Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 923-925

Received: 20-05-2018
Accepted: 23-06-2018

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Assessment of yield losses due to *Meloidogyne incognita* on ivy gourd (*Coccinia indica* L)

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Abstract
An experiment was conducted in the field of Department of Nematology located at Instructional-cum-Research (ICR) Farm, AAU, Jorhat during the *rabi* season of 2015 to estimate the avoidable yield losses in local variety of ivy gourd due to root-knot nematode, *Meloidogyne incognita* in nematode infested field (374 J_2/200 cc soil). The experiment was laid out in paired plot technique with ten replications. Required quantity of Carbofuran granules @ 3 kg a.i./ha was applied at the spot two days before planting. Ten plots each of 3.0m x 3.5m size were treated and another ten plots were kept untreated control (without Carbofuran application). The results indicated that the loss in yield of ivy gourd was recorded to the extent of 35.09 per cent, when the crop was treated with Carbofuran granules @ 3 kg a.i./ha.

Keywords: Carbofuran, Ivy gourd, *Meloidogyne incognita*, field conditions, yield loss

1. Introduction
Ivy gourd, (*Coccinea indica* L.) also known as little gourd (kundru) is a perennial cucurbitaceous vegetable crops grown extensively in all the tropical and subtropical parts of the world. In India it is widely grown in southern; eastern and western regions, mainly in Assam, Tamil Nadu, Karnataka, Kerala, Maharastra, Gujarat, Andhra Pradesh and West Bengal. It is one of the most important nutritious vegetable and medicinal plants and it has been recognized as a rich source of Beta-carotene, a major vitamin A precursor [10, 11]. It is also considered as a good source of iron, vitamin C, protein and fiber [12]. Hundred gram (100 gm) of ivy gourd fruit has a number of essential nutrients such as water 93.5g, carbohydrate 3.1g, fiber 1.6 g, protein 1.2g, fat 0.1g, calcium 40 mg, phosphorus 30 mg, iron 1.4 mg and energy 75KJ. The root, stem, leaves and fruits of ivy gourds are used as medicine for controlling blood glucose level in hyperglycemics. Fruits are effective for hypoglycemic, analgesic (medicine that reduces pain), antipyretic, hepatoprotective (liver protective), tuberculosis, eczema, anti-inflammatory etc. The crop is attacked by various insect and non-insect pests. In addition to insect pests and diseases, plant parasitic nematodes have also becoming a limiting factor in the successful cultivation of this crop. Many species of phytonematodes have been found associated with rhizosphere of ivy gourd plant. Amongst these, root-knot nematode, *Meloidogyne incognita* is considered to be of great economic importance. And it has a host range of about 232 host genera recorded by Krishnappa [7]. Kanwar and Bhatti [4] recorded the stem galls on a cucurbitaceous host *Luffa acutangulla* caused by *M. javanica*. Krishnaveni and Subramanian [8] recorded 69.2 per cent yield losses in cucumber due to *M. incognita*. The genus *Meloidogyne* attacks nearly every crop and has been reported to cause an annual loss of Rs. 547.5 million INR in cucurbits [1, 3]. Literature on study of infection by root knot nematode on ivy gourd is very limited. Therefore, in the present study, the assessment of yield losses due to *Meloidogyne incognita* on ivy gourd was studied.

2. Materials and methods
The experiment was conducted in the root knot nematode sick plots of Department of Nematology located at Instructional-cum-Research (ICR) Farm, AAU, Jorhat during the *rabi* season of 2015 to evaluate the crop losses due to root-knot nematode, *M. incognita* on ivy gourd. A portion of experimental field of Department of Nematology measuring 318.5 sq.m. was selected for estimation of loss. Paired plot technique given by Leclerg [9] was employed to conduct the experiment, *viz.*, (i) treated and (ii) untreated and each treatment was replicated ten times in plot size measuring 3.5 m × 3.0 m each.

After field preparation pit having size of 30 cm × 30 cm × 30 cm are dug. Pits were filled with a mixture of soil and well-rotten farmyard manure. Before application of Carbofuran granules 200 g soil samples were processed by Cobb's sieving and decanting method in laboratory for initial root-knot nematode population in the plots. Ten plots were treated with Carbofuran granules @ 3 kg a.i./ha prior to planting the cuttings and the rest ten plots were kept as untreated. Ivy gourd local variety was planted in spots at a spacing of 1.5 m from row to row and 1.5 m from plant to plant. Observations were taken at full maturity and observations were made on yield from all plants of each plot (6 plants /plot). Plants from each plot were uprooted and washed carefully in the tap water to remove adhering soil particles. Number of root galls and egg masses on roots per plant were recorded and gall indices 1 to 5 scales were worked out. From these observations per cent decrease in gall index over an untreated control was worked out. Fresh and dry weights of shoots and roots were also recorded at termination. From these observations, per cent increase in fresh and dry weights of shoots and roots over an untreated plots were worked out. The ivy gourd fruit yield obtained from the plants in the plots of each treatment at each picking made at 10 days interval commencing from 140 days after planting up to termination was recorded. From these observations, the per cent loss in yield and number of fruits of an untreated control was ascertained. For recording the dry weights, the shoots and roots were separately cut in to small pieces and kept in an oven running constantly at 60°C. The materials were weighted at every 24 hours interval till a constant weight was obtained. For final nematode population soil sample comprising of several subsamples were collected from different sites of each plot and mixed thoroughly and 200 cc of soil was drawn and processed by Cobb's sieving and decanting method. From these observations, per cent decrease in nematode population was worked out.

3. Results

The results obtained in the study on Assessment of yield losses due to *M. incognita* on ivy gourd revealed that there was a reduction in nematode population in treated plots by 57.65 per cent over untreated control and also reduction in number of gall index in treated plots was up to 31.81per cent. A decrease of 32.86 per cent of fresh shoot weight and 34.71 per cent of dry shoot weight of ivy gourd had been recorded in the untreated plots in comparison to the shoot weights recorded in treated plots. Decrease in 14.62 per cent of fresh root weight and 10.31 per cent of dry root weight of ivy gourd was recorded in the untreated plots in comparison to the root weights recorded in treated plots. The results further indicate that field infested with 374 larvae of *M. incognita* per 200 cc of soil caused 35.09 per cent loss in yield of ivy gourd in untreated plots, when the crop was treated with Carbofuran granules @ 3 kg a.i./ha. in treated plots and also decrease in number of fruits of ivy gourd by 27.58 per cent was recorded in untreated plots in comparison to the number of fruits recorded in the treated plots. (Table 1).

Table 1: Yield losses due to root-knot nematode, *M. incognita* in ivy gourd (Mean of 6 plants)

Treatments	Nematode Popl/200cc soil		Gall index/plants	Fresh weight/plant (g)		Dry weight/plant (g)		No. of fruit Yield (g)
	Initial	Final		Root	Shoot	Root	Shoot	
Treated (Carbofuran 3G at 3kg a.i./ha.)		238[a] (57.65) [1]	2.68[a] (31.81) [2]	156.81[a]	252.84[a]	50.12[a]	146.23[a]	41.16[a] 1152.13[a] (54.07)
	374							
Untreated control		562	3.93	133.88 (14.62) [3]	169.75 (32.86) [4]	44.95 (10.31) [5]	95.47 (34.71) [6]	29.81 747.81 (27.58) [7] (35.09) [8]

a= Highly significant (p=0.01) differences from an untreated plots according to 't' tests for paired comparisons

4. Discussion

The statistical analysis of the data revealed that performance of ivy gourd local variety with Carbofuran 3G at 3 kg a.i./ha was significantly better over the years as compared to the control. The decreasing agronomic parameters recorded for the untreated ivy gourd local 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. The yield of ivy gourd was found to be higher with the application of nematicide-Carbofuran at 3kg a.i/ha. The percentage increase over the untreated control is 54.07 per cent. A significant reduction in the yield of ivy gourd in untreated plots was mainly attributed to direct damage of the root system by the feeding activities of root knot nematode (*M. incognita*). The results obtained under study are in conformity with those of Darekar and Mhase [2] who reported 36.72 per cent yield losses in bitter gourd *(M. charantia*) CV. Coimbatore White long due to *M. incognita* race 3 and Krishnaveni and Subramanian [8] and Khanna and Kumar [5] also recorded 69.2 per cent and 22.9 to 42.8 per cent losses in yield of cucumber and bitter gourd respectively due to *M. incognita*. Similar findings were also reported by Khan *et al.* [6] on bottle gourd, snake gourd, bitter gourd, cucumber and pumpkin due to the infestation of root-knot nematodes.

5. Conclusion

In summary, the work confirms the suppressive effects of Carbofuran-a nematicide and insecticide on root knot nematodes Meloidogyne species on cowpea crop which is well adapted to the stressful growing conditions of the tropics and has excellent nutritional qualities. And that without controlling the activities of root knot nematode (M. incognita), appreciable yield and income on cowpea cultivation will not be possible.

The work confirms the suppressive effects of Carbofuran on root knot nematodes *Meloidogyne* species on ivy gourd crops which is well adapted to the stressful growing conditions of the tropics and has excellent nutritional qualities. And that without controlling the activities of root knot nematode (*M. incognita*) appreciable yield and income on ivy gourd cultivation will not be possible.

6. Acknowledgement

Sincere thanks to the head of department, Nematology, AAU, Jorhat-13 for permitting and providing facilities for carrying out the research work. Thanks also extended to the members of advisory committee for kind help and encouragement throughout the research work.

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