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Analysis of biochemical parameters in tomato fruits before and after inoculation with root knot nematode (*Meloydogyne incognita*)

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Abstract: Changes in biochemical and antioxidative parameters after nematode inoculation were investigated in tomatoes of four varieties, two resistant i.e. Hisar Lal, PNR-7 and two susceptible i.e. Punjab Varkha Bahar-1 and Punjab Varkha Bahar-2. These four varieties were infected at the nursery stage with root knot nematode (*M. incognita*). The egg masses of *M. incognita* were taken from the infected brinjal plants. The sampling of roots and leaves were done after 7 days and 20 days of infection. Tomato fruits from uninoculated and inoculated plants were evaluated for their nutritional quality parameters. The biochemical parameters such as lycopene carotenoids and ascorbic acid showed an increase in the inoculated tomato plants of resistant genotypes as compared to that of suseptible genotypes. TSS (total soluble solids) and titrable acidity showed a decrease in resistant genotypes after inoculation as compared to that of susceptible genotypes.There was no change in pH in both resistant as well as susceptible genotypes after inoculation. Roots and leaves of tomato varieties were taken at different time intervals after inoculation i.e. 7 days and 20 days after inoculation. The phenolic compounds showed an increase in the resistant varieties after inoculation with root knot nematode, whereas susceptible varieties showed a gradual decrease in phenolic compounds after inoculation. The orthodihydorxyphenols and flavonols also showed an increase after inoculation in resistant plants as compared to that in susceptible plants.

Keywords: Tomato, nematode, biochemical parameters, *Meloidogyne incognita*, phenols

Introduction

Tomato (*Lycopersicon esculentum* L.) a member of family Solanaceae, is universally known as a protective food. It is used directly as raw vegetable, in sandwiches, salad etc. and also as purees, chutneys and pickles in processed forms. Tomato fruit has undoubtedly assumed the status of a functional food considering the overwhelming epidemiological evidence for its anti-cancer activity (Rao and Aggarwal 1999). It is a reservoir of diverse antioxidant molecules like ascorbic acid, vitamin E, carotenoids, flavonoids and phenolics (Khachik *et al.,* 2002, Vinson *et al.,* 1998).

Phenolic compounds are considered as non-specific defense metabolites against the pathogen and resistant plants have the tendency to accumulate these metabolites in higher amounts than in susceptible ones following infection (Alam *et al.,* 1991). The increase in phenolics in resistant plants is due to high activity of â-glucosidase, which converts non-toxic phenolic glycosides to toxic phenolics which are inhibitory to the pathogen. These phenolic compounds are possibly converted by increased peroxidase activity to quinines in resistant cultivars and quinines are reported to be more toxic to microorganism (Sempio *et al.,* 1975). Increased level of phenolic compounds has been correlated with the resistance of plants to various nematological diseases (Bajaj and Mahajan 1977).

Materials and Methods

The seeds of tomato genotypes viz: (Hisar lal, PNR-7, Punjab Varkha Bahar-1 and Punjab Varkha Bahar-2) were procured from the Department of Vegetables Crops, Punjab Agricultural University, Ludhiana.

Egg masses of *Meloidogyne incognita* were collected from pure culture already maintained on brinjal plants in the Department of Plant Pathology, Punjab Agricultural University, Ludhiana. These egg masses were transferred to tissue paper kept on wire gauge suspended in water in petri plate, to allow the eggs to hatch. The second stage juveniles were then inoculated to brinjal plants growing in 30 cm diameter earthen pots for further multiplication. One week old seedlings of tomato genotypes sown in pots were inoculated with

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Table 1: Total phenols content (mg/100g FW) in tomato roots (R) and leaves (L) of resistant and susceptible genotypes against root knot nematode at different days of inoculation with *M. incognita*

Genotype	Days after inoculation			
Resistant genotypes	7		20	
	U	I	U	I
Hisar lal (R)	203±7.00	659±4.00	220±7.00	697±5.00
PNR-7 (R)	223±7.00	652±8.00	245±6.00	689±4.00
Hisar lal (L)	1185±8.00	2346±6.50	1276±7.00	2608±7.54
PNR-7 (L)	1143±7.00	1529±6.00	1368±6.00	1908±8.00
Susceptible genotypes				
Varkha Bahar 1 (R)	125±7.00	212±7.00	169±6.00	238±7.00
Varkha Bahar 2 (R)	146±7.00	251±9.00	188±7.00	292±9.00
Varkha Bahar 1 (L)	639±8.00	702±9.00	718±8.00	797±9.00
Varkha Bahar 2 (L)	590±7.00	625±8.00	636±7.00	712±8.00

Table 2 : Orthodihydroxyphenol (ODH) content (mg/100g FW) in tomato roots (R) and leaves (L) of resistant and susceptible genotypes against root knot nematode at different days of inoculation with *M. incognita*

Genotype	Days after inoculation			
Resistant genotypes	7		20	
	U	I	U	I
Hisar lal (R)	30±0.73	46±0.84	35±0.52	57±0.61
PNR-7 (R)	20±0.52	33±0.61	31±0.65	44±0.56
Hisar lal (L)	156±8.01	172±4.00	212±6.00	243±7.00
PNR-7 (L)	114±6.03	156±5.04	169±8.00	227±7.03
Susceptible genotypes				
Varkha Bahar 1 (R)	39±0.63	31±0.54	42±0.60	34±0.41
Varkha Bahar 2 (R)	26±0.52	19±0.63	39±0.44	28±0.71
Varkha Bahar 1 (L)	145±6.02	131±5.14	170±6.12	157±6.03
Varkha Bahar 2 (L)	107±4.05	92±5.00	115±6.01	103±7.00

Table 3 : Flavonol content (mg/100g FW) in tomato roots (R) and leaves (L) of resistant and susceptible genotypes against root knot nematode at different days of inoculation with *M. incognita*

Genotype	Days after inoculation			
Resistant genotypes	7		20	
	U	I	U	I
Hisar lal (R)	172±6.05	233±6.10	185±6.07	363±6.15
PNR-7 (R)	169±7.03	258±8.06	214±6.04	385±6.11
Hisar lal (L)	257±7.00	303±5.03	299±6.01	416±7.05
PNR-7 (L)	204±6.03	331±7.05	270±7.04	369±6.08
Susceptible genotypes				
Varkha Bahar 1 (R)	139±5.00	143±6.01	158±6.07	161±4.10
Varkha Bahar 2 (R)	122±7.00	129±6.08	170±5.05	175±4.06
Varkha Bahar 1 (L)	218±6.03	221±8.00	264±5.10	273±6.04
Varkha Bahar 2 (L)	199±6.07	204±6.08	221±6.05	227±7.00

freshly hatched larvae of root knot nematode (*M .incognita*) @ 1 larvae/cc of soil. Leaf and root samples were collected at 7 and 20 days after inoculation with root knot nematode. Simultaneously, root and leaf samples were also collected from uninoculated plants and carried to the laboratory in an ice box.The tomato fruits were harvested at maturity and analyzed for biochemical parameters such as total soluble solids, acidity, vitamin C, lycopene, â-carotene, pH & phenolic compounds.

Table 4 : Changes in biochemical parameters in resistant and susceptible genotypes of tomato against root knot nematode after infection with *M. incognita*

Genotypes	TSS		Acidity		Lycopene		Carotene		Vitamin C		pH	
Resistants Genotype	U	I	U	I	U	I	U	I	U	I	U	I
Hisar Lal	4.4± 0.3	5.0± 0.2	0.32± 0.02	0.13± 0.01	1.83± 0.11	1.90± 0.13	1.19± 0.10	1.50± 0.11	15.85± 0.26	18.02± 0.24	5	5
PNR-7	3.8± 0.2		0.36± 0.02	0.16± 0.01	2.23± 0.15	4.50± 0.24	2.11± 0.14	2.86± 0.25	8.81± 0.23	9.61± 0.22	5	5
Susceptible Genotypes												
Varkha Bahar-1	5.0± 0.4	.3	0.16± 0.01	0.19± 0.01	3.07± 0.27	2.64± 0.22	1.30± 0.11	0.22± 0.11	4.40± 0.23	3.11± 0.22	5	5
Varkha Bahar-2	5.8± 0.3	5.	0.22± 0.02	0.32± 0.02	2.98± 0.26	2.01± 0.14	1.94± 0.12	0.46± 0.02	4.45± 0.24	2.89± 0.21	5	5

Results and Discussion

Effect of root knot nematode infection on phenolic compounds in resistant and susceptible genotypes of tomato after inoculation

The total phenolic content of different tomato genotypes increased after inoculation in roots and leaves as compared to that in their respective uninoculated genotypes. The total phenolic content of roots and leaves collected at different time intervals (7 and 20 days) after inoculation increased. The total phenolic content of uninoculated as well as inoculated was higher in resistant genotypes as compared to susceptible genotypes at all intervals of time. Among various resistant genotypes, the genotype Hisar Lal recorded highest phenolic content i.e. 697 mg/ 100 g FW in roots at 20 days after inoculation. The genotype Hisar Lal showed the highest phenolic content in leaves at 20 days after inoculation i.e. 2608 mg/100 g FW.The data on the orthodihydroxy phenolic content in the roots and leaves of various tomato genotypes after inoculation with *M. incognita* revealed that orthodihydroxyphenols in resistant genotypes were higher in the roots and leaves from the inoculated plants as compared to uninoculated ones. Similarly, the flavonol content of inoculated roots and leaves was higher in resistant genotypes as compared to that in susceptible genotypes at all intervals of time. Similar results were showed by Rani *et al.,* (2008) that the increased phenolic content in roots indicated the degree of resistance to root knot nematode. The presence of these compounds may cause the browning and the resistant reaction to *M.incognita*.

Bajaj and Mahajan (1977) reported that the oxidized forms of phenolic compounds occurring in high concentration in roots of resistant tomato plants, might contribute to the M. incognita resistance by creating a toxic environment for nematode penetration and multiplication.

Changes in biochemical parameters in resistant and susceptible genotypes of tomato against root knot nematode after infection with *M. incognita*.

The TSS content increased after inoculation in the resistant genotypes as compared to that in uninoculated ones. The value of titrable acidity in all the resistant genotypes decreased after inoculation with root knot nematode, whereas acid value of susceptible genotypes was higher after inoculation. Low value of acidity is considered ideal for processing and desirable for high quality juice (Gould and Berry 1972; Shibli *et al.,* 1995).

The ascorbic acid content increased in resistant genotypes and decreased in susceptible genotypes after inoculation of plant with root knot nematode. The resistant genotypes showed higher level of carotene and lycopene content in the tomato fruits from inoculated plants, whereas the value of lycopene and carotene content were lower in tomato fruits from inoculated susceptible genotypes. The lycopene imparts red color to the tomato fruits which is important for fresh market as well as for fresh product.

There was no change in the pH of both resistant as well susceptible genotypes after inoculation of plants with root knot nematode.

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