Red Boar	35.6	11.87	0.47	9	0.43	0.03	2.6	48	MR
HY-1458	31	10.33	0.50	13.3	0.80	0.03	3.8	56	S
HY-Marina	32.3	10.77	0.40	12.6	0.97	0.10	3.6	59	S
Check (Patharkuchi)	27.46	6.40	0.76	4.40	2.50	0.39	4.6	80	HS
C.D.	2.90	0.35	0.03	1.77	0.20	0.02	0.16	1.66	-
C.V.	5.17	1.86	2.58	7.80	11.36	12.90	2.63	1.58	-

[R = Resistant; MR = Moderately resistant; S = Susceptible; and HS = Highly susceptible] shoot weight of the remaining kinds was notably similar to that of the heaviest and lightest. In terms of root length, the tomato varieties Abhinav and HY-1217 had the largest root length, 19.3 cm, while the tomato variety HY-Red Boar had the shortest root length, 9 cm. It was also discovered that two types, Abhinav and HY-1217, are statistically indifferent to each other and one variation is indifferent to HY-Red Boar. The remaining 32 variants' root lengths differed statistically from the longest and shortest root. When it comes to fresh root weight, the variety HY-3682 (Special) had the biggest fresh root weight, 2.33 g and the variety HY-Abhilash had the lowest roots, 0.33 g. Furthermore, one variation was determined to be statistically equivalent to the variety HY-3682 (Special), three varieties were statistically equivalent to HY-Abhilash and all other varieties differed greatly from these two types. The performance pattern of the varieties in terms of dry root weight of the plants was identical to that reported in terms of fresh root weight. The smallest dry root weight is 0.03 g for Villa, Jumbo, Heemsekhar, Heemsona, NS-2535, Abhimanyu, Akruthi, HY-Rocky, HY-Odosh, HY-Abhilash, HY-1458, HY-3682, HY-Nell, HY-1276, HY-Red Boar and the maximum dry root weight 0.27 g reported for Golchmelt and HY-3682 (Special) respectively. The varieties Golchmelt and HY-3682 (Special) were statistically indifferent. According to the root knot index, four types were moderately resistant, 21 variations were susceptible and ten varieties were severely susceptible. However, no resistant variants have been identified. The smallest dry root weight 0.03 g for Villa, Jumbo, Heemsekhar, Heemsona, NS-2535, Abhimanyu, Akruthi, HY-Rocky, HY-Odosh, HY-Abhilash, HY-1458, HY-3682, HY-Nell, HY-1276, HY-Red Boar and the maximum dry root weight 0.27 g reported for Golchmelt and HY-3682 (Special) respectively. The varieties Golchmelt and HY-3682 (Special) were statistically indifferent. Ten varieties were very vulnerable, 21 variations were susceptible and four types were somewhat resistant, according to the root knot index. No resistant cultivars have been found, though.

The root knot index indicates a plant's susceptibility to root-knot nematodes when it is forced to accommodate extra cell growth and an excess number of cells produced in the plant as a result of the organism's feeding site establishment in the plant. According to Krishnappa (1985), nematode resistance in host plants is characterized by lower nematode population densities than in susceptible plants due to decreased rates of worm reproduction and egg masses. This conclusion is consistent with Krishnappa's (1985) discovered that the growth of galls on plant roots increased considerably in vulnerable genotypes compared to resistant genotypes. *Meloidogyne* spp. infected plants, according to Caveness and Ogunforowa (1985), suffer greatly from their intake and movement of water and nutrients, which affects shoot weight. It was also discovered that as cultivar resistance levels increased, shoot parameters (plant height, number of leaves, fresh shoot weight) increased while root parameters (fresh and dried weight) decreased. According to Siddiqui and Alam (2001), heavily infested plants have stunted development and decreased shoot growth. El-Sherif *et al.* (2007) also discovered that root knot nematode increases root weight in vulnerable cultivars while lowering root weight in resistant cultivars. Nematode parasitism causes sensitive cultivars' root weight to grow while shoot weight decreases, altering the root-shoot balance (Roberts, 1995).

Conclusion

It is plausible to assume that the local tomato cultivars are not resistant to the root-knot nematode *M. incognita* based on their responses to growth and host responses. Four moderately resistant varieties (Abhimanyu, HY- Rocky, HY-1276 and HY-Red Boar) are offered for future breeding trials as a suitable source for producing root knot nematode resistant cultivars.

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References

Anwar, S.A., Mckenry, M.V., 2010. Incidence and reproduction of *Meloidogyne incognita* on vegetable crop genotypes. *Pakistan Journal of Zoology* 42(2), 135-141.

Casteel, C.L., Walling, L.L, Paine, T.D., 2006. Behavior and biology of the tomato psyllid, *Bactericerca cockerelli*, in response to the Mi-1.2 gene. *Entomologia experimentalis et applicata*, 121(1), 67-72. DOI: https://doi.org/10.1111/j.1570-8703.2006.00458.x.

Caveness, F.E., Ogunforowa, A.O., 1985. Nematological studies worldwide. In: *Cowpea Research Production and Utilization*. (Eds.) Singh, S.R. and Rachie, K.O. John Wiley and Sons, New York. pp. 273-285.

Coyne, D.L., Ross, J.L., 2014. Protocol for Nematode Resistance Screening: Root Knot Nematodes, *Meloidogyne* spp. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. p. 27.

Darban, D.A., Pathan, M.A., Jiskani, M.M., Wagan, K.H., 2003. Response of some tomato cultivars to root-knot nematodes, *Meloidogyne incognita*. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences* 19(1), 36-38.

El-Sherif, A.G., Refaei, A.R., El-Nagar, M.E., Salem, H.M.M., 2007. The role of eggs inoculum level of *Meloidogyne incognita* on their reproduction and host reaction. *African Journal of Agricultural Research* 2(4), 159-163.

Jain, R.K., Mathur, K.N., Singh, R.V., 2007. Estimation of losses due to plant parasitic nematodes on different crops in India. *Indian Journal of Nematology* 37(2), 219-221.

Kamran, M., Anwar, S.A., Javed, M., Khan, S.A., Sahi, G.H., 2010. Incidence of root-knot nematodes on tomato in Sargodha, Punjab, Pakistan. *Pakistan Journal of Nematology* 28, 253-262.

Krishnappa, K., 1985. Nematology in developing countries. In: *An Advanced Treatise on Meloidogyne*: *Biology and Control*. Volume 1. (Eds.) Barker, K.R., Carter, C.C. and Sasser, J.N. Department of Plant Pathology and the USAID, North Carolina State University Graphics, Raleigh, North Carolina, USA. pp. 379-398.

Roberts, P.A., 1995. Conceptual and practical aspects of variability in root-knot nematodes related to host plant resistance. *Annual Review of Phytopathology* 33, 199-221. DOI: https://doi.org/10.1146/annurev.py.33.090195.001215.

Siddiqui, M.A., Alam, M.M., 2001. Integrated management of the root-knot and reniform nematodes with cropping sequences and ploughing. *Archives of Phytopathology and Plant Protection* 33(5), 415-430. DOI: https://doi.org/10.1080/03235400109383363.

Sikora, R.A., Fernandez, E., 2022. Nematode parasites of vegetables. In: *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture*. 2nd Edition. (Eds.) Luc, M., Sikora, R.A., Bridge, J. CAB International, UK. pp. 319-392. DOI: https://doi.org/10.1079/9780851997278.0319.

Shrestha, S., Kumar, R., Behera, T.K., Sharma, H.K., 2012. Inheritance of resistance to root-knot nematode (*Meloidogyne incognita* race 1) in tomato (*Solanum lycopersicum* L.) 'Pusa 120'. *The Journal of Horticultural Science and Biotechnology* 87(3), 211-216. DOI: https://doi.org/10.1080/14620316.2012.11512854.

Sujatha, R., Vethamoni, P.I., Manivannan, N., Sivakumar, M., 2017. Screening of tomato genotypes for root knot nematode (*Meloidogyne incognita* Kofoid and White Chitwood). *International Journal of Current Microbiology and Applied Sciences* 6(3), 1525-1533. DOI: https://doi.org/10.20546/ijcmas.2017.603.175.

Talavera, M., Verdejo-Lucas, S., Ornat, C., Torres, J., Vela, M.D., Macias, F.J., Cortada, L., Arias, D.J., Valero, J., Sorribas, F.J., 2009. Crop rotations with *Mi* gene resistant and susceptible tomato cultivars for management of root-knot nematodes in plastic houses. *Crop Protection* 28(8), 662-667. DOI: https://doi.org/10.1016/j.cropro.2009.03.015.

Tariq, M., Khan, T.A., Akhtar, G., Khan, N., 2016. Screening of fenugreek (*Trigonella foenum-Graecum*) varieties against root-knot nematode *Meloidogyne incognita*. *Journal of Plant Pathology and Microbiology* 7(2), 335. DOI: https://doi.org/10.4172/2157-7471.1000335.

Taylor, A.L., Sasser, J.N., 1978. Biology, identification and control of root-knot nematodes (*Meloidogyne* species). Dept. of Plant Pathology, North Carolina State University and the United States Agency for International Development, Raleigh. p. 111.

Whitehead, A.G., Hemming, J.R., 1965. A comparison of some quantitative methods extracting small vermiform nematodes from the soil. *Annals of Applied Biology* 55(1), 25-38. DOI: https://doi.org/10.1111/j.1744-7348.1965.tb07864.x.