Original Research Article

Assessment of yield losses due to *Meloidogyne incognita on* cucumber (*Cucumis sativus* L.)

ABSTRACT

In order to determine the avoidable yield losses in cucumber varieties caused by the root-knot nematode *Meloidogyne incognita* in nematode-infested fields, an experiment was carried out in the field of the Department of Nematology at the Odisha University of Agricultural and Technology, OUAT, Bhubaneswar during the *rabi* season of 2021–2022. Ten replications were used in the paired plot design of the experiment. Two days prior to planting, the necessary amount of carbofuran granules at a rate of 2 kg a.i./ha was spread on the area. Each 3.0m × 3.5m plot received treatment, whereas a control group of ten plots received no treatment (without Carbofuran application). The findings showed that using carbofuran granules at a rate of 2 kg a.i./ha on the crop caused a reduction in cucumber production of 66.23 percent.

Keywords: *Carbofuran, cucumber, Meloidogyne incognita, field conditions, yield loss*

1. INTRODUCTION

A common vegetable crop in the family Cucurbitaceae, which has 750 species and 70 genera, is the cucumber (*Cucumis sativus* L.). In India, the area and production under cucumber is 44,000 ha and 685,000 tonne per ha (Anonymous, 2015). Cucumber fruit contains 3% carbohydrates, 1% protein, 0.5% total fat, and 1% dietary fibre per 100 g of edible part. Typically, cucumbers contain more than 90% water. Many pests, both insect and non-insect, are attacking the crop. Plant parasitic nematodes have also started to play a role as a limiting factor in the effective cultivation of this crop, in addition to insect pests and diseases. Several Phyto nematode species have been discovered in close proximity to the cucumber plant's rhizosphere. *Meloidogyne incognita*, a root-knot nematode, is one of them and is regarded as having significant economic importance. 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 (Thangamani *et al*.2018). When *M. incognita* is present, field-grown cucumber yields can decrease by 25% annually (Anwar and McKenry,2012). 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

In order to assess the crop losses caused by the root-knot nematode, *M. incognita*, on cucumber during the *rabi* season of 2021–2022, the experiment was carried out in the root knot nematode sick plots of the Department of Nematology at the Odisha University of Agricultural and Technology, OUAT, Bhubaneswar an area of the Department of Nematology's experimental field. 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. 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 (1980).

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

An experimental trial was conducted to find out the avoidable yield losses caused by *Meloidogyne incognita* infecting cucumber variety (12 Patra). Data were analysed to interpretate research findings and exhibited in Table 1 & Table 2 and illustrated through Figure 1.

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
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 (%)

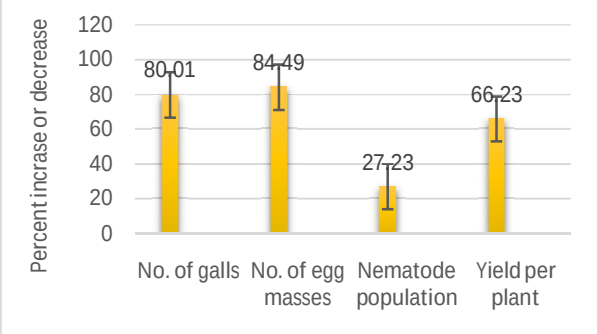

Fig. 1. Estimation of avoidable losses caused by root-knot nematode, *M. incognita* infecting cucumber

3.1 Number of galls

Results revealed that application of Carbofuran 3G @ 2 kg active ingredient ha-1 at the time of sowing as soil treatment significantly reduced number of galls. Galls (14.08) was recorded minimum in plants treated with Carbofuran 3G @ 2 kg active ingredient ha-1 (Pooled 2021 and 2022) as compared to untreated control (70.45). Decreasing in number of galls was determined to the tune of 80.01 per cent in treated plants over untreated check (Table 1).

3.2 Number of egg masses

Results showed minimum number of egg masses (8.95) recorded in plants treated with Carbofuran 3G @ 2 kg a.i. ha-1. The treatment significantly reduced egg masses of root-knot nematode on cucumber. It was observed 57.72 egg masses in roots in untreated check. Reduction in egg masses was noticed 84.49% with Carbofuran 3G @ 2 kg a.i. ha-1 (Pooled 2021 and 2022) over untreated check on cucumber.

3.3 Final nematode population per 200 cc soil

Results showed that the final population of nematode significantly reduced at the time of harvest with the application of Carbofuran 3G @ 2 kg active ingredient ha-1 over untreated check in cucumber variety. It was obtained minimum (484.91 larvae per 200 cc soil) with chemical treated application, while maximum population per 200 cc soil (666.40) was recorded in untreated check. Final nematode population was reduced 27.23 per cent with application of Carbofuran 3G @ 2 kg active ingredient ha-1 over check.

3.4 Yield (kg per plant) and avoidable yield loss (%)

Results revealed that application of Carbofuran 3G @ 2 kg a.i. ha-1 at the time of sowing as soil treatment significantly increased yield of cucumber (12 Patra) infested with *M. incognita*. It was recorded 3.88 kg plant-1 with Carbofuran 3G @ 2 kg active ingredient ha-1 and 1.31 kg plant-1 in untreated check. The avoidable yield loss was estimated to be 66.23 per cent on cucumber by *M. incognita* in present investigation (Table 2).

Root-knot nematode is a key pest for reduction in agricultural production. Experimental results showed a reduction of 80.01 per cent in number of galls, 84.49 per cent in egg masses, 27.23 per cent in the population of nematode with Carbofuran 3G @ 2 kg active ingredient ha-1. Use of chemical avoided, 66.23 per cent yield loss caused by *M. incognita* on cucumber(12 Patra).

The findings of the analysis are in keeping with those of prior researchers who evaluated the losses brought on by plant parasitic nematodes on a variety of crops. In a commercial polyhouse, Nagesh and Reddy (2005) found that the yield loss for both carnations and gerbera was 26 and 30%, respectively. 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). The outcomes of the investigation are consistent with those of Darekar and Mhase, who reported yield losses of 36.72% in bitter gourd (*M. charantia*) CV. Coimbatore due to *M. incognita* race 3 and long white due to *M. incognita*, 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 a root-knot nematode infection, similar findings were also found by Khan *et al*. on bottle gourd, snake gourd, bitter gourd, cucumber, and pumpkin. Root-knot nematodes were found to be a significant problem in vegetable farms by Bem *et al*. (2014). According to Gautam *et al*. (2014), plant parasitic nematodes caused yield losses in vegetable crops of 5 to 43%. Baheti and Bhati (2017) 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. 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.

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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