J. Phytol. Res. **21**(1) : 131-134, 2008

STUDIES ON BIO EFFICACY OF ENTOMOPATHOGENIC NEMATODE AGAINST *HELICOVERPA ARMIGERA*

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Studies on the entomopathogenic nematode, *Steinernema carpocapsae* against *Helicoverpa armigera* infesting gram. The bioefficacy of *S. carpocapsae*, revealed that in foliar application maximum mean per cent mortality (41.67, 41.67) was recorded at 600 IJs/plant. Whereas in soil application (34.17, 34.17) was recorded @ 600 IJs/plant after 5th day of inoculation. Combinations studies exhibited that the mean per cent mortality i.e. 47.00, 45.00 was found superior at 600 IJs in foliar as well as in soil as compared to other combinations followed by 40.00, 42.50 per cent at 600 IJs foliar with 400 IJs in soil after 5th day of inoculation. However, minimum per cent mortality (2.50, 2.50) was recorded at 600 IJs as foliar with 200 IJs in soil foliar application during *rabi* 2003 and 2004.

Keywords: Bioefficacy; Gram; *Steinernema carpocapsae*.

Introduction

Entomopathogenic nematode of the genus *Steinernema* have great promise for use as biological agents because their infective juveniles (IJs) introduce bacteria which are lethal to an insect host. One or the other insect pests are always associated with every crop but not all these pests are of economic importance. When the pest in abundance crosses the threshold or the economic injury level, their control become one of the main agricultural requirement for increase in crop productivity. Although chemical control recommendations are available for protecting the crop from insect pests, but there are many disadvantages in their use. Firstly, the pests are wide spread and the large quantities of toxic chemical put into the environment leads to environmental pollution. Secondly, the use of insecticides protects the crops in the treated field only and does not curb the pest population in the surrounding areas. Thirdly, the development of resistance, persistent residues, residual effect, contamination of food and water sources etc. During the last decade there has been heightened interest world over in the biological control of insects using entomopathogenic nematodes belonging to the family steinernematidae.

Materials and Methods

The bioefficacy of entomopathogenic nematode, *Steinernema carpocapsae* was studied against *Helicovera armigera* on gram and tomato through different inoculum level in combination of spray and soil application in pots.

Inoculum levels

Through spray application :	Soil application :
(i) 200 IJs/plant	(i) 200 IJs/pot
(ii) 400 IJs/plant	(ii) 400 IJs/pot
(iii) 600 IJs/plant	(iii) 600 IJs/pot

Inoculation

The entomopathogenic nematode suspension consisting IJs stored in sterile distilled water and examined under stereoscopic microscope to check the activity of the juveniles and diluted with known quantity of sterile distilled water for making the suspension according to required number of IJs.

The infective juveniles of EPNs as an aqueous suspension were sprayed on two months old plants @ 200 IJs/ml in 15 ml distilled water per plant, with 2.0 per cent glycerin was used as adjuvant in foliar application. In soil application treatment IJs were applied @ 200 IJs/ml at upper surface of soil in the pots. Control was kept without IJs application, only distilled water applied. Soon after application of EPNs five same sized insect larvae of *Helicoverpa armigera* were placed on foliage as well as on upper surface of soil in pot. The treatments were replicated four times. The observations on mortality percentage of insect larvae were recorded after 1st, 2nd, 3rd, 4th and 5th day of inoculation.

Results and Discussion

The bio-efficacy of *Steinernema carpocapsae*, was tested (Table 1) and found that the maximum mean per cent mortality (41.67, 41.67 during *rabi* 2003 and 2004,

Table 1. Bioefficacy of *Steinernema carpocapsae* against *Helicoverpa armigera* on gram.

Treatments Nematode IJs/plant/pot	Percent mortality of Helicoverpa armigera Ist day		IInd day		IIIrd day		IVth day		Vth day	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Foliar application										
200=F_1	-	-	-	-	5.83 (13.88)	5.83 (13.88)	11.67 (19.93)	12.50 (20.62)	17.50 (24.57)	17.50 (24.69)
400=F_2	-	-	-	0.83 (3.02)	11.67 (19.94)	12.50 (20.64)	21.67 (27.68)	23.33 (28.78)	29.17 (32.65)	30.83 (33.70)
600=F_3	4.17 (11.60)	5.00 (12.60)	5.83 (13.89)	7.50 (15.73)	19.17 (25.95)	20.83 (27.12)	28.33 (32.15)	30.00 (33.20)	41.67 (40.19)	41.67 (40.19)
SEm±	0.247	0.217	0.189	0.217	0.339	0.287	0.321	0.298	0.280	0.275
CD (P=0.05)	0.730	0.641	0.560	0.641	1.003	0.850	0.950	0.881	0.829	0.814
Soil application										
200=S_1	0.83 (3.02)	0.83 (3.02)	1.67 (4.30)	1.67 (4.30)	10.83 (18.68)	10.83 (18.68)	18.33 (24.92)	18.33 (24.91)	25.00 (29.48)	25.83 (30.03)
400=S_2	1.67 (4.30)	1.67 (4.30)	1.67 (4.30)	2.50 (5.29)	12.50 (20.05)	13.33 (20.63)	20.83 (26.87)	22.50 (27.97)	29.17 (32.39)	30.00 (32.87)
600=S_3	1.67 (4.29)	2.50 (5.30)	2.50 (5.30)	4.17 (9.16)	13.33 (20.04)	15.00 (22.32)	22.50 (29.96)	25.00 (29.72)	34.17 (35.54)	34.17 (35.57)
SEm±	0.247	0.217	0.189	0.217	0.339	0.287	0.321	0.298	0.280	0.275
CD (P=0.05)	0.730	0.641	0.560	0.641	1.003	0.850	0.950	0.881	0.829	0.814

Contd..

Interaction (F x S)										
F_1S_1	-	-	-	-	5.00(12.89)	5.00(12.89)	10.00(18.42)	10.00(18.39)	12.50(20.69)	12.50(20.69)
F_1S_2	-	-	-	-	5.00(12.89)	5.00(12.89)	12.50(20.69)	12.50(20.69)	17.50(24.72)	17.50(24.72)
F_1S_3	-	-	-	-	7.50(15.85)	7.50(15.87)	12.50(20.69)	15.00(22.78)	22.50(28.31)	22.50(28.31)
F_2S_1	-	-	-	-	10.00(18.42)	10.00(18.44)	17.50(24.72)	17.50(24.72)	25.00(30.00)	27.50(31.63)
F_2S_2	-	-	-	-	12.50(20.69)	12.50(20.69)	22.50(28.31)	25.00(30.00)	30.00(33.21)	30.00(33.21)
F_2S_3	-	-	-	2.50(9.05)	12.50(20.70)	15.00(22.78)	25.00(30.00)	27.50(31.63)	32.50(34.75)	35.00(36.27)
F_3S_1	2.50(9.05)	2.50(9.05)	5.00(12.89)	5.00(12.89)	17.50(24.72)	17.50(24.72)	27.50(31.62)	27.50(31.63)	37.50(37.76)	37.50 (37.76)
F_3S_2	5.00 (12.89)	5.00 (12.89)	5.00 (12.89)	7.50 (15,87)	20.00 (26.56)	22.50 (28.31)	27.50 (31.62)	30.00 (33.21)	40.00 (39.23)	42.50 (40.68)
F_3S_3	5.00 (12.86)	7.50 (15.87)	7.50 (15.89)	10.00 (18.44)	20.00 (26.56)	22.50 (28.31)	30.00 (33.20)	32.50 (34.76)	47.50 (43.57)	45.00 (42.19)
Control	-	-	-	-	-	-	-	-	-	-
SEm±	0.427	0.375	0.328	0.375	0.587	0.497	0.556	0.516	0.485	0.476
CD (P=0.05)	1.265	1.110	0.971	1.110	NS	1.472	1.645	1.526	1.436	1.409

Figures in parenthesis are angular transformed value

respectively) of *H. armigera* larvae with foliar application of 600 IJs, was observed which significantly differed as compared to other doses after 5th day of inoculation.

Among soil application, maximum mean per cent mortality (34.17, 34.17) was observed at 600 IJs followed by 400 and 200 IJs during the year i.e. 2003 and 2004, respectively after 5th day of inoculation. Interactions between foliar and soil application doses, the interaction of foliar with soil application @ 600 IJs same dose of both the application was found superior combination, in respect to mean per cent mortality (47.50, 45.00) during *rabi* 2003 and 2004, respectively. However, minimum per cent mortality (2.50, 2.50) was recorded at 600 IJs as foliar with 200 IJs in soil application. Similar studies in this regards were made by earlier workers[1-3] who concluded that *Helicoverpa armigera* and *Earias vittella* are important boll worm of cotton in Gujarat. In this context to promote natural enemies against boll worm, field efficacy of promising native entomopathogenic nematode, *Steinernema riobrave* (GAU EPN-3, Anand isolate) alone and with 5 per cent soluble starch and gum arabic adjuvant was tested in cotton hybrid-6. However, addition of adjuvant in EPN suspension were not found effective for better suppression of boll worms. The biological control of *Helicoverpa armigera* by native EPNs *Steinernema riobrave* (GAU EPN-3, Anand isolate) and *Heterorhabditis* sp. (GAU EPN-16, Dehgam isolate) on pigeonpea and chickpea crops in pots, respectively was studied in the net house. Six dosage of nematodes *viz.*, 0, 125, 250, 500, 1000 and 2000 IJs/ 5 plant / pot were applied in completely randomized design with 4 replications, EPN-3 was able to give highest (96.8 per cent) larval mortality at 1000 and 2000 IJs / pot dose of 6th day of treatment in pigeonpea. Whereas, EPN-16 induced maximum (70.9 per cent) mortality at 2000 IJs / pot on 6th day in chickpea. The native *Steinernema* sp. could be used as soil drench at the dosage of 13×10^4 IJs / m^2 against pupae of *Spodoptera litura* but it was comparatively less virulent than the exotic *Steinernema glaseri*. A green house study showed that the native *Steinernema* sp. and *S. glaseri* were equally effective against *S. litura* 4th instar larvae when sprayed on black gram at the dosage of 1500 IJs / plant. The nematode infected larvae caused significantly less damage to the leaflets of black gram, 48, 72 and 96 hrs. after spraying.

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