Evaluation of two native isolates of entomopathogenic nematodes *Steinernema* sp. and *Heterorhabditis Indica* from Andhra Pradesh against *Amsacta albistriga* walk in groundnut

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ABSTRACT

The efficacies of two native entomopathogenic nematodes *viz.*, *Steinernema* sp. and *Heterorhabditis indica* was evaluated under laboratory and microplot conditions against red hairy caterpillar *Amsacta albistriga* walk in groundnut.80% and 42% of mortality was observed in filter paper assay within 24 h by *H. indica* and *Steinernema* sp. respectively. *Steinernema* was more virulent against 2nd and 3rd instar larvae, while *H. indica* showed virulence at all the stages. Microplot application of *H. indica* at 100000 IJ/ml showed more efficient control than other concentrations. Entomopathogenic nematodes remain viable in soil upto 3 months after treatment. To the best of author's knowledge this is the first report of using entomopathogenic nematodes against red hairy cateriplllar.

INTRODUCTION

Groundnut, *Arachis hypogaea* Linn is an important food and legume crop. India holds the proud to be the largest producer of groundnut in the world. In India the crop is grown in an area of 7.6million ha with a production of 7.8t of pods / annum. Among the states, Andhra Pradesh has the highest area of groundnut cultivation. The crop suffers from a variety of pests which causes heavy loss to an extent of Rs.2380 million/annum. Among the insects red hairy caterpillar, *Amsacta albistriga* Walk. is the most important pest (Paramasivam *et al*., 1973; Murali Krishna and Prasad, 2008). When an out break occurs a total loss over large areas was common (Nagarajan *et al*., 1957). Synthetic chemical insecticides used for pest management poses numerous problems *viz*., insecticide resistance, food hazards, ground water contamination and destruction of natural enemies. These disadvantages serve as a strong impetus for the development of alternative insect control measures. Attention to biological control agents were increasing recent years.

Entomopathogenic nematodes in the families Steinernematidae and Heterorhabiditidae are potential biocontrol agents (Gaugler, 1981). Most biocontrol agents take days or weeks to kill the pest but entomopathogenic nematodes with their symbiotic bacteria kills the pest with in 24-48 h. Inexpensive, mass production, high virulence and broad host range are the important attributes which extends over the other biocontrol agents. Therefore the present study aims to investigate the biocontrol potential of native isolates of *Steinernema* sp. and *H. indica* against *A. albistriga*

MATERIALS AND METHODS

Bioassay

Steinernema sp. and *H. indica* were tested for their virulence against second, third, fourth, fifth and sixth larval instars of *A.albistrica*. The test nematodes were suspended in distilled water to obtain desirable concentrations. Fresh leaves of groundnut variety K6 were collected from field and placed in petridishes lined with filter paper. The leaves were sprayed with different concentrations of nematode suspensions (T_1 – Control, T_2-100 IJ/ml, T_3-1000, T_4-10000, T_5-100000 IJ/ml) using hand held aerosol sprayer. The leaves were left for 30min to avoid water condensation. Ten larvae of the same instars were placed in the treated leaves. The experiment was replicated 5 times. Untreated leaves contain only distilled water spray. The larvae were allowed to feed on the treated leaves for 24h later they were transferred to fresh untreated leaves.

Mortality counts were recorded daily for 5 days from the initiation of the experiment. Percent mortality was calculated for each concentration separately. Probit analyses was used for determining the LC_{50} and LT_{50} values (Finney, 1977).

Microplot Experiment

A microplot experiment was conducted at Kadiri, Ananthapur District. Groundnut var. K6 was sown in season. After the plots were heavily infested with *A. albistriga*, initial insect population was counted prior to the treatment. Standard cultural practices were followed as recommended by Acharya N.G. Ranga Agricultural University. Three days after infestation, the treatments were given using hand sprayer. The treatments were replicated five times in a randomized block design. Ten plants were observed in each replication for each treatment. Observations on total number of larvae per plot and total number of larvae died due to treatment, leaf area/ m^2 and leaf consumed by the larvae were recorded Nematode population in the microplot soil was estimated

Table 1. Relative efficacy of entomopathogenic nematodes against red hairy caterpillar ***A. albistriga***

life stages	LC_{50}		LT_{50}	
	Steinernema sp.	*H. indica*	*Steinernema* sp.	*H. indica*
Second	13.39	14.36	14.6	10.2
Third	21.76	15.25	16.3	12.3
Fourth	131.24	27.46	24.9	18.6
Fifth	432.64	63.52	76.3	20.8
Sixth	1000.68	131.78	98.7	26.3

by inoculation of *Galleria mellonella* (L.) larvae in the soil sampled from the plots.

RESULTS AND DISCUSSION

The virulence of the native isolates of *Steinernema* sp. and *H. indica* were compared as indicated by the values of lethal mortality concentrations and lethal time (Table 1). From the results it can be concluded that *Steinernema* sp. was more virulent to second and third instar larvae of red hairy caterpillar and less virulent to other instar larvae. *H. indica* showed high virulence to all instars larvae. *Steinernema* sp. kills the second and third instar larvae in 14.6 and 16.3 h respectively while it takes 98.7 h for killing of sixth instar larvae. While *H. indica* kills fifth instar larvae in 20.8h and sixth instar in 26.3h. Normal emergence of both entomopathogenic nematodes were observed from the dead insects. This indicates the lack of host resistance against the nematodes. The results obtained were in accordance with those of Albrecht *et al.* (2007) who obtained high mortality in the early instar larvae of *Spodoptera littoralis*. Baskaran *et al.* (1994) reported the potential of *S. carpocapsae* and 3 native isolates of *Heterorhabditis* sp. from Tamil Nadu. They reported the ineffectiveness of *Heterorhabditis* sp. to manage the insect population.

Data obtained indicate that the higher nematode inoculum levels caused higher and faster mortality than the lower levels. The death of the treated insects was caused by the effects of the symbiotic bacteria. Production of proteolytic enzymes by the bacteria helps to overcome the problem in resistance (Poinar, 1979 Michael *et al.*, 2003). LC_{50} value increases in proportion to age of the insects as indicated by the increase in values of lethal mortality concentrations. This may be attributed due to the difference in rate of phagocytosis of infected juveniles in the host hemolymph. This is in agreement with the findings of Glazer and Navon (1990) and Theodora and Martin (2007).

Higher virulence of *H. indica* was attributed due to the presence of mural tooths which helps the nematode to penetrate the soft joints of the insect while *Steinernema* sp. has to enter through natural openings of the insects. Presence of hairs on the body of the larvae prevents the access of nematodes directly. This may be the probable reason for the less effectiveness of *Steinernema* sp.

Application of *Steinernema* sp. in microplot revealed 100000IJ/ml is highly efficient in controlling red hairy caterpillar upto 58.76 percent (Table 2). Due to the effect of entomopathogenic nematode leaf feeding also decreased when compared to control. In *H. indica* treatment, application of 1000IJ/ml reduced the larval incidence up to 46.40 percent and in 100000IJ/ml reduced the infection by 92.47 percent (Table 2). Increased growth

Table 2. Efficacy of different concentrations of *Steinernema* sp. and *H. indica* on red hairy caterpillar and plant growth

Treatments	Total No of larvae		Percent infection	Leaf area (cm2)	
	Live	Dead		Before Treatment	After Treatment
			***Steinernema* sp.**		
T1	118.42	3.74	-	22217.3	11641.6
T2	122.65	13.65	11.13	21850.1	16201.0
T3	132.43	24.38	18.41	22535.88	14460.2
T4	108.65	37.42	34.44	21226.88	13008.4
T5	112.48	58.76	52.24	20888.24	18455.2
			H. indica		
T1	120.86	4.36	-	20869.88	9668.24
T2	110.23	23.47	21.29	22045.6	15253.08
T3	112.84	52.36	46.40	22182.62	17449.3
T4	109.74	78.32	71.37	20767.88	20353.76
T5	118.36	109.45	92.47	20869.88	9668.24

of foliage was also observed in arresting the feeding rate of the larval pest. Bedding *et al.* (1983) reported that infectivity of entomopathogenic nematodes varies widely according to nematode species and strains also to insect species. The faster invasion rate was recorded with smaller insects for all nematodes strains. Thus the LC_{50} and LT_{50} increase in proportion to the size of insect larvae.

Entomopathogenic nematodes applied in soil were viable up to 3 months. Viability of infective juvenile in soil is directly proportionate to the environmental conditions. Since this isolate is native of Andhra Pradesh it fits well to the environmental conditions. In field conditions availability of the soil insects will be more and the viability of the nematodes can still be extended.

To conclude *H. indica* isolate is highly efficient in controlling red hairy caterpillar of groundnut. Foliar application of entomopathogenic nematodes takes care not only of redhairy caterpillar but also of other foliar pests like *Spodoptera litura*, *Helocoverpa armigera* and leaf weber of groundnut.

REFERENCES

Albrecht M. K. , Parwinder S. G. and Eugene M. F. 2007. Divergences in penetration routes and establishment rates of four entomopathogenic nematode species into four white grub species. *Journal of Invertebrate Pathology,* **94:** 184–195.

Baskaran R.K.M., Sivakumar C.V., Venugopal M.S. 1994. Biocontrol potential of native entomopathogenic nematodes in controlling red hairy caterpillar (*Amsacta albistriga*) (Lepidoptera: Arctiidae) of groundnut (*Arachis hypogaea*). *Indian Journal of Agricultural Sciences,* **64:** 655-657.

Bedding, R. A., Molyneux A. S. and Akhurst, R. J. 1983. *Heterorhabditis* spp. *Neoaplectana* spp. and *Steinernema kraussie* interspecfic and interspecific difference in infectivity for insects. *Experimental Parasitology,* **55:** 249- 257.

Finney, D.J. 1977. Probit analysis. 3rd ed. Repr. Cambridge University Press, 333 **PP**.

Gaugler, R. 1981. Biological control potential of neoaplectanid nematodes. *Journal of Nematology,* **13:** 241-249.

Glazer, L. and Navon, A. 1990. activity and persistence of entomparastitic nematodes tested against *Heliothis armigera*. *Journal of Economic Entomology,* **83:** 1795 -1800.

Heungens, K., Cowles C.E., and Goodrich-Blair, H. 2002. Identification of *Xenorhabdus nematophila* genes required for mutualistic colonization of *Steinernema carpocapsae* nematodes. *Molecular Microbiology,* **45:** 1337-1353

Michael J. W., Edwin E. L. Floyd Y. and Randy G. 2003. Application pattern and persistence of the entomopathogenic nematode *Heterorhabditis bacteriophora. Biological Control,* **26:** 180–188.

Murali Krishna, T.and Prasad, T.V. 2008. Hairy Cauerpillam.In Groundnut Entomology (Nandagopal,V. and Gunathilagaraj,K.eds). Satis Serial Publishing House, Delho. 129-151 **PP**.

Nagarajan K. R., Perumal, K. and Shanmugan, N. 1957. The red hairy caterpillar and its field scale control. *Madras Agricultural Journal,* **4** (4):150-153.

Paramasivam, V., Let Choumanane, S. and Sreeramulu, O.S. 1973. Preliminary studies on the insecticidal control of groundnut red hairy caterpillar. *Madras Agricultural Journal,* **20:** 36-38.

Poinar, G. O. Jr., 1979. Nematodes for biological control of insects. Boca Raton, CrC press, Fl, 249-277 **PP**.

Theodora L. and Martin D. 2007 Biological control of black vine weevil *Otiorhynchus sulcatus* in Ireland using *Heterorhabditis megidis. Biological Control,* **40:** 314–319

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