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Assessment of Yield Losses due to *Meloidogyne incognita on* Cucumber (*Cucumis sativus* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out in the field of Department of Nematology Odisha University of Agricultural and Technology, Bhubaneswar during the *rabi*, 2021–2022 to estimate the avoidable yield losses in 12 Patra variety of cucumber due to root-knot nematode, *Meloidogyne incognita* in nematode infested field. Ten replications of the experiment were set up using the paired plot technique. Required quantity of Carbofuran granules@2kg a.i./ha was applied two days before sowing. Ten plots were treated and another ten plots were kept untreated control (without carbofuran application). The findings exhibited that application of carbofuran significantly reduced the number of galls, egg masses and nematode population -80.01, -84.49, -27.23 respectively. Avoidable yield losses were recorded to the tune of 66.23 percent on cucumber plants by *M. incognita*.

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1. INTRODUCTION

"Cucumber (*Cucumis sativus* L.) is an important vegetable of the cucurbitaceous family. The crop is fourth most important vegetable crop after tomato, cabbage and onion in Asia. Cucumber is low-calorie food, consisting of 90% water, that's why it provides superior hydration. Its medicinal value is another distinguished property, which includes its antioxidant ability, ability to lower glycaemic and antimicrobial activity, etc. cucumber is a long, green and cylinder-shaped edible fleshy fruit of a creeping plant. The fruit is used primarily for pickling and for slicing as a salad. In India, salad is incomplete without this green fruit. In India, the area and production under cucumber is 116 ha and 1608 MT per ha (NHB 2021-2022 First Advance estimates)" [1,2]. "Many pests, including both insect and non-insect the plant parasitic nematode cause approximately 21.3% losses in crops it's amounting to Rs.102,039.79 million (1.58 billion USD) annually in India. Among nematodes, root-knot nematode, Meloidogyne spp. is responsible for 75.83% of the estimated losses. It causes 12.00% losses on cucumber with estimated monetary loss of Rs. 110.46 million per annum in open field" recorded by Kumar et al. (2020). The nematode causes plant damage by directly eating through the root system of an infected plant and altering intake of water and nutrients, impairing photosynthesis [3,4-6]. When *M. incognita* is present, field-grown cucumber yields can decrease by 25% annually [7]. There is very little research on root knot nematode infection of cucumbers in the literature. Therefore, in the present study, the assessment of yield losses due to *Meloidogyne incognita* on cucumber was studied.

2. MATERIALS AND METHODS

The experiment was carried out in the sick plots infested by root-knot nematode of Department of Nematology at the Odisha University of Agricultural and Technology, OUAT during the *rabi* season of 2021–2022 to evaluate crop losses caused by root-knot nematode *M. incognita* on cucumber plants. The experiment was carried out using the paired plot technique proposed by Leclerg, where each treatment was reproduced ten times in a plot measuring 3.5 m by 3.0 m.

2.1 Identification of Root-knot Nematode Species

Cucumber root samples were taken from the trial and properly washed under running water to remove any soil residue. Under a binocular stereoscopic zoom microscope, the egg masses of the nematode were dissected from the infected roots [8,9]. Fresh egg masses were stored in water-filled hollow blocks for 24 hours to allow for the emergence of juveniles, and female nematodes were collected from roots to help identify the species. These females' perineal patterns were cut with a sharp knife, and the body parts were taken out to allow for clear views. The nematode species was recognised as M. incognita, as described by Eisenback et al. based on the perineal pattern that was seen [10].

A pit with dimensions of 30 cm by 30 cm by 30 cm is dug after field preparation. A mixture of soil and thoroughly decomposed farmyard manure was used to fill the pits. 200 g of soil samples were processed by Cobb's sieve and decanting procedure in the lab prior to the application of carbofuran granules to determine the initial root-knot nematode population in the plots. Prior to planting the cuttings, ten plots were treated with carbofuran granules at a dosage of 2 kg a.i./ha, whereas the other ten were left untreated. Cucumber variety (12 Patra) were planted in certain locations with a 1.5 m between-row and 1.5 m between-plant spacing. All plants in each plot (6 plants/plot) were observed at full maturity, and observations were made on yield from each plant. Each plot's plants were carefully removed and rinsed with tap water to get rid of any soil that had clung to them. The cucumber fruit yield from the plants in the plots of each treatment was measured at each picking, which was done every ten days starting 60 days after planting and continuing until the experiment was over. These observations allowed for the calculation of the yield loss and fruit yield percentages for an untreated control.

3. RESULTS AND DISCUSSION

The findings of the study on the assessment of yield losses brought on by *M. incognita* on cucumber showed that there was a reduction in number of galls in treated plots by 80.01 per cent over untreated control and also in reduction of number of egg masses in treated plots was up to 84.49 per cent. A decrease of 31.87 per cent in gall index has been recorded in the treated plots

as compared to untreated plots (Table 1). Decrease in 27.23 per cent of nematode population recorded in treated plots in comparison to untreated plots. The results further indicated that reduction of 66.23 percent avoidable yield loss seen when the crops are treated with carbofuran @ 2kg.a.i.ha in treated plots as compared to untreated plots (Table 2).

The statistical analysis of data revealed that the performance of cucumber 12 Patra variety with Carbofuran @ 2kg.a.i./ha was significantly better over the years as compared to the control. The decreasing yield recorded for the untreated cucumber 12 Patra variety was probably a result of the stunting action of root-knot nematode (*M. incognita*). The treated plants started flowering earlier than the untreated. Early flowering is very important because it affects the time of maturity and harvesting of plants [11-14]. The yield of cucumber was found to be higher with the application of nematicide carbofuran at 2kg.a.i./ha. A significant reduction in the yield of cucumber in untreated plots was mainly attributed to direct damage of the root system by the feeding activities of root knot nematode (*M. incognita*)[3]. The results obtained under study are in conformity with those of Darekar and Mhase, who reported yield losses of 36.72% in bitter gourd (*M. charantia*) CV. Coimbatore White long due to *M. incognita* race 3 and Krishnaveni, Subramanian, Khanna, and Kumar also noticed yield reductions of 69.2% and 22.9 to 42.8 % for cucumber and bitter gourd, respectively due to *M. incognita*. Similar findings were also found by Khan *et al*. “on bottle gourd, snake gourd, bitter gourd, cucumber, and pumpkin due to infestation of root-knot nematodes”. According to Gautam et al. [15], plant parasitic nematodes caused yield losses in vegetable crops of 5 to 43%. This little organism causes significant crop yield losses across several nations. Nematodes are thought to have cost India a loss of Rs 21,068.73 million (plant parasitic) [16-18]. Due to a root-knot nematode infection, Baheti and Bhati [19] also noted preventable yield losses in Rajasthan due to *M. incognita* on okra of 41.30–45.50%, 37.50–41.52%, and 22.4–25.38% in light, medium, and heavy soil, respectively. Significant problem in vegetable farms were found due to root-knot nematode studied by Bem et al. [20]. Recently, Kumar et al. (2020) calculated that *Meloidogyne* spp. in India caused a 12% crop production loss and Rs. 110.46 million in financial losses to the cucumber industry.

Table 1. Effect of treatment on reproduction parameters of root-knot nematode, *M. incognita* infecting cucumber (Mean of 6 plants)

Treatments	No. of galls			No. of egg masses			Gall index
	2021	2022	Pooled	2021	2022	Pooled	
Treated (Carbofuran 3G at 2kg a.i./ha.) (T_1)	15.84 (-77.83)	12.32 (-82.26)	14.08 (-80.01)	10.48 (-82.89)	7.42 (-86.29)	8.95 (-84.49)	3.42 (-31.87)
Untreated control(T_2)	71.46	69.45	70.45	61.28	54.16	57.72	4.51

Figures in parentheses are per cent decrease over untreated check
Data are the average value of six replications

Table 2. Estimation of avoidable losses caused by root-knot nematode, *M. incognita* infecting cucumber

Treatments	Nematode population/200cc of soil			Yield kg/plant and avoidable loss %		
	2021	2022	Pooled	2021	2022	Pooled
Treated (Carbofuran 3G at 2kg a.i./ha.) (T_1)	423.45 (-49.90)	546.37 (-30.35)	484.91 (-27.23)	3.75 (66.13) *	4.02 (65.92) *	3.88 (66.23) *
Untreated control(T_2)	845.25	784.56	666.40	1.27	1.35	1.31

Figures in parentheses are per cent decrease over untreated check
Data are the average value of six replications
**Avoidable loss (%)*

4. CONCLUSION

According to experimental data, *Meloidogyne incognita* is a significant pest that significantly reduces cucumber plant growth and causes yield losses of 66.23 percent. In conclusion, the study supports the suppressive effects of carbofuran, an insecticide and nematicide, on root knot nematodes of the *Meloidogyne species* on the cucumber crop, that is well adapted to the challenging tropical growing circumstances and has superior nutritional value. And that it will be impossible to cultivate cucumber with a significant yield and income if root knot nematode (*M. incognita*) activity is not controlled. The research supports the suppressive effects of carbofuran on *Meloidogyne species* root knot nematodes on cucumber crops, which are well suited to the challenging tropical growth circumstances and have superior nutritional value. And that it will be impossible to grow cucumbers with a significant yield and income if root knot nematode (*M. incognita*) activity is not controlled.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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