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Performance of tomato cultivars grafted on root-knot nematode resistant *Solanum torvum* rootstock for growth and yield parameters

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Abstract

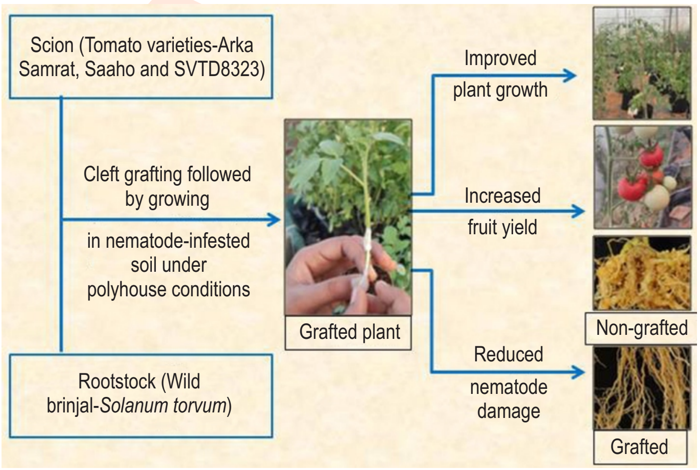
Aim: To study the grafting of tomato cultivars on root-knot nematode resistant *Solanum torvum* for plant growth, yield parameters and nematode damage under polyhouse conditions.

Methodology: Three tomato cultivars *viz.,* Arka Samrat, Saaho and SVTD8323 were grafted on *Meloidogyne incognita*-resistant *S. torvum* Sw. (IC618029) by cleft grafting technique. The experiment was conducted in a polyhouse using factorial randomized block design (FRBD) with two factors. The first factor was planting material with grafted and non-grafted tomato cultivars. The second factor was with and without nematode infestation. Observations on plant growth and yield parameters were taken.

Results: Grafted and non-grafted tomato cultivars differed significantly in terms of flowering and yield parameters and nematode damage. Under nematode-infested conditions, grafted cultivars yielded significantly more number of flowers per cluster (4.22 to 4.47), flower clusters per plant (11.25 to 11.63), fruits per cluster (3.74 to 4.19), higher percentage of fruit set (89.78 to 94.00) and fruit yield per plant (2,984.6 to 3114.36 g), with less nematode damage (10.60 to 11.53 galls per root system) as compared to non-grafted cultivars (302.53 to 314.33 galls per root system).

Interpretation: Tomato grafting with *S. torvum* rootstock can be utilized in root-knot nematode management, especially in protected cultivation.

Key words: *Meloidogyne incognita,* Nematodes, Rootstock, Tomato grafting, Wild brinjal



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Introduction

Plant parasitic nematodes are one of the major constraints for vegetable production. In India, an yield loss of 23% and a monetary loss of Rs. 6035.20 million were estimated in tomato due to *Meloidogyne* spp. (Kumar *et al.,* 2020). The root-knot nematode (*Meloidogyne* spp.) problem is increasing in protected cultivation due to the conducive environmental factors such as favorable moisture and temperature, continuous availability of suitable hosts, and little exposure to environmental extremities. Nematode management using resistant cultivars in combination with other management practices is economically and environmentally safe in protected cultivation (Holajjer *et al.,* 2024).

Grafting is one of the best options to develop resistance against root-knot nematodes (Kubota *et al.,* 2008) and is a quick and efficient way to increase vegetable plant resistance to nematodes in place of breeding and biotechnological methods (Dutta *et al.,* 2024). Currently, graftages account for 20–40% of global tomato production (Phani *et al.,* 2024). Worldwide, the potential genetic base for selecting tomato rootstocks is wide, as a large number of closely related species are used for grafting purposes (Phani *et al.,* 2024; Dutta *et al.,* 2024).

Majority of the tomato genetic rootstock sources are interspecific derivatives and hybrids. However, *Mi* gene in tomato that imparts resistance to root-knot nematodes is not effective at high soil temperatures (Rivard *et al.,* 2010; Miguel *et al.,* 2011). In developing countries, eggplant rootstocks, *viz., Solanum torvum, S. sisymbrifolium, S. macrocarpon* and *S. aethiopicum* are commonly used for tomato grafting (Gisbert *et al.,* 2011). Use of inter-specific rootstocks, such as Big Power, Beaufort and Maxifort, for tomato grafting has resulted in increased crop output, decreased numbers of galls and population of root-knot nematodes in the soil (Rivard *et al.,* 2010). Other interspecific rootstocks like Brigeor and Hypeel45, as well as hybrid rootstocks like PG76 and RST-104-106-T, were also promising for reducing root-knot disease severity (Thies, 2021).

In India, Pomato (tomato scion grafted on potato rootstock) and Brimato (dual grafting of brinjal and tomato on eggplant rootstock) were demonstrated in the field during 2020–21, and commercial production of grafted Brimato was initiated (Bahadur *et al*., 2023). In several studies, it has been demonstrated that grafting tomato onto *Solanum* species has been found to decrease disease severity and increase crop yield (Rivard *et al.,* 2010; Owusu *et al.,* 2016; Frey *et al.,* 2020). Therefore, the use of grafted commercial cultivars onto selected nematode-resistant rootstock could be an effective and promising tool to manage nematodes and also to sustain the yield. Thus, in the current study, three commercial tomato cultivars were selected and grafted on root-knot nematode-resistant *S. torvum* in order to examine plant growth and yield parameters, including nematode damage under greenhouse conditions, in order to explore their utilization in a nematode management programme.

Materials and Methods

Plant material: *M. incognita*-resistant *S. torvum* (IC618029) obtained from ICAR-NBPGR, Regional Station, Hyderabad, was used as a rootstock. Three commercial tomato cultivars *viz*., Arka Samrat (ICAR-IIHR, Bengaluru), Saaho (TO-3251) (Syngenta India Private Limited) and SVTD8323 (Seminis Vegetable Seeds (India) Ltd.), were procured from the market and used as scions. The experiment was conducted in a polyhouse, located at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Hyderabad during *Rabi*, 2022-23.

Vegetable grafting: Seeds of *S. torvum* were sown in 50 celled protrays (45 mm diameter) and tomato cultivars were sown in 98 celled protrays (32 mm diameter) containing sterilized coco peat. Seedlings were raised by following standard practices. When, tomato cultivars attained 2-3 leaf stage and 3-5 mm stem diameter (20-25 days after sowing), grafting was performed onto a *S. torvum* rootstock with an equivalent stem diameter attained in 50-55 days after sowing. A cleft grafting technique was used and young grafted seedlings were tied together with polythene stretchable tape and placed in shade net for healing for two weeks in the month of November under natural conditions. Thereafter, grafts were exposed to sunlight for four days for hardening before transplanting into polybags (Kumar *et al*., 2021).

Experimental design: The root-knot nematode, *M. incognita* was identified based on the perennial pattern of female root-knot nematode and maintained at ICAR-NBPGR Regional Station, Hyderabad were obtained and multiplied on tomato (cv. Pusa Ruby). The nematode-infested soil was mixed with a sterilized pot mixture (Red soil: FYM in 3:1 ratio). The final nematode population in potting mixture was adjusted to 2 juveniles (J_2) per cm^3 of soil before filling into polythene bag. Twenty-day-old grafted seedlings and 30-day-old non-grafted healthy seedlings were selected and transplanted into each polythene bag (24 cm diameter) containing 8000 cm^3 soil. The experiment was laid out in factorial randomized block design (FRBD) with two factors and three replications (3 plants per replication). The first factor was planting material with six levels, grafted and non-grafted tomato cultivars *viz*., Arka Samrat, Saaho and SVTD8323. The second factor was with and without nematode infestation in soil.

Data recording: Observations on growth parameters, *viz.,* diameter (mm) and height (cm) of rootstock and scion, leaf area (cm^2), and number of primary branches were recorded at 30, 60, 90 and 120 days after transplanting (DAT). The ratio of rootstock to scion was calculated on diameter basis. Flowering parameters include days to first flowering, days to 50 percent flowering, number of flowers per cluster and flower clusters per plant, and fruit set percentage. The yield parameters include number of fruits per cluster, number of fruits and fruit yield (g) per plant and days taken from first harvest to last harvest (IPGRI, 1996). Weekly observations were taken and cumulative value at the end of the harvest was presented. Root-galling and nematode population density in soil were recorded at the end of the

Table 1: Effect of *Meloidogyne incognita* infestation on height of rootstock (cm) and scion (cm) of tomato cultivars grafted on *Solanum torvum*

Factors / Treatment details	Height of rootstock (cm)					Height of scion (cm)		
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
Factor I: Planting material								
P1: Arka Samrat (Grafted)	4.37	4.37	4.37	4.40	61.09	108.25	118.13	127.58
P3: Saaho (Grafted)	4.53	4.53	4.53	4.59	65.35	115.10	124.62	136.35
P5: SVTD 8323 (Grafted)	4.59	4.59	4.59	4.62	62.95	108.68	119.82	131.20
SE (m) ±	**0.0554**	**0.0554**	**0.0554**	**0.0398**	**1.9876**	**1.125**	**1.3474**	**1.3181**
CD (P = 0.05)	**0.1746**	**0.1746**	**0.1746**	**0.1254**	**NS**	**3.5449**	**4.2458**	**4.1536**
Factor II: Nematode (N)								
N1: Soil with nematode infestation	4.49	4.49	4.49	4.50	59.26	102.74	113.93	129.00
N2: Soil without nematode infestation	4.50	4.50	4.50	4.57	67.00	118.61	127.79	134.42
SE (m) ±	**0.0452**	**0.0452**	**0.0452**	**0.0325**	**1.6229**	**0.9185**	**1.1001**	**1.0763**
CD (P = 0.05)	**NS**	**NS**	**NS**	**NS**	**8.8573**	**2.8944**	**3.4667**	**3.3914**
I x II: Interactions								
P_1 x N_1	4.22	4.22	4.22	4.23	55.87	103.70	114.17	125.50
P_1 x N_2	4.53	4.53	4.53	4.56	66.31	112.80	122.10	129.66
P_3 x N_1	4.61	4.61	4.61	4.63	57.57	105.10	116.41	135.67
P_3 x N_2	4.45	4.45	4.45	4.56	73.13	125.09	132.83	137.03
P_5 x N_1	4.63	4.63	4.63	4.65	64.33	99.43	111.20	125.83
P_5 x N_2	4.54	4.54	4.54	4.58	61.57	117.93	128.43	136.56
SE (m) ±	**0.0784**	**0.0784**	**0.0784**	**0.0563**	**2.8109**	**1.5909**	**1.9055**	**1.8641**
CD (P = 0.05)	**0.2469**	**0.2469**	**0.2469**	**0.1773**	**8.8573**	**5.0132**	**6.0044**	**5.8741**

DAT- Days after transplanting; NS: Non significant @ 5% level of significance

experiment (120 DAT). Plants were uprooted from the pots and their roots were washed separately with tap water and the number of galls and egg masses per root system were counted under a magnifying glass. The juveniles were extracted from 200 cm^3 soil of each pot by Cobb's decanting and sieving method (Cobb, 1918), followed by modified Baermann funnel technique (Schindler, 1961). The reproductive factor was calculated by dividing the final population with the initial population. The data were analyzed statistically by following the ANOVA techniques appropriate for FRBD, which was carried out using SAS package, version 9.4. (Panse and Sukhatme, 1985). The treatment differences were tested by 'F' test of significance on the basis of null hypothesis. The critical difference (CD) at P = 0.05 was calculated when difference between the treatments was found significant by 'F' test. Data on the number of galls, egg masses and nematode population density were square root transformed before analysis.

Results and Discussion

During growth period, the height of rootstock was unaffected across the cultivars by *M. incognita*, while a significant difference was observed in scion height of grafted cultivars in nematode infested and non-infested soil on most days of observations. The difference was not significant between Saaho and SVTD 8323 at 60 DAT and between Arka Samrat and Saaho at 120 DAT (Table 1). The diameter ratio of rootstock and scion (data not presented) was also unaffected across the cultivars by *M. incognita*. Grafted and non-grafted tomato cultivars differed significantly in terms of leaf area and number of primary branches due to *M. incognita* infection. Nematodes significantly reduced the leaf area and this reduction was more pronounced at 60 DAT and the number of primary branches at 90 DAT, irrespective of tomato cultivars and grafting (Table 2).

In *M. incognita* infested plants, the leaf area increase was 88.91 to 89.95% in grafted tomato cultivars, as compared to 38.65 to 38.87% in non-grafted cultivars. In addition, the number of primary branches at the end of the experiment (120 DAT) was comparatively more in grafted cultivars (7.55 to 7.91) than in non-grafted cultivars (6.21 to 6.66). Similarly, an increase in number of branches was recorded in tomato (Phule Raja) grafted on *S. torvum* (Chandanshive *et al.,* 2023). An increase in plant vigour and number of branches is attributed to a vigorous root system of rootstock that absorbs more nutrients (Bletsos *et al.,* 2003). There was no significant difference in leaf area between nematode-infested and non-infested grafted cultivars at 90 and 120 DAT, except in cultivar "SVTD8323," which showed significant difference at 120 DAT (Table 2).

Differences in days to first flowering and days to 50 percent flowering were observed among grafted and non-grafted tomato cultivars, which may be due to the difference in age between grafted and non-grafted seedlings used for planting. Grafting with resistant rootstock significantly showed differences in all flowering and yield parameters. The grafted tomato cultivars on

Table 2: Effect of grafting of tomato with rootstock of *Solanum torvum* and *Meloidogyne incognita* infestation on growth parameters of tomato cultivars

Factors / Treatments	Leaf area (cm^2)				Primary branches per plant (No.)			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
Factor I: Planting material								
P1: Arka Samrat (Grafted)	182.17	273.11	326.44	342.94	4.20	6.72	7.55	7.82
P2: Arka Samrat (Non grafted)	181.61	261.24	285.58	297.04	4.17	6.67	6.82	6.85
P3: Saaho (Grafted)	183.69	279.17	332.51	349.14	4.23	6.82	7.62	7.70
P4: Saaho (Non grafted)	181.81	265.96	290.49	308.62	4.22	6.77	7.07	7.12
P5: SVTD 8323 (Grafted)	182.57	278.49	331.82	349.80	4.25	6.68	7.47	7.57
P6: SVTD 8323 (Non grafted)	181.40	263.79	288.98	304.33	4.22	6.72	7.00	7.12
SE (m) ±	**0.332**	**0.428**	**1.095**	**0.990**	**0.041**	**0.074**	**0.050**	**0.032**
CD (P = 0.05)	**0.977**	**1.271**	**3.232**	**2.902**	**NS**	**NS**	**0.147**	**0.093**
Factor II: Nematode (N)								
N1: Soil with nematode infestation	181.77	263.11	287.80	299.51	4.23	6.64	7.01	7.11
N2: Soil without nematode infestation	182.65	277.48	330.81	351.11	4.19	6.81	7.50	7.61
SE (m) ±	**0.192**	**0.249**	**0.632**	**0.573**	**0.024**	**0.043**	**0.029**	**0.018**
CD (P = 0.05)	**0.562**	**0.734**	**1.853**	**1.690**	**NS**	**0.127**	**0.085**	**0.055**
I x II: Interactions								
$P_1 \times N_1$	182.20	274.75	328.08	344.20	4.27	6.90	7.57	7.91
$P_1 \times N_2$	182.15	271.47	324.80	341.69	4.13	6.53	7.53	7.73
$P_2 \times N_1$	181.30	250.35	245.70	251.78	4.20	6.20	6.20	6.21
$P_2 \times N_2$	181.92	272.13	325.46	342.30	4.13	7.13	7.43	7.50
$P_3 \times N_1$	183.25	278.95	332.29	347.77	4.27	6.77	7.60	7.71
$P_3 \times N_2$	184.13	279.39	332.73	350.52	4.20	6.87	7.63	7.69
$P_4 \times N_1$	180.91	250.46	246.18	256.52	4.20	6.63	6.63	6.66
$P_4 \times N_2$	182.71	281.47	334.80	360.71	4.23	6.90	7.50	7.57
$P_5 \times N_1$	182.38	277.51	330.85	346.43	4.27	6.80	7.47	7.55
$P_5 \times N_2$	182.76	279.47	332.80	353.17	4.23	6.57	7.47	7.59
$P_6 \times N_1$	180.58	246.63	243.68	250.37	4.20	6.57	6.57	6.63
$P_6 \times N_2$	182.21	280.95	334.28	358.28	4.23	6.87	7.43	7.61
SE (m) ±	**0.469**	**0.605**	**1.548**	**1.402**	**0.058**	**0.105**	**0.071**	**0.045**
CD (P = 0.05)	**NS**	**1.773**	**4.54**	**4.140**	**NS**	**NS**	**0.2072**	**0.133**

DAT: Days after transplanting, NS: Non-significant @ 5% level of significance

nematode infestation recorded significantly more number of flowers per cluster (4.22 to 4.47) and flower clusters per plant (11.25 to 11.63) compared to non-grafted cultivars (2.67 to 2.80 flowers/ cluster and 5.86 to 6.42 flower clusters/ plant). Similarly, the grafted plants had significantly higher percentage of fruit set (89.78 to 94.00) and more fruits per cluster (3.74 to 4.19), as compared to non-grafted cultivars (Table 3). Increase in the number of flowers per plant and significantly higher fruit set have been reported in tomato grafted onto African eggplant compared to those self-grafted and the control (Nkansah *et al.,* 2013). The increased number of flower cluster per plant may be due to increased number of nodes as reported in grafted cherry tomato by Naik *et al.* (2021).

The average number of fruits on grafted cultivars ranged from 43.33 to 47.07, as compared to 10.27 to 11.20 in non-grafted cultivars. Total fruit yield per plant also showed similar trend (Table 3). Similarly, improved crop vigour in terms of stem diameter, leaf area, above-and below-ground biomass and increased fruit yield, including the number and weight of fruits on susceptible tomato cultivars grafted on nematode resistant rootstock has been reported earlier (Owusu *et al.,* 2016; Frey *et al.,* 2020). The study by Rivard *et al.* (2010) also showed that tomato fruit yield was higher for plants grafted onto resistant rootstocks in a field naturally infested with root-knot nematodes. Similarly, Verdejo-Lucas and Sorribas (2008) found that grafted tomato plants produced a better cumulative yield when grown in soil that had been artificially infected with *Meloidogyne javanica*. In grafted tomato cultivars, the harvest period was significantly higher (76.33 to 83 days) than in non-grafted cultivars (11.33 to 13.00 days) in nematode infested soil (Table 3). Recently, Chandanshive *et al.,* (2023) reported an increase in crop duration of 235 days, i.e. an increase of 57 days compared to non-grafted has been reported in tomato grafted on *S. torvum.*

The grafted cultivars recorded significantly fewer number of galls (10.60 to 11.53) and egg masses (6.13 to 7.00) per root system and significantly reduced nematode population (891.40 to 973.67 J_2 per 200 cm^3 soil) as compared to non-grafted plants

Table 3: Effect of grafting of tomato with rootstock of *Solanum torvum* and *Meloidogyne incognita* infestation on flowering and yield parameters of tomato cultivars

Factors / Treatments	Days to first flowering	Days to 50 per cent flowering	Flowers per cluster (No.)	Flower clusters per plant (No.)	Fruit set percentage	Fruits per cluster (No.)	Fruits per plant (No.)	Fruit yield per plant (g)	Duration from first harvest to last harvest (days)
Factor I: Planting material									
P1: Arka Samrat (Grafted)	25.43	31.83	4.34	11.42	88.22	3.79	43.07	2974.35	79.00
P2: Arka Samrat (Non grafted)	28.87	34.50	3.21	7.77	78.78	2.28	18.03	1150.65	33.00
P3: Saaho (Grafted)	23.40	30.33	4.47	11.36	92.11	4.09	46.40	3079.50	82.50
P4: Saaho (Non grafted)	29.47	35.00	3.23	7.10	78.55	2.58	19.10	1146.67	35.33
P5: SVTD 8323 (Grafted)	26.93	34.00	4.17	11.29	90.00	3.76	42.43	2958.64	76.17
P6: SVTD 8323 (Non grafted)	30.40	39.33	3.30	6.68	79.00	2.67	18.20	1133.80	32.33
SE (m) ±	**0.112**	**0.295**	**0.052**	**0.274**	**1.134**	**0.079**	**0.490**	**36.525**	**0.579**
CD (P = 0.05)	**0.329**	**0.866**	**0.153**	**0.809**	**3.348**	**0.234**	**1.446**	**107.817**	**1.710**
Factor II: Nematode (N)									
N1: Soil with nematode infestation	27.41	34.06	3.53	8.79	80.52	2.86	27.73	1790.30	12.67
N2: Soil without nematode infestation	27.42	34.28	4.05	39.26	88.37	3.53	34.68	2357.57	52.00
SE (m) ±	**0.065**	**0.170**	**0.030**	**0.158**	**0.655**	**0.046**	**0.283**	**21.088**	**0.334**
CD (P = 0.05)	**NS**	**NS**	**0.088**	**0.467**	**1.933**	**0.135**	**0.835**	**62.248**	**0.987**
I x II: Interactions									
P1 x N1	25.40	31.33	4.29	11.63	89.78	3.74	43.33	2984.60	78.67
P1 x N2	25.47	32.33	4.40	11.20	86.67	3.83	42.80	2964.10	79.33
P2 x N1	28.93	34.33	2.80	6.42	70.44	1.67	10.27	528.92	11.33
P2 x N2	28.80	34.67	3.62	9.12	87.11	2.89	25.80	1772.38	54.67
P3 x N1	23.33	30.33	4.47	11.25	94.00	4.19	47.07	3114.36	83.00
P3 x N2	23.47	30.33	4.47	11.47	90.22	3.99	45.73	3044.65	82.00
P4 x N1	29.33	35.33	2.71	5.86	70.67	1.91	11.13	543.42	13.00
P4 x N2	29.60	34.67	3.76	8.35	86.44	3.25	27.07	1749.91	57.67
P5 x N1	27.00	33.67	4.22	11.36	90.00	3.83	43.40	3011.00	76.33
P5 x N2	26.87	34.33	4.11	11.22	90.00	3.70	41.47	2906.28	76.00
P6 x N1	30.47	39.33	2.67	6.22	68.22	1.80	11.20	559.49	12.67
P6 x N2	30.33	39.33	3.93	7.15	89.78	3.53	25.20	1708.12	52.00
SE (m) ±	**0.158**	**0.417**	**0.073**	**0.388**	**1.604**	**0.112**	**0.693**	**51.654**	**0.819**
CD (P = 0.05)	**NS**	**NS**	**0.216**	**1.144**	**4.735**	**0.331**	**2.045**	**152.476**	**2.418**

DAT: Days after transplanting, NS: Non-significant @ 5% level of significance

(302.53 to 314.33 galls; 116.33 to 123.33 egg masses; 2999.60 to 3488.53 J_2 population per 200 cm^3 soil), irrespective of type of scion cultivar used. The increase in nematode population density was less in grafted cultivars (2.23 to 2.43-fold) as compared to 7.5 to 8.7 fold in non-grafted cultivars (Table 4). Similarly, suppression of nematode reproduction and population density and less egg masses were reported in nematode resistant rootstock (Murata *et al.,* 2022; Bajek and Rudolph, 2023). The lower reproductive factor in nematode resistant plants is attributed to inhibition of nematode reproduction after it has penetrated the roots (Karssen and Moens, 2006). There was no significant difference in fruit yield among the non-grafted cultivars, although higher root galling was recorded in SVTD8323 (314.33 galls per root system) than in Saaho (307.87 galls) and Arka Samrat (302.53 galls).

Combining beneficial features from the scion and rootstock into a single composite plant helps to sustain tomato productivity in a polyhouse infested with nematodes. In the current study, severe root galling affected the growth and yield in susceptible non-grafted cultivars due to the 7-8 fold increase in threshold level of root-knot nematode population within four months. On the contrary, significant reduction in root-galling and nematode multiplication rate was recorded in grafted cultivars with higher fruit yield. *S. torvum* provides broad-spectrum resistance against root-knot nematodes (Ocal *et al.,* 2018; Sargin and Devran, 2021). Sesquiterpenoids, chitinases, and NLR genes appear to be involved in nematode survival at different phases of resistance response (Zhang *et al.,* 2023).

The average fruit production recorded per plant among grafted cultivars was more under nematode-infested (3037 g) and non-infested (2972 g) conditions than the non-grafted plants (544 g and 1743 g, under nematode-infested and non-infested conditions, respectively), indicating the effect of grafting in reducing nematode infestation and increasing the length of harvest period. Only two harvests were possible in the non-

Table 4: Effect of grafting of tomato with rootstock of *Solanum torvum* on root galling and *Meloidogyne incognita* population

Treatments	Galls/root system (No.)	Egg masses/root system (No.)	Final nematode population in 200cc soil	Reproduction factor (RF= Pf/Pi)
Arka Samrat (Grafted)	10.73 (3.42) *	6.60 (2.76)	943.27 (30.73)	2.36 (1.83)
Arka Samrat (Non grafted)	302.53 (17.42)	118.60 (10.94)	3451.47 (58.76)	8.63 (3.10)
Saaho (Grafted)	10.60 (3.40)	6.13 (2.67)	891.40 (29.87)	2.23 (1.80)
Saaho (Non grafted)	307.87 (17.57)	116.33 (10.83)	2999.60 (54.78)	7.50 (2.91)
SVTD 8323 (Grafted)	11.53 (3.54)	7.00 (2.83)	973.67 (31.22)	2.43 (1.85)
SVTD 8323 (Non grafted)	314.33 (17.76)	123.33 (11.15)	3488.53 (59.07)	8.72 (3.12)
SE (m) ±	0.040	0.035	0.199	0.009
CD (P = 0.05)	0.127	0.110	0.635	0.029

*Values in parentheses are square root √ (X+0.5) transformed values, Pf= Final population density in soil, Pi= Initial population density in soil (400 J_2/200 cc soil).

grafted cultivars due to poor growth and flowering and quick withering of plants due to high nematode infestation. Earlier studies also indicate that grafting of tomato with *S. melongena* and *S. torvum* rootstocks resulted in reduced nematode infestation and disease severity, and increased yield (Ramesh *et al.,* 2022). *S. torvum* has proved to be a successful resistant rootstock to *M. incognita, M. javanica* and *M. arenaria* (Rahman *et al.,* 2002; Uehara *et al.,* 2016; Garcia-Mendivil *et al.,* 2019). Vegetables grafted on nematode-resistant rootstocks have been shown to have higher fruit yields than non-grafted plants, including fewer root galls, and less nematode counts in the roots, and better plant growth (Garcia-Mendivil and Sorribas, 2021; Thies and Panthee, 2023).

Grafting is also a useful method for managing other soil-borne diseases, like Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopersici*) and bacterial wilt (*Ralstonia solanacearum*) (Rivard and Louws, 2008). In case of *S. torvum*, rootstock grown from seeds has high compatibility in interspecific tomato grafting with a greater grafting success rate (Petran and Hoover, 2014), which indicates its potential use in nematode management programme.

It is concluded from the study that tomato cultivars grafted on *S. torvum* (IC618029) resulted in significantly higher ($P < 0.05$) yield than the non-grafted cultivars and also a significant reduction ($P < 0.05$) in root galling and root-knot nematode population density in soil. Thus, tomato grafting with *S. torvum* rootstock can be utilized in root-knot nematode management, especially in protected cultivation.

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