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Assessment of avoidable yield losses due to root-knot nematode, *Meloidogyne incognita* infesting tomato

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Abstract
An experiment was conducted at a field of All India Co-ordinated Project (AICRP) on Nematodes in Agriculture, Department of Agricultural Entomology, Post Graduate Institute, M.P.K.V., Rahuri during summer 2022 to assess the avoidable yield losses due to root-knot nematode. The experiment was conducted in paired plot design which had 2 treatments (Fluensulfone 2% GR @30kg/ha and Untreated Control) and 10 replications. The results indicated that the per cent loss in the yield of tomato (cv. Phule Raja) was recorded to the extent of 49.62.

Keywords: *Meloidogyne incognita*, fluensulfone

Introduction
Tomato (*Lycopersicum esculentum*) belongs to the family Solanaceae is one of India's most important cash, commercial and protective food crop. It has been cultivated on around 8.44 lakh ha with a production of 21.18 MT, whereas in Maharashtra it has been cultivated on an area of 56,640 ha with an average production of 1.18 MT (Department of Agriculture and Commerce, Ministry of Agriculture and Farmers Welfare, Government of India 2021). Among different biotic factors, the root-knot nematode (*Meloidogyne incognita*) is found to be causing heavy losses to tomato crop. According to reports, a high annual loss has been documented in many crops in India due to root knot nematode, *Meloidogyne incognita* infection, including tomato (11–35%), okra (10–29%), and brinjal (10–42%). (Kumar *et al*., 2020) [9]. Bhatti and Jain (1977) predicted crop losses of up to 46.0 per cent. Considering the above facts, the present study was formulated to assess the avoidable yield losses due to root-knot nematode.

Materials and Methods
A statistically designed experiment was conducted during summer 2022 in root-knot nematode sick field of AICRP on Nematodes in Agriculture, M.P.K.V., Rahuri. The experiment was conducted in paired plot design which had 2 treatments and 10 replications The seeds of tomato (cv. Phule Raja) were sown in 4 m x 3 m size plots with spacing of 60 x 45 cm^2. The granular nematicide, Fluensulfone 2% GR @30kg/ha was used. The nematicide was mixed thoroughly in the infested soil in the plots and then transplanting was done in the plots. Observations on Initial, Final nematode population/200 cm^3 of soil, number of galls and egg masses per plant and gall index per plant were recorded as per standard procedures (Campbell 1980) [5]. The nematodes (Cobb's Sieving and Decanting Method followed by Baermann's funnel assembly technique) and their egg masses were extracted by using standard extraction procedure (Christie and Perry 1951) [4].

Results and Discussion
Results revealed that the fluensulfone treated plots reduced the population of *M. incognita* compared to untreated control. The initial root knot nematode population was non-significant and it ranged from 460 to 620 nematodes (J_2) / 200 cm^3 of soil. The highly significant differences in soil root-knot nematode population, between treated and untreated plots were observed at termination of the experiment. The per cent reduction in root-knot nematode population in treated plots ranged from 38.70 to 53.40 per cent as presented in table 1. Fluensulfone treated plots had reduced egg masses compared to untreated control. The per cent decline in number of root galls and egg masses in treated plots ranged from 50.00 to 65.28 (Table 2) and also had reduced the gall index/ plant and increased fruit yield at termination compared to untreated control.

The per cent decline in gall index/ plant at termination was in the range from 9.10 to 28.00 as presented in table 2. The average yield recorded in treated and untreated plots were 184.14 and 91.43 q/ha, respectively (Table 3).

The study showed that *M, incognita* caused high per cent loss in tomato. This is might be due to the environmental condition, cropping pattern, crop variety etc. The current findings are in line with Sharma and Baheti (1992) [11] who reported the losses caused by root-knot nematode, *M. incognita* and *M. javanica* on pea, okra, tomato and bottle gourd as 46.0, 46.7, 47.8 and 55.4 per cent losses, respectively. Jain *et al*. (1994) [7] reported 71.9 per cent avoidable yield losses in tomato due to *M. incognita*. Jain *et al*. (2007) [8] estimated annual yield losses in okra (14.1%), brinjal (16.67%), chilli (12.05%), tomato (27.21%) and cucurbits (18.2%) due to root-knot nematode, *Meloidogyne incognita* in different agro-ecological conditions of India. Singh and Kumar (2015) [12] reported 40 per cent yield losses caused by root-knot nematode in tomato. Morris *et al*. (2015) [10] reported the efficacy of fluensulfone (3.0 kg a.i./ha. via drip irrigation) for controlling *Meloidogyne* spp. tomato-cucumber double-cropping system with 73 per cent reduction in root galling compared to the untreated control.

Table 1: Effect of nematicidal treatment on soil population of root-knot nematode infesting tomato

Replications	Root-knot nematode population / 200 cm3 of soil				Decline in nematode population at termination (%)
	Initial		Final		
	Treated (Fluensulfone 2% GR @ 30kg/ha)	Untreated control	Treated (Fluensulfone 2% GR @ 30kg/ha)	Untreated control	
1	500	620	340	640	46.90
2	560	520	360	700	48.58
3	540	560	340	620	45.16
4	500	580	400	660	39.40
5	460	540	360	740	51.36
6	460	550	300	600	50.00
7	480	520	360	680	47.05
8	600	540	380	620	38.70
9	580	560	280	600	53.40
10	620	600	380	700	45.71
Mean	530	559	350	656	46.626
't' cal.	1.472		24.15		

't' table 0.01 % = 3.25
't' table 0.05 % = 2.26
a = Highly significant differences from untreated plots according to 't' tests for paired comparison

Table 2: Effect of nematicidal treatment on number of root galls/egg masses and gall index of root-knot nematode infesting tomato

Replications	Number of root galls and egg masses/plant at termination		Decline in number of root galls/egg masses (%)	Gall index/plant at termination		Decline in gall index (%)
	Treated Fluensulfone (2% GR @ 30 kg/ha)	Untreated control		Treated Fluensulfone (2% GR @ 30 kg/ha)	Untreated control	
1	59	118	50.00	4.00	4.40	9.10
2	52	108	51.85	3.80	4.80	20.84
3	52	111	53.15	3.60	4.80	25.00
4	47	106	55.66	3.70	4.80	22.92
5	52	112	53.57	3.80	5.00	24.00
6	45	109	58.71	3.80	4.80	20.84
7	43	112	61.60	3.60	5.00	28.00
8	43	101	57.42	3.80	5.00	24.00
9	42	121	65.28	3.84	5.00	23.20
10	45	10	59.09	3.70	4.80	22.92
Mean	48	110.8	56.63	3.76	4.84	22.08
't' cal	28.81			12.89		

't' table 0.01 % = 3.25
't' table 0.05 % = 2.26
a = Highly significant differences from untreated plots according to 't' tests for paired comparison

Table 3: Effect of nematicidal treatment on fruit yield of tomato

Replications	Yield (q /ha) at termination		Loss in yield (%)
	Treated (Fluensulfone 2% GR @ 30kg/ha)	Untreated Control	
1	183.00	100.00	45.35
2	225.00	116.67	48.14
3	175.00	84.33	51.81
4	150.00	84.33	43.78
5	216.77	84.33	61.09
6	158.34	91.67	42.10
7	150.00	84.33	43.78

8	175.00	100.00	42.85
9	208.34	84.33	59.52
10	200.00	84.33	57.83
Mean	184.14	91.432	49.62
't' cal	11.468		

't' table 0.01 % = 3.25
't' table 0.05 % = 2.26
a = Highly significant differences from untreated plots according to 't' tests for paired comparison

Gall index

1	No of galls/egg masses/plant
2	1 to 10 galls/egg masses/plant
3	11 to 30 galls/egg masses/plant
4	31 to 100 galls/egg masses/plant
5	> 101 galls/egg masses/plant

Conclusion
The data in respect of various parameters in the experiment of estimation of avoidable yield losses indicated that nematode population (soil as well as root) and root knot index both were suppressed in plots subjected to nematicidal treatment. From this study it is concluded that in view of the incidence, density and losses of plant parasitic nematodes there is urgent need to manage and create awareness amongst the growers.

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