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Kadam DB
Head of Agricultural Entomology Section, College of Agriculture, Muktainagar, Jalgaon, Maharashtra India

Band SS
Assistant Professor, Agricultural Entomology Section, College of Agriculture, Muktainagar, Jalgaon, Maharashtra, India

Hajare AR
Senior Research Assistant, Department of Agricultural Entomology, PGI, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
Kadam DB
Head of Agricultural Entomology Section, College of Agriculture, Muktainagar, Jalgaon, Maharashtra India

Assessment of avoidable yield losses due to root-knot nematode, meloidogyne incognita race-ii chitwood, infesting pomegranate

Kadam DB, Band SS and Hajare AR

Abstract
A statistically designed experiment was conducted in naturally infested soil with root-knot nematode in the farmer's field. In field, the crop of pomegranate cv. Bhagwa was raised by following the recommended agronomic practices. Only one plant was maintained at each hill. The initial population of root-knot nematode, number of root galls and eggs masses/5 g roots in untreated and treated trees were found to be non-significant and ranged from 680 to 760 J2/200 cm3 of soil, 26.00 to 31.00 and 29.00 to 40.00 root galls/5 g roots, respectively. The reduction of soil population of root-knot nematode at intermediate stage of the crop ranged from 57.14 to 65.79 per cent in treated trees with Carbofuran 3 g at 2.00 kg a.i./ha. However, the average reduction of 60.49 per cent population of root-knot nematode was recorded in this treatment. At termination, the reduction in soil population of root-knot nematode ranged from 34.21 to 44.44 per cent in the trees treated with Phorate 10 G at 2.00 kg a.i./ha. However, the average reduction of 38.63 per cent in the population of root- knot nematode was recorded in this treatment.

Keywords: population, nematode, reduction, Carbofuran, Phorate etc.

Introduction
The root-knot nematode, Meloidogyne incognita (Chitwood, 1949) is one of them causing considerable yield loss in pomegranate. The root-knot nematodes, Meloidogyne spp. are basically parasites of roots that causes root galls or knots, as a below ground symptom. The above ground symptoms are those of slow debility of roots in its function of nutrient and water uptake and translocation. The plants may be stunted, yellowish with smaller foliage and poor and fewer fruits. The symptoms are often mistaken for macro or micro-nutrient deficiency or moisture stress. Besides, the direct damage caused to the plant, the root-knot nematodes are notorious for the disease complexes involving fungi, bacteria, virus, mycoplasma, insects and other nematodes (Dasgupta and Gaur, 1986). In general, the root-knot nematode, M. incognita is detrimental to pomegranate by depressing the plant growth and thereby reducing the yield.
Khanna and Sunilkumar (2003) [5] conducted the experiment on assessment of yield losses in Momordica charantia due to M. incognita race-II. In the field, 12 spherical beds of 1.5 m2 diameter were prepared. While half of the beds were given pre transplanting treatment of carbofuran 3 G @ 3 kg a.i./ha, the remaining half was untreated. A significant increase in yield was observed in the plots receiving pre-sowing Carbofuran application compared to the untreated control plots. The maximum increase in yield was achieved during the second year when 5825 kg of fruits were harvested from nematicides-treated beds compared to 3333.3 kg/ha from the untreated control beds. Yield losses ranging between 22.9 and 42.8% were recorded during different years. Initial nematode population seemed to play a major role as the initial number of below 200 (count of less than one nematode per gram) in the third year, though caused yield losses of 22.9%, their non-significant 't' value revealed the yields in treated plot at par with the untreated control. However, nematode count beyond this limit caused significant damage to the crop.

Material and Methods
A statistically designed experiment was conducted in naturally infested soil with root-knot nematode in the farmer's field. In field, the crop of pomegranate cv. Bhagwa was raised by following the recommended agronomic practices. Only one plant was maintained at each hill. The details of the experiments are given below.

Details of the experiment

a. Crop : Pomogranate
b. Variety : Bhagwa
c. Design : Paired Plot Design
d. Replications : Ten
e. Treatments : Two
T1: Carbofuran 3G @ 2 kg.a.i/ha
T2: Untreated control
f. Spacing : 4.5×3 m
g. Plot size : 121.5 m2

Nematicide/insecticide

The granular nematicide, carbofuran 3 G was applied @ 2 kg a.i./ha. The nematicide was mixed thoroughly in the infested soil applied to the soil around the plants in root zone area in the field help of small sickle (khurpi) mixed well with the soil and then well covered with soil.

Method of recording observations

Pre, intermediate and post sampling of the soil was done from the individual plots from the field to count the nematode population before the commencement, intermediate and at termination of the experiment. The 200 g of composite soil samples were collected from each treatment at the time of each observation. The soil samples were processed as above for nematode count in the laboratory. Out of thirty plants in each plot, five plants selected at random by omitting the border plants and 5 g root samples at intermediate and at the time of termination of the experiment were collected and processed as above for number of galls and egg masses. On the basis of these observations per cent decrease in nematode population, number of galls and egg masses was worked out. The pomegranate fruit yield from the net plot of each treatment in the field at each picking made upto termination was recorded and expressed in kg per plot. From these observations, the per cent increases in the yield over an untreated control were ascertained.

Analysis of the experimental data

The data obtained were subjected to statistical analysis for 't' test to find out the significance of difference between two treatments.

Results and Discussion

The field experiment was conducted to assess the avoidable yield losses due to root-knot nematode in pomegranate (cv. Bhagwa) by soil application of carbofuran 3 G at 2.00 kg a.i./ha. The observations on initial, intermediate and final root-knot population and number of root galls and egg masses per 5 g roots at termination were recorded and presented in Table 1 to 4. The initial population of root-knot nematode, number of root galls and eggs masses/5 g roots in untreated and treated trees were found to be non significant and ranged from 680 to 760 J2/200 cm3 of soil, 26.00 to 31.00 and 29.00 to 40.00 root galls/5 g roots, respectively.

Root knot nematode population

It could be seen from the Table 1 that the highly significant differences in treated and untreated trees in recording soil population of root knot nematode were observed at intermediate and termination. The reduction of soil population of root-knot nematode at intermediate stage of the crop ranged from 57.14 to 65.79 per cent in treated trees with carbofuran 3 g at 2.00 kg a.i./ha. However, the average reduction of 60.49 per cent population of root-knot nematode was recorded in this treatment. At termination, the reduction in soil population of root-knot nematode ranged from 34.21 to 44.44 per cent in the trees treated with phorate 10 G at 2.00 kg a.i./ha. However, the average reduction of 38.63 per cent in the population of root- knot nematode was recorded in this treatment.

Number of root galls and eggs masses

It could be seen from the Table 2 that the highly significant differences in treated and untreated trees in recording the number of root galls were observed at intermediate and termination. The reduction of the number of root galls at intermediate stage of the crop ranged from 40.00 to 57.67 per cent in the treated trees with carbofuran 3 G at 2.00 kg a.i./ha. However, the average reduction of 51.33 per cent in root galls was recorded in this treatment at this stage of crop. At termination, the reduction in root galls of root-knot nematode were ranged from 14.81 to 26.67 per cent in trees treated with carbofuran 3 G at 2.00 kg a.i./ha. However, the average reduction of 21.09 per cent in the root galls was recorded in this treatment. The highly significant differences in treated and untreated trees in recording the number of egg masses (Table 3) were observed at intermediate and termination. The reduction of the number of egg masses at intermediate stage of the crop ranged from 62.70 to 68.00 per cent in the plot treated trees with phorate 10 G at 2.00 kg a.i./ha. However, the average reduction of 65.57 per cent in egg masses root-knot nematode was recorded in this treatment. At termination, the reduction in egg masses of root- knot nematode were ranged from 45.00 to 55.00 per cent in trees treated with carbofuran 3 G at 2.00 kg a.i./ha. However, the average reduction of 50.00 per cent in the number of egg masses was recorded in this treatment.

Yield losses due to root-knot nematode

It is revealed from Table 4 that the average yields recorded in treated and untreated trees of pomegranate were 19.91 and 13.28 tonne/ha, respectively. The loss in yield of pomegranate in untreated trees ranged from 21.00 to 42.85 per cent with mean 32.80 per cent in the yield of pomegranate was recorded in untreated trees when the plant were treated with carbofuran 3 G at 2.00 kg a.i./ha.

Table 1: Effect of treated treatment on root-knot nematode, M. incognita population in assessment of yield losses in pomegranate

Sr. No.	Root knot nematode population (J2)/200 cm3 of soil							
	Initial count		Intermediate		Termination		Decline in root-knot nematode population (%)	
	Treated (Carbofuran 3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofuran 3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofuran 3 G at 2 kg a.i./ha)	Untreated	Intermediate	Termina-tion
1	700.00	680.00	280.00	780.00	460.00	700.00	62.86	34.29
2.	720.00	700.00	280.00	820.00	400.00	700.00	61.11	44.44
3.	720.00	700.00	260.00	760.00	440.00	660.00	63.59	38.39
4.	740.00	680.00	300.00	800.00	440.00	680.00	59.46	40.54
5.	720.00	740.00	280.00	760.00	400.00	660.00	61.11	44.44
6.	700.00	760.00	300.00	820.00	460.00	700.00	57.14	34.29
7.	760.00	680.00	260.00	760.00	480.00	680.00	65.79	36.84
8.	720.00	700.00	600.00	780.00	460.00	640.00	58.33	34.21
9.	720.00	680.00	300.00	760.00	440.00	680.00	58.33	38.89
10.	700.00	680.00	300.0	760.00	440.00	680.00	60.49	38.63
Mean	720.00	700.00	280.00	780.00	440.00	680.00	60.49	38.63
‘t’ Cal		2.88		2.55		4.20		

‘t’ table (0.05) = 2.262 ‘t’ table (0.01) = 4.20 a highly significant differences from untreated control to ‘t’ test for paired comparison.

Table 2: Effect of treated treatment on number of root galls/5 g root of M. incognita in assessment of yield losses in pomegranate

Sr. No.	Number of root galls/5 g root							
	Initial count		Intermediate		Termination		Decline in root-knot nematode population (%)	
	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Intermediate	Termina-tion
1	29.00	28.00	13.00	36.00	23.00	58.00	55.17	20.69
2.	28.00	29.00	13.00	36.00	23.00	59.00	53.57	17.86
3.	27.00	28.00	14.00	36.00	22.00	59.00	48.15	18.52
4.	30.00	27.00	13.00	36.00	22.00	58.00	56.67	26.67
5.	31.00	29.00	14.00	36.00	22.00	59.00	54.84	29.03
6.	26.70	30.00	15.00	36.00	23.00	57.00	51.85	14.81
7.	27.00	31.00	13.00	36.00	23.00	59.00	53.57	17.86
8.	28.00	27.00	13.00	37.30	23.00	59.00	53.57	17.86
9.	30.00	25.30	12.70	37.00	23.70	59.00	57.67	21.00
10.	30.00	29.00	12.00	37.00	22.00	57.30	40.00	26.67
Mean	28.67	28.33	13.27	36.33	22.67	58.33	51.53	21.09
‘t’ Cal		3.09		4.20		4.20		

‘t’ table (0.05) = 2.262 ‘t’ table (0.01) = 4.20 a highly significant differences from untreated control to ‘t’ test for paired comparison.

Table 3: Effect of treatment on number of egg masses/5 g root of M. incognita, assessment of yield losses in pomegranate

Sr. No.	Number of egg masses/5 g root							
	Initial count		Intermediate		Termination		Decline in root-knot nematode population (%)	
	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Treated (Carbofura n3 G at 2 kg a.i./ha)	Untreated	Intermediate	Termina-tion
1	35.00	34.00	12.25	40.00	17.15	44.00	65.00	51.00
2.	34.00	36.00	11.22	42.00	18.70	48.67	67.00	45.00
3.	40.00	35.00	14.00	39.00	20.00	43.00	65.00	50.00
4.	30.00	38.00	10.80	43.00	14.40	46.00	64.00	52.00
5.	32.00	37.00	11.84	41.00	14.40	45.00	63.00	55.00
6.	38.00	29.00	12.16	35.00	18.62	39.00	68.00	51.00
7.	40.00	38.00	14.00	45.00	21.20	47.00	65.00	47.00
8.	36.00	39.0	10.80	43.00	19.44	46.00	70.00	46.00
9.	38.00	39.00	12.92	42.00	19.76	45.00	66.00	48.00
10.	37.00	38.00	13.80	43.00	16.65	44.00	62.70	55.00
Mean	36.00	36.30	12.39	41.30	18.03	44.70	65.57	50.00
‘t’ Cal		4.20		2.82		2.80		

‘t’ table (0.05) = 2.262 ‘t’ table (0.01) = 4.20 a highly significant differences from untreated control to ‘t’ test for paired comparison.

Table 4: Assessment of yield losses due to root-knot nematode, M. incognita infesting pomegranate

Sr. No.	Yield (t/ha)		
	Treated (Carbofuran 3 G at 2 kg a.i./ha)	Untreated control	Loss in yield (%)
1	20.00	14.00	30.00
2.	21.00	12.00	42.85
3.	22.00	13.00	40.90
4.	20.00	13.00	35.00
5.	21.00	12.00	42.85
6.	19.00	12.00	36.84
7.	18.00	14.00	22.22
8.	20.00	13.00	35.00
9.	18.00	14.00	22.22
10.	20.00	15.80	21.00
Mean	19.91	13.28	32.80
't' Cal	9.65		

It is revealed from table 4 that the average yield recorded in treated and untreated trees of pomegranate were with 19.91 and 13.28 tonnes per ha, respectively. The loss in yield of pomegranate in untreated trees ranged from 21.00 to 42.85 per cent with mean 32.80 per cent in the yield of pomegranate was recorded in untreated trees when the plant were treated with carbofuran 3 G at 2.00 kg a.i./ha.

The reduction in nematode population as a result of soil application of carbofuran 3 G may be due to inhibition of root-knot nematode. This is in conformity with that of reported by Hashim (1983) [4] and Siddiqui and Khan (1986) [6].

Conclusion

Application of Carbofuran 3 G @ 2 kg.a.i/ha is very promising in checking RKN population.

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