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Renu Yadav
Department of Vegetable Science, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

AK Bhatia
Department of Vegetable Science, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

Indu Arora
Department of Vegetable Science, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

Rahul
Department of Vegetable Science, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

Anil Kumar
Department of Nematology, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

Corresponding Author:
Renu Yadav
Department of Vegetable Science, CCS, Haryana Agricultural University (CCS HAU), Hisar, Haryana, India

Screening of tomato genotypes against root-knot nematode (*Meloidogyne incognita*) under screen-house conditions

Renu Yadav, AK Bhatia, Indu Arora, Rahul and Anil Kumar

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Abstract
Tomato (*Solanum lycopersicum* L.) is an important vegetable crop grown throughout the world and it is adversely affected by the root pathogen known as root-knot nematode (*Meloidogyne incognita*). Drastic effects on yield and quality of the crop are evidenced by this pathogen. Resistant genotypes are thus needed to mitigate the adverse effects of this nematode and to get economic yields. Therefore, this investigation was carried out to find the resistant genotypes against root-knot nematode under screen-house conditions and it resulted into four moderately resistant genotypes among the thirty screened genotypes on basis of number of galls per root system, number of egg masses per root system and root-knot index (RKI). The phenol content of these four moderately resistant genotypes was significantly higher than the susceptible check. These moderately resistant genotypes can be further used as rootstocks in grafting technique under nematode infested soil conditions.

Keywords: Tomato, root-knot nematode, resistant genotypes, root-knot index, rootstock

Introduction

Tomato is an important warm season crop having the potential to grow all the year round in mild climatic conditions (Hazra and Som, 2015) [11]. Tomatoes are rich source of vitamins like vitamin-A, C, E and minerals like calcium, magnesium, *etc*. as well as have antioxidant properties which provide various health benefits. The tomato and other crops face heavy yield losses due to the root parasite called as root-knot nematode (RKN). The root-knot nematodes are polyphagous pest which have been reported to affect various vegetable crops like tomato, brinjal, okra, potato, chilly, radish, carrot, onion, cabbage, cauliflower, lettuce, *etc*. and also other crops from plain regions to high hills of the country (Amatya and Shrestha 1969, PPD 2009) [13]. Among the various species of the RKN, *Meloidogyne* incognita is commonly widespread in the country contributing to heavy yield losses. Eradication of the nematodes is very challenging; however it is necessary to reduce the economic damage for sustainable production. Prevention of the nematode development could be more economical than their management in the infested fields. Thus, the nematodes can be managed by growing resistant plants or using resistant rootstocks in grafting with susceptible scion. The root-knot nematodes in tomato can be effectively decreased by using grafted resistant rootstock with susceptible scion (Luc *et al*. 2005) [12].

Material and Methods

Tomato Genotypes: The experiment was carried out under the year 2019-20 in the screen-house of Department of Nematology, CCS Haryana Agricultural University, Hisar. Thirty tomato genotypes present in Table 1 were procured from the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar.

Table 1: List of thirty tomato genotypes of this experiment

Sr. No.	Genotype	Sr. No.	Genotype
1.	TR-1	16.	TR-16
2.	TR-2	17.	TR-17
3.	TR-3	18.	TR-18
4.	TR-4	19.	TR-19
5.	TR-5	20.	TR-20
6.	TR-6	21.	TR-21
7.	TR-7	22.	TR-22
8.	TR-8	23.	TR-23
9.	TR-9	24.	TR-24
10.	TR-10	25.	TR-25
11.	TR-11	26.	TR-26
12.	TR-12	27.	TR-27
13.	TR-13	28.	TR-28
14.	TR-14	29.	TR-29
15.	TR-15	30.	TR-30

Genotype Screening

The genotypes were screened for resistance against the RKN (*M. incognita*). 25-30 days old seedlings of the thirty genotypes with three replications were transplanted in the pots as one seedling per pot. The pots were filled with steam sterilized sandy loam soil. The seedlings were inoculated with 1000 freshly hatched second stage juveniles of *M. incognita* per pot (*i.e.*, freshly hatched J2/g soil) after one week of transplanting in the screen-house. The screening was performed in completely randomized design (CRD). Plants were raised as per standard package of practices under the screen-house.

Plant Response to *M. incognita*

The pot-raised plants were examined after 40 days of inoculation with *M. incognita*. The plants were uprooted and washed carefully under running tap water to remove the adhering soil particles and thereafter, dried with butter paper. The roots of the uprooted plants were examined for number of galls per root system, number of egg masses per root system and root-knot index for categorization of the genotypes (AICRP Root-Knot Index). The counting of root galls was done in all the replications and then their average was worked out, which led to root-knot index (RKI). Root knot indices were determined as No galls – Highly resistant (RKI-1), 1-10 galls – Resistant (RKI-2), 11-30 galls – Moderately Resistant (RKI-3), 31-100 galls – Susceptible (RKI-4) and 101 and above galls – Highly Susceptible (RKI-5). Total phenol content of the roots showing resistant reaction was determined using Swain and Hillis (1959) [14] method.

Results and Discussion

The response of the screened genotypes significantly varied for different genotypes. According to the observations recorded during the screening, four genotypes (TR-5, TR-21, TR-27 and TR-28) were found moderately resistant, the rest of the genotypes had susceptible to highly susceptible response as presented in Table 2. The values for Root-Knot Index were observed in the range from 2.33 to 3.00 for the moderately resistant genotypes, 3.33 to 4.00 for the susceptible genotypes and 4.67 to 5.00 for the highly susceptible genotypes. The smaller number of galls per root system and number of egg masses per root system were attained for the moderately resistant genotypes in comparison to susceptible and highly susceptible genotypes (Table 2). The variation in nematode resistance levels in different screened tomato genotypes were also stated by Jaiteh *et al*. (2012) [4] and Sujatha *et al*. (2017) [7]. In various tomato genotypes, the variation in susceptible reaction for *M. incognita* was observed due to genetic variations as reported by Brow *et al*. (1997) [1] and Jacquet *et al*. (2005) [3]. Variable reproduction was observed for *Meloidgyne incognita* by Roberts *et al*. (1986) [6] on various tomato cultivars.

Table 2: Screening of tomato genotypes for the resistance against root-knot nematode (*Meloidogyne incognita*) in screen-house

Sr. No.	Genotypes	No. of galls per root system	No. of egg masses per root system	Root-knot Index	Categorization of genotypes
1	TR-1	85.00	71.00	4.00	Susceptible
2	TR-2	81.00	59.00	4.00	Susceptible
3	TR-3	104.67	75.33	4.67	Highly Susceptible
4	TR-4	67.33	58.00	4.00	Susceptible
5	TR-5	19.00	13.33	2.33	Moderately Resistant
6	TR-6	126.33	105.33	5.00	Highly Susceptible
7	TR-7	51.67	41.00	3.67	Susceptible
8	TR-8	70.33	58.67	3.33	Susceptible
9	TR-9	102.67	85.67	5.00	Highly Susceptible
10	TR-10	102.33	81.33	4.67	Highly Susceptible
11	TR-11	103.67	75.67	4.67	Highly Susceptible
12	TR-12	102.67	79.00	4.67	Highly Susceptible
13	TR-13	107.33	95.00	4.67	Highly Susceptible
14	TR-14	112.00	102.67	4.67	Highly Susceptible
15	TR-15	105.33	69.67	4.67	Highly Susceptible
16	TR-16	118.67	86.33	5.00	Highly Susceptible
17	TR-17	107.67	82.67	4.67	Highly Susceptible
18	TR-18	115.00	88.33	5.00	Highly Susceptible
19	TR-19	34.67	26.00	3.33	Susceptible
20	TR-20	84.00	70.00	4.00	Susceptible
21	TR-21	29.33	23.33	3.00	Moderately Resistant
22	TR-22	50.00	36.67	4.00	Susceptible
23	TR-23	100.67	66.33	4.67	Highly Susceptible
24	TR-24	111.33	93.00	4.67	Highly Susceptible
25	TR-25	95.33	69.67	4.00	Susceptible
26	TR-26	57.33	43.67	3.67	Susceptible
27	TR-27	25.00	21.00	3.00	Moderately Resistant
28	TR-28	21.67	15.67	2.67	Moderately Resistant
29	TR-29	103.33	83.00	4.67	Highly Susceptible
30	TR-30 (Check-Hisar Arun)	102.67	78.67	4.67	Highly Susceptible

Khan and Mukhopadhyay (2004) [9] also screened germplasm for the nematode resistance and noticed three tomato germplasm as highly resistant (*i.e.*, Hisar N-1, Hisar N-2 and Hisar N-3), while, four accessions as resistant to *M. incognita* race 2 (*i.e.*, IAHS-881, IAHS- 882, IAHS-883 and TH-2312). Kaur *et al*. 2014 [10] reported fifteen lines out of total 200 germplasm lines as resistant against the root-knot nematode when screened under the nematode infested conditions.

Total phenol content of roots showing resistant reaction

Variation in phenol content was noted for resistant and susceptible screened genotypes. The roots of genotypes showing moderately resistant reaction (TR5, TR21, TR27 and TR28) for the nematode had significantly higher phenol content than the susceptible check (Hisar Arun) which was 1.59 mg TAE/g dry weight (Table 3). The maximum phenol content (2.96 mg TAE/g dry weight) was noticed for the TR5 genotype which showed non-significant difference with the remaining moderately resistant genotypes. Masood and Husain (1976) also indicated that the phenol content in the roots is a good indicator of the degree of nematode resistance. Similar results were conveyed by Rani *et al*. (2008) [5] in which high level of peroxidase and polyphenol oxidase enzyme activity was identified in resistant male parent (SL 120) and resistant hybrid (CLN 2026C x SL 120) in comparison with the susceptible check (COTH-1).

Table 3: Phenol content of roots showing resistant reaction against the *Meloidogyne incognita* under nematode infested conditions in screen-house

Sr. No.	Genotypes	Categorization of genotypes	Phenol content (mg TAE/g dry weight)
1. 1.	TR-5	Moderately Resistant	2.96
2. 2.	TR-21	Moderately Resistant	2.16
3. 3.	TR-27	Moderately Resistant	2.19
4. 4.	TR-28	Moderately Resistant	2.32
5. 5.	TR-30 (check-Hisar Arun)	Highly Susceptible	1.59
	CD at 5%		0.83
	SE(m)		0.25

Conclusion

From this experiment it is concluded that the four genotypes, *i.e.*, TR-5, TR-21, TR-27 and TR-28 were moderately resistant genotypes. Also the phenol content possessed by these moderately resistant genotypes was significantly higher than the highly susceptible check (Hisar Arun). These four genotypes can be further used as resistance source or rootstocks in grafting with the susceptible scion in tomato crop under nematode infested conditions to get economic yields.

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