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Bio-efficacy of *Heterorhabditis indica* against Groundnut White Grub

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A B S T R A C T

The investigations on bio-efficacy of entomopathogenic nematode, *Heterorhabditis indica* against white grub was carried out at Biocontrol Research Laboratory, Department of Entomology, Junagadh Agricultural University, Junagadh during 2014-15. Bio-efficacy of *H. indica* against groundnut white grub in pot revealed that mortality of white grub reached up to 73.34 % at higher inoculums level (100 IJs/grub) after 120 hrs of application. Per cent of mortality of white grub increased with rise in inoculum levels and exposure time.

Introduction

Among the different insect pests infesting this crop in Saurashtra region of Gujarat state, whitegrub, *Holotrichia consanguinea* (Blanchard) is considered as key soil dwelling insect. Yadava and Sharma (1995) reported that the presence of one grub/M^2 may cause 80-100 per cent plant mortality. Yield reduction occurs because larvae kill plants in the seedling stage and impair pod production by weakening the plants. White grubs also damage pods causing direct yield losses (Anitha, 1992). Maximum damage occurs when the grubs are in 3rdinstar. It is known fact that this pest showed certain levels of behavioral resistance to different class of insecticides, hence successful control of this pest is some extent difficult.

Entomopathogenic nematodes (EPNs) especially members of genus *Steiner nema* (27 species) and *Heterorhabditis* (8 valid species) are innovative bioagents for plant protection scientists of India. These EPNs are having symbiotic bacteria (Genus *Steinernema* – *Xenorhabdus* spp. and Genus *Heterorhabditis* – *Photorhabdus* spp.) which are gram negative, facultative anaerobic rods belonging to enterobacteriaceae having dimorphism nature. These mutually associated bacteria cause quick mortality of target insects having wide host range among class Insecta. They are also found safe to non

- target organisms and compatible with many pesticides. Symbiont also produces antifungal and antibacterial metabolites like Xenorhabdin, Xenocoumacins, Xenoxodus, Nematophines (3' indol ethyl 3' methyl-2' oxo) and soluble proteineous compounds which make EPN a broad spectrum bioagents for biological suppression of agricultural pests (Vyas, 2000).

EPNs are naturally found in soil and are extra ordinarily lethal to many important soil insect pests and safe to plants and animals (Smart, 1995). Due to this high degree of safety compared to chemicals, Application of EPN does not require special safety equipments and reduces time. Also they have no residues, avoid ground water contamination, general environmental pollution and are safe to pollinators and arthropod parasites.

In general many biological agents require days to weeks to kill the target, but EPN juveniles (IJs) working with their symbiotic bacteria, kills target insect within 24-72 hrs. Extreme conditions like temperature and moisture will affect moderately to the immature stage of EPN, many EPN species and strains are better adapted to wide range of extreme environmental conditions with long persistence in soil.

In India, *Steinernema* (nr. riobrave) was first time reported from Gujarat state (Ganguly *et al.,* 2002). Besides these few more species were discovered during last decade in India and many scientists have taken keen interest in entomopathogenic nematodes as an arsenal for soil insect pests in the country. Entomopathogenic nematode families, *Steinernematidae* and *Heterorhabditidae* have been proved more useful against insect pests. EPNs are now emerged as second most valuable bio insecticide besides *Bacillus thuringiensis* for the effective suppression of insect pests in western countries during last three decades. In India, scientists have tested imported EPN cultures against few important insect pests during last three decades proving them very useful. EPN DD – 136 strain (*S. carpocapsae*) against *S. litura* (Narayan and Gopalkrishna, 1987) DD – 136 strain (*S. glaseri*) against *H. consanguinea* (Vyas and Yadav 1992) and *H. armigera* (Patel and Vyas, 1995). At recent, *Steinernema* and *Heterorhabditis* nematodes against white grub, *Brahminacoriacea* Hope in potato crop (Anupam Sharma *et al.,* 2009) and against white grub of *Holotrichialongipennis* on turf grass in Srinagar (Hussaini *et al.,* 2005).

Materials and Methods

Appropriate amount of IJs suspension of *H. indica* were mixed in sterile soil to obtain concentration of 20, 40, 60, 80 and 100 IJs / g soil. All the concentration was tested in 3 repetitions by soil inoculation method. The soil thus inoculated with IJs was distributed in respective beaker. Untreated (distilled water) and treated check (Chlorpyrifos 20 EC) was applied for comparison purpose. White grub was tested individually in plastic tubes. The tested grub was provided fresh groundnut roots and pegs as food material. The food materials were changed daily.

Laboratory rearing of white grub

The field collected beetles were released in wooden cages (1 m^2 × 60 cm) filled up with moist sandy loam soil up to the depth of 30 cm(Plate III). The cages were covered by black cotton cloth to avoid the escape of beetles. They were fed daily with fresh neem leaves. The eggs (Plate IV) laid by the beetles in the soil were collected daily. The eggs were kept in screw cap tube with moist soil. After hatching of the eggs, groundnut root nodules and pegs were provided as food for the grubs, such laboratory reared grubs were used in further experiment.

Mass production of entomopathogenic nematode, *H. indica*

Local strain of entomopathogenic nematode, *Heterorhabditis indica* was multiplied in laboratory on larvae of ground white grub. 27 petri dishes (9 cm) were lined with Whatman filter paper no.1 were sterilized in autoclave at 121º C, 1.36 kg/cm^2 and cool downed for 20 minutes at room temperature (Plate VII). The nematode, *H. indica* was applied as per above treatment at 1 ml distilled water and allow to distribute on the filter paper for 30 minute.

Results and Discussion

The present study was framed with an aim to assess the bio-efficacy of entomopathogenic nematode, *H. indica* against groundnut white grub. The result observed on bio-efficacy during study is presented here.

After 24 hrs

The results (Table 1) on mortality of groundnut white grub at 24 hrs after the application of *H. indica* revealed that the higher dose (100 IJs/grub) caused 40% grub mortality followed by treatments of chlorpyrifos 20 EC @ 2 ml/ lit., 80 and 60 IJs/grub, which caused 31.06%, 26.63% and 13.85% grub mortality, respectively.

The lowest (7.70%) mortality was recorded at 40 IJs/grub, whereas no grub mortality was recorded at 20 IJs/ grub and in control set.

After 48 hrs

The data on bio-efficacy of *H. indica* against white grub, *H. consanguinea* is summarized in Table 1. The experimental result indicated that the application of chlorpyrifos 20 EC @ 2 ml/ lit. caused 57.77 % grub mortality followed by treatments of 100, 80, 60, 40 and 20 IJs/ grub, which caused 46.65%, 33.31%, 20.00%, 13.89% and 7.77% grub mortality, respectively, whereas no grub mortality was recorded in control set (Fig. 1 and 2).

Table.1 Bio-efficacy of *H. indica* against Groundnut white grub

Treatment No.	Dose (IJs / Grub)	Percent mortality of white grub after				
		24 hrs.	48 hrs.	72 hrs.	96 hrs.	120 hrs.
T1	20	7.40* (1.66)	16.19 (7.77)	21.85 (13.85)	26.57 (20.00)	31.09 (26.66)
T2	40	16.12 (7.70)	21.88 (13.89)	26.45 (19.84)	31.07 (26.63)	35.26 (33.33)
T3	60	21.85 (13.85)	26.57 (20.00)	31.07 (26.63)	35.25 (33.31)	39.23 (40.00)
T4	80	31.07 (26.63)	35.25 (33.31)	39.23 (40.00)	43.09 (46.66)	46.92 (53.35)
T5	100	39.23 (40.00)	43.08 (46.65)	50.77 (60.00)	54.75 (66.69)	58.91 (73.34)
T6	Chlorpyrifos 20 EC @ 2 ml/ lit.	33.87 (31.06)	49.47 (57.77)	57.47 (71.09)	63.44 (80.00)	68.58 (86.67)
T7	Control	7.40(0)	7.40(0)	7.40(0)	7.40(0)	7.40(0)
S. Em.±		0.89	0.98	1.02	0.76	0.76
C. V. %		6.93	5.96	5.29	3.57	3.22
C.D. at 5%		2.71	2.98	3.10	2.33	2.31

*Arc sin transformed values Figures in parenthesis are retransformed values.

Fig.1 Bioefficacy of *H. indica* against groundnut white grub

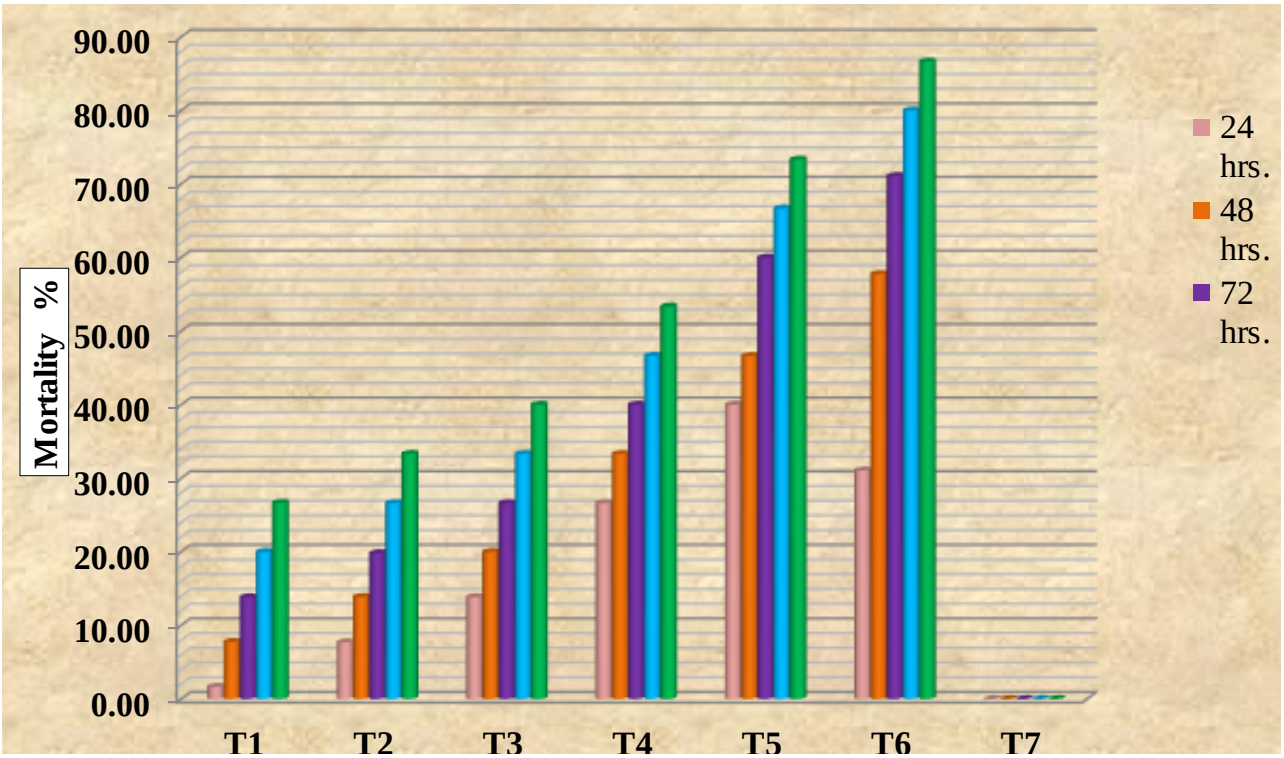

Fig.2 White trap method for harvesting EPNs emerged from Groundnut white grub

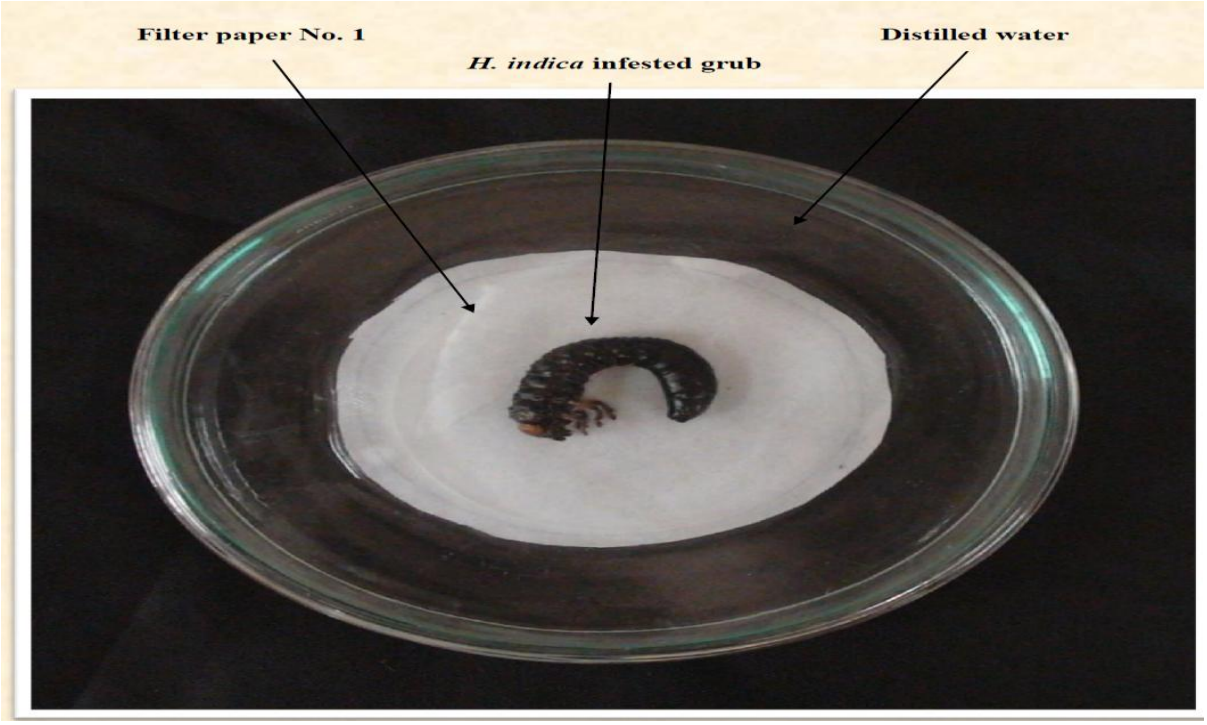

Plate.1

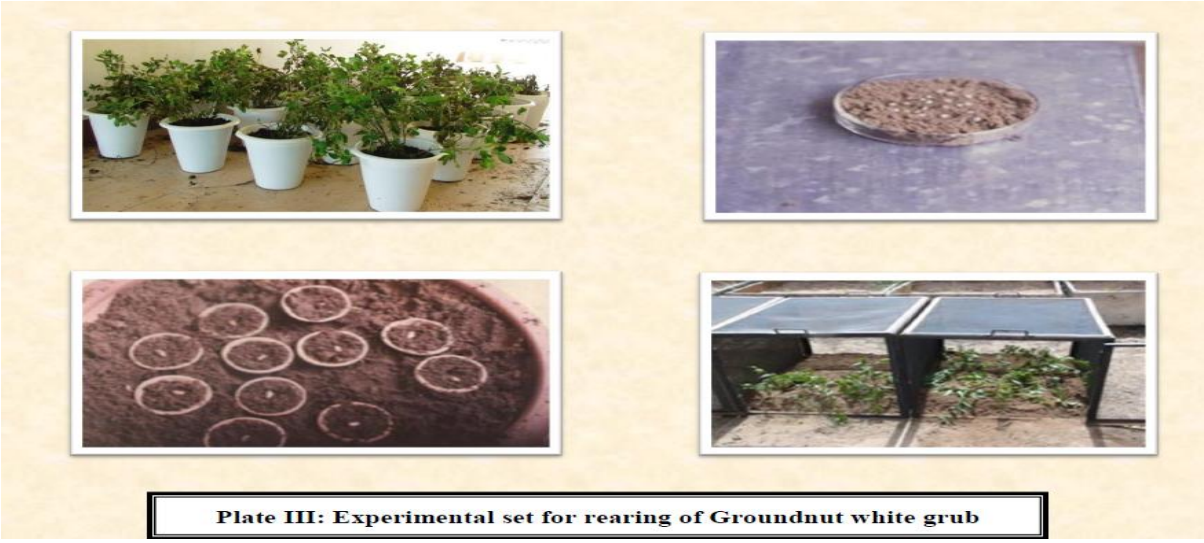

Plate III: Experimental set for rearing of Groundnut white grub

Plate.2

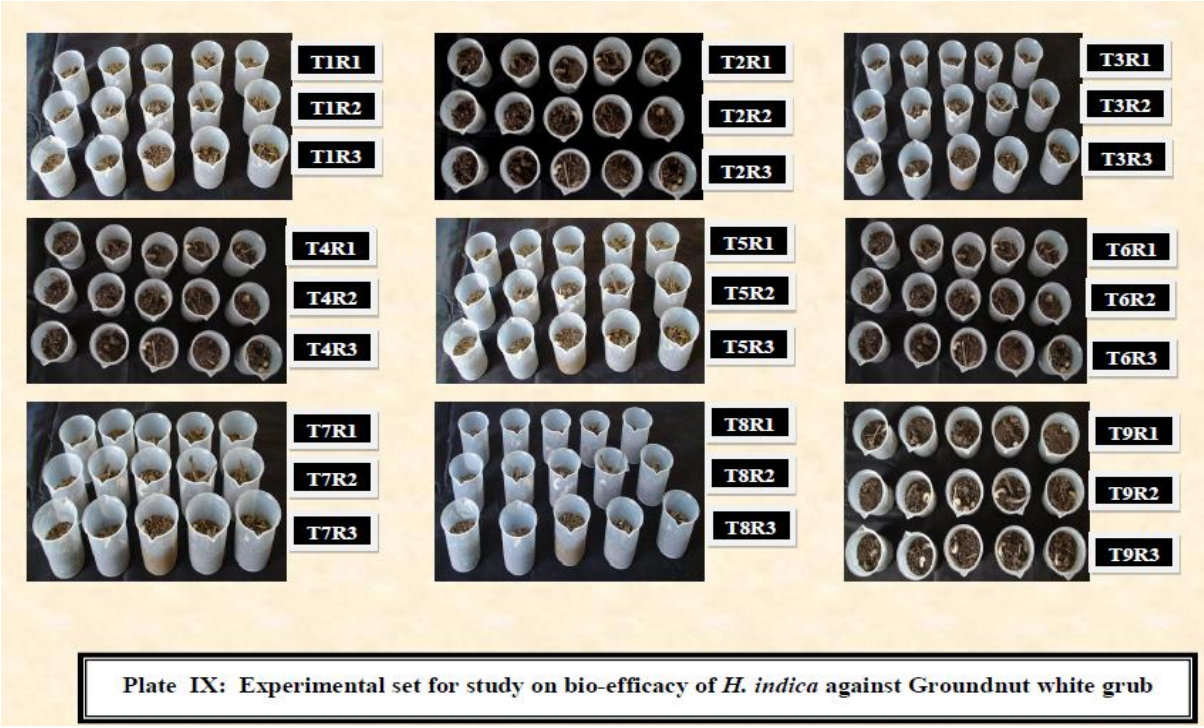

Plate IX: Experimental set for study on bio-efficacy of *H. indica* against Groundnut white grub

After 72 hrs

The data presented in Table 1 discovered that the application of chlorpyrifos20 EC @ 2 ml/ lit caused 71.09% grub mortality followed by treatments of 100, 80, 60 and 40 IJs/ grub, which caused 60.00%, 40.00%, 26.63% and 19.84% grub mortality, respectively. While, lowest IJs (20 IJs/grub) caused 13.85% grub mortality. No grub mortality was recorded in control set.

After 96 hrs

At 96 hrs. after the application of *H. indica* (Table 1), the application of chlorpyrifos 20

EC @ 2 ml/ lit. caused 80 % grub mortality followed by treatments of 100, 80, 60, 40 and 20 IJs/ grub which caused 66.69%, 46.66%, 33.31%, 26.63% and 20% grub mortality, respectively, whereas no grub mortality was recorded in control set.

After 120 hrs

The results (Table 1) on mortality of groundnut white grub at 120 hrs after the application of *H. indica* revealed that the application of chlorpyrifos 20 EC @ 2 ml/ lit. caused 86.67% grub mortality followed by treatments of 100, 80, 60, 40 and 20 IJs/ grub, which caused 73.34%, 53.35%, 40%, 33.33% and 26.66% grub mortality, respectively, whereas no grub mortality was recorded in control set.

The present findings indicated that the per cent of mortality increased with escalation of inoculum levels and exposure time of infective juveniles. The empirical data showed significant difference in results on bio-efficacy of *H. indica* at different inoculum levels and time of exposure. In present findings, grub mortality was ranged from 7.70 to 73.34 % due to *H. indica,* are in agreement with the results of Shanthi and Sivakumar (1991), who reported 15 to 85 % grub mortality. More or less similar result was also reported by Haviland and Hernandezn (2012).

Similarly, Vyas and Yadav (1992) also reported cent per cent mortality of *A. ipsilon* larvae by *S. glaseri* at 32 IJs/g soil in laboratory at 48 hrs exposure. They also reported that the grub mortality increased with an increase in number of nematodes and time of exposure.

Sankaranarayanan *et al.,* (2006) also reported lowest LD_{50} value (127.0 IJs/pupa) and LT_{50} value (27.3 hrs.) in *H. indica.*

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