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# Estimation of avoidable yield losses due to root-knot nematodes, *Meloidogyne* spp. infesting okra [*Abelmoschus esculentus* (L.) Moench.]

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**Abstract**
A field experiment was conducted to estimate avoidable yield losses due to root-knot nematodes, *Meloidogyne* spp. infesting okra. The application of Carbofuran 3G @1.5 kg a.i/ha significantly enhanced the plant growth parameters and yield of okra with significant reduction in root-knot index and nematode population under field conditions. The avoidable yield loss recorded at the end of two years was 23.00 percent due to root knot nematodes in okra cv. GAO 5.

**Keywords:** Okra, GAO-5 *Meloidogyne* spp., carbofuran, yield loss

## Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] also known as 'lady's finger' in Western style or 'Bhindi' in Indian language is grown extensively in tropical and sub-tropical parts of the world. It is one of the important pod vegetable crops being cultivated all over India. The crop is attacked by various insects and non-insect pests. In addition to insect pests and diseases, plant parasitic nematodes have also becoming a limiting factor in the successful and profitable cultivation of this crop. Many species of phytonematodes have been found associated with rhizosphere of okra. In susceptible plants, the nematode population build up to a maximum usually as crop reaches maturity (Shendge *et al*., 2010) [12]. Among various phytonematodes, root-knot nematode is considered to be of great economic importance having wide host range (Krishnappa, 1985) [3]. Root knot nematodes occasionally cause complete crop loss under adverse growing conditions, but even in an ideal environment losses up to 50% or more are not uncommon (Ramesh & Gupta 2005) [8]. The estimated yield losses due to plant parasitic nematodes are 20.40 percent on worldwide basis (Sasser, 1987) [11].

## Materials and Methods
The present investigation was carried out in root-knot nematodes (mix population of M. incognita and M. javanica) sick field at Department of Nematology, B. A. College of Agriculture, AAU, Anand during 2015-16 and 2016-17. The experiment consists of two treatments *viz*., Carbofuran 3G @ 1.5 kg a.i/ha and an untreated control which were replicated ten times following paired plot design. Each plot measured 2.40 X 4.20 m. Seeds of okra cv. GAO 5 were sown at spacing 45 cm row to row and 30 cm from plant to plant. Carbofuran 3G @1.5 kg a.i/ha was applied at the time of sowing followed by light watering (Yadav *et al*., 2008) [14]. Equal number of plant population was maintained in each plot. After germination, the seedlings were thinned off to maintain one seedling/spot. Nematode population from soil was assessed by Cobb's sieving & decanting method (Cobb, 1918) [2]. Data on nematode multiplication, its development in soil and roots was recorded at the time of harvest of crop. The okra fruits were harvested and thereby yield was recorded. Root-knot index on the basis of 1-5 scale were also worked out from the above said observations. Percent decrease over control was also calculated.
The data of the two seasons (2015-16 and 2016-17) were analyzed by using paired plot design.

## Results and Discussion
Perusal of data presented in Table 1 indicated that application of Carbofuran 3G @1.5 kg a.i/ha significantly increased the plant growth by 86.07% with significant reduction in root-knot index, root-knot nematode population in soil and roots by 39.23, 50.77 and 50.52% respectively during 2015-16. Similar trend was also found during 2016-17 where the treated

plots increased the plant growth by 62.89% with significant reduction in root-knot index and root-knot nematode population in soil and roots by 32.47, 38.51 and 28.36, respectively. This inflicted an avoidable yield loss of 24.00% during the first year and 23.50% in the second year. Data pooled over two years clearly indicated that Carbofuran 3G @1.5 a.i./ha significantly increased the fruit yield of okra by 29.85% with simultaneous reduction in root-knot nematode population in soil and also in roots and root-knot index by 44.89, 45.89 and 35.73% respectively, which resulted an avoidable yield loss to the tune of 23.00%. Significant effect between treated and untreated plot with respect to the plant growth parameter, yield, root-knot index and root-knot nematode population soil as well as roots were noticed from the pooled analysis (Table 2). On the basis of above finding in okra, similar results were reported by Roy *et al*. (2008) [10] incurring 13.79% avoidable yield loss in cowpea.

**Table 1:** Effect of root-knot nematodes on okra: To estimate avoidable yield loss under field condition. (2015-16 and 2016-17)

| Treatments | Plant height at 30 DAS (cm) | | Root-knot index (1-5 scale) | | FNP (J2/200 cc soil) | | FRP (No. of female/5 gm roots) | | Yield (Kg/plot) | | Yield (Kg/ha) | | Avoidable yield loss (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year |
| Treated (Carbofuran @3 kg a.i./ha) | 20.84 | 21.42 | 2.68 | 2.85 | 288 | 332 | 188 | 245 | 12 | 16.30 | 11,893 | 16,072 | 24.00 | 23.50 |
| Untreated control | 11.20 | 13.15 | 4.41 | 4.22 | 585 | 540 | 380 | 342 | 9.12 | 12.47 | 9049 | 12,487 | - | - |
| % Increase over control | 86.07 | 62.89 | (-) 39.23 | (-) 32.47 | (-) 50.77 | (-) 38.51 | (-) 50.52 | (-) 28.36 | 31.58 | 30.71 | 31.43 | 28.70 | - | - |
| "t" test | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |

INP 1st year: 263 J2/200 $cm^3$ of soil, INP 2nd year: 216 J2/200 $cm^3$ of soil

**Table 2:** Effect of root-knot nematodes on okra: To estimate avoidable yield loss under field condition. (Pooled)

| Treatments | Plant height at 30 DAS (cm) | Root-knot index (1-5 scale) | FNP (J2/ 200 cc soil) | FRP (no. of female/5 gm roots) | Yield (Kg/plot) | Yield (kg/ha) | Avoidable yield loss (%) |
|---|---|---|---|---|---|---|---|
| Treated (Carbofuran @3 kg a.i./ha) | 21.13 | 2.77 | 310 | 216 | 14.15 | 13,982 | 23.00 |
| Untreated control | 12.17 | 4.31 | 562 | 361 | 10.80 | 10,768 | - |
| % increase over control | 73.62 | (-) 35.73 | (-) 44.89 | (-45.89) | 31.02 | 29.85 | - |
| "t" test | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |

A significant loss in the yield of okra by 24.00% and 23.50% at initial root-knot nematodes population of 263 J2 and 216 J2/200 cm3 of soil were obtained by employing Carbofuran 3G @1.5 kg a.i/ha. The damage results in the reduction of qualitative and quantitative production of okra. Yield loss to 90% by Lamberti *et al*. (1988) [4], 27.02% by Shendge *et al*. (2010) [12] and 38% by Singh and Kumar (2013) [13], respectively similar to the present study. These varied results clearly showed that losses caused by root-knot nematode was highly variable on okra. This might be perhaps because of variation in nematode species, initial nematode population, soil type, environmental conditions as well as chemical and its dose employed during the course of investigation. Prasad (1999) [7] reported similar results. The difference in the yield loss estimated by Meloidogyne spp. in the present study to that of the different workers are primarily to the initial inoculum level of Meloidogyne spp. as well as to the cultivars of the crops and environmental conditions (Mote & Mhase, 1997) [6]. Mahalik and Mahapatra (2020) [5] reported 25.3% avoidable yield loss in okra due to M. incognita. Reddy (1986) [9] also reported yield loss of 28.00 to 43.00 percent in okra. Poor plant growth of nematode damaged roots might be due to inefficient and poor functions of roots leading to moisture stress and reduced photosynthetic efficiency.

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