Evaluation of entomopathogenic nematodes, *Steinernema carpocapsae* and *Heterorhabditis indica* for their virulence against *Spodoptera litura*

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ABSTRACT

The 3rd and 4th instar larvae of *Spodoptera litura* were exposed to infective juveniles (IJs) of EPNs @ 2, 5, 10, 20 and 40 IJs cm^{-2} under laboratory condition. Both the species of EPNs showed higher activity against 4th instar larvae of *S. litura* than to 3rd instar lavae. *Heterorhabditis indica* caused significantly higher mortality at lower IJs level than *Steinernema corpocapse.* The reproductive potential of nematode was not affected by the level of IJs.

Key words: *Arachis hypogaea*, EPN, *Spodoptera litura*.

Groundnut is an important oil seed crop grown in India and is attacked by several insect pests, pathogens and nematodes. The avoidable yield loss due to defoliators in groundnut is estimated to be about 24.5% (Baskaran & Rajavel, 2013). Among defoliators, the tobacco caterpillar, *Spodoptera litura* (F.) is a major pest that can cause significant yield loss during severe pest outbreaks (Satyanarayana *et al*., 2010). There is a need to test non-chemical methods to manage this pest owing to ill-effects of synthetic insecticides. The use of entomopathogenic nematodes (EPNs) for the management of insect pests has gained importance. However, EPNs used for controlling a specific insect pest should be better adapted to local environmental conditions for better efficacy under field condition. The environmental conditions affect survival, reproductive potential and virulence of EPN. Hence, a study was undertaken to evaluate the virulence of *Steinernema carpocapsae* and *Heterorhabditis indica* against larvae of *S. litura.*

Materials and Methods

Spodoptera litura larvae were collected from groundnut (*Arachis hypogaea* L.) field and maintained under laboratory condition on their host plant. The 3rd and 4th instar larvae were used for laboratory bioassay and was performed under 5 cm dia. Petri dishes lined with filter paper. Infective juveniles (IJs) suspensions were prepared to obtain @ 2, 5, 10, 20 and 40 IJs cm^{-2} and each applied with 500 µl water; controls received water only. Twelve Petri dishes with one larva / dish were used for each concentration and control treatment. The study was repeated twice. The larval mortality was recorded after 48, 72 and 96 hrs. To assess reproductive potential of EPN's, cadavers were placed individually on white traps and incubated under laboratory condition until emergence of new generation of IJs of EPN's. The data on mortality were arc sine transformed and analysed by two factorial analysis of variance (ANOVA). Probit analysis from mortality data were carried out to calculate LC_{50} using SAS software.

Results and Discussion

Larval mortality was affected by the nematode concentration and larval stage. Significant increase in mortality of *S. litura* with increase in IJs concentration (Fig 1 & 2; Table 1). The *S. carpocapsae* caused 33.3 and 66.6% larval mortality at 2 IJs/cm^2, which was increased to 100% mortality at 20 IJs/cm^2 after 96 hrs, respectively in 3rd and 4th instar larvae of *S. litura* (Fig 1; Table1). Similarly, *H. indica* caused 33.3 and 66.6 % larval morality at 2 IJs/cm^2, which increased to 100% mortality at 10 IJs/cm^2 after 96 hrs., respectively, in 3rd and 4th instar larvae (Fig 2; Table1). Similar results were reported by Kumar *et al*. (2003). The *H. indica* caused significantly higher mortality at lower IJs concentration than *S. corpocapsae* as it caused 100% mortality at 10 IJs/cm^2 after 72 and 96 hrs., respectively for 3rd and 4th instar larvae of *S. litura*. However, *S. corpcapse* caused 100% mortality at 20 IJs/cm^2 after 72 and 96 hrs., respectively, for 3rd and 4th instar larvae of *S. litura*. The variation in effectiveness of entomopathogenic nematodes were reported by Saravanapriya and Subramanian (2007) and Seal *et al*. (2010). Both the species of EPNs found to have higher activity against 4th instar larvae of *S. litura* than to 3rd instar lavae (Fig 1 & 2). The differential susceptibility of the *Spodoptera* larvae to the fungal bio-organisms was reported by Purwar and Sachan (2005).

The LC_{50} (no. of IJs / cm^2 for 50% larval mortality) of *S. carpocapsae* for 3rd instar larvae was 49, 5 and 4 cm^{-2}; and for 4th instar was 253, 7, 2 cm^{-2}; respectively, after 48, 72 and 96 hrs of inoculation. However, LC_{50} of *Heterorhabditis indica* for 3rd instar larvae was 74, 5 and 2 cm^{-2}; and for 4th instar larvae was 55, 4 and 2 cm^{-2}, respectively, after 48, 72 and 96 hrs of inoculation (Table 2). The reproductive potential of nematode was not affected by dose. However, *Heterorhabditis indica* produced more IJs / larva (12101-18420) as compared to *S. carpocapsae*

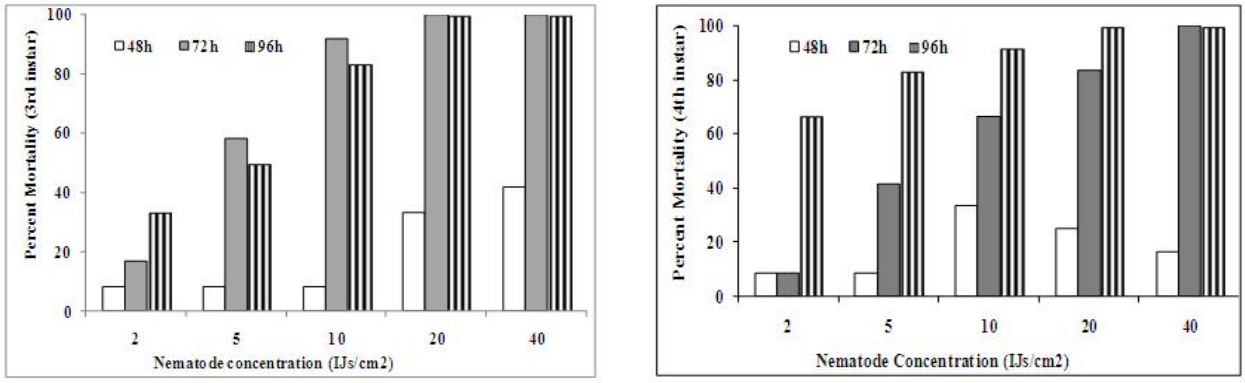

Fig. 1. Effect different concentrations of *Steinernema carpocapsae* on 3rd and 4th instar larvae of *Spodoptera litura.*

Table 1. Least significant differences for effect of entomopathogenic nematode on *Spodoptera litura*.

EPNs	*Steinernema carpocapsae*		*Heterorhabditis indica*	
Larval stage	**3rd Instar**	**4th Instar**	**3rd Instar**	**4th Instar**
IJs concentration (C)	4.66 ± 1.61*	4.80 ± 1.66	3.04 ± 1.05	4.87 ± 1.69
Time (T)	3.61 + 1.25	3.72 ± 1.29	2.35 ± 0.81	3.77 ± 1.31
C × T	8.07 ± 2.80	8.32 ± 2.88	5.26 ± 1.82	8.44 ± 2.92

*Least significant differences P =0.05%; ± Standard error of mean.

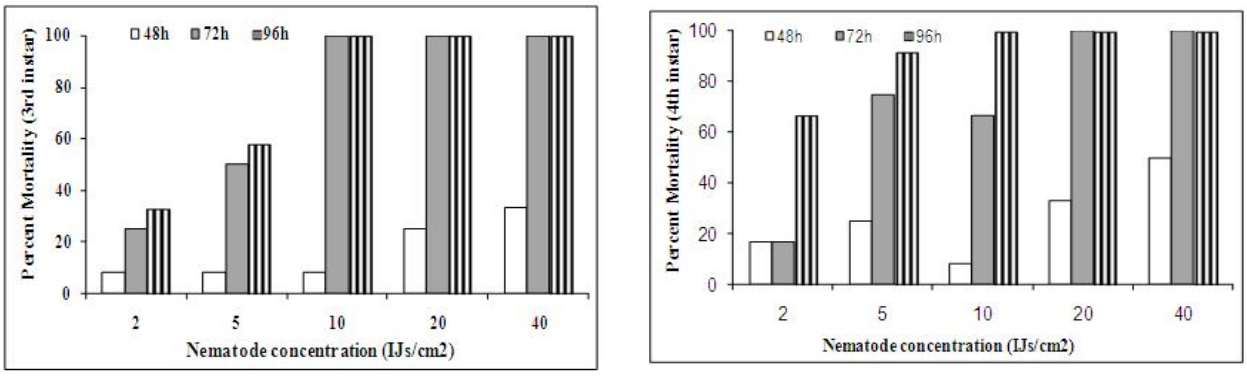

Fig. 2. Effect different concentrations of *Heterorhabditis indica* on 3rd and 4th instar larvae of *Spodoptera litura.*

Table 2. LC_{50} of *Steinernema carpocapsae* and *Heterorhabditis indica* on larvae of *Spodoptera litura*

EPN's	LC_{50} (no. of IJs / cm^2 for 50% larval mortality)		
	48 hrs	72 hrs	96 hrs
Steinernema carpocapsae			
3rd instar	49	5	4
4th instar	253	7	2
Heterorhabditis indica			
3rd instar	74	5	2
4th instar	55	4	2

(7250-12333) indicating towards more damage to the insect pests because of the populations pressure and symbiont bacteria associated.

The study revealed that both the species of EPNs were found to be virulent and could cause 50% mortality at 2 IJs cm^{-2} *in vitro*. As *Spodoptera* larvae feed on foliage and pupate in soil, the future studies are needed to test the efficacy of foliar and soil applications of EPNs against *Spodoptera* and other lepidopterous pests in groundnut.

References

Baskaran, R.K. and D.S. Rajavel (2013). Yield loss by major insect pests in groundnut. *Ann. Pl. Protec. Sci.* **21**: 189-190.

Kumar, M. Raj., A. Parihar and A.U. Siddiqui (2003). Effects of entomopathogenic nematode, *Heterorhabditis* sp., on *Spodoptera litura. Ann. Pl. Protec. Sci*. **11**: 406-407.

Purwar, J.P. and G.C. Sachan (2005). Biotoxicity of *Beauveria bassiana* and *Metarhizium anisopliae* against *Spodoptera litura* and *Spilarctia obliqua. Ann. Pl. Protec. Sci.* **13**: 360-364.

Saravanapriya, B. and S. Subramanian (2007). Pathogenicity of EPN to certain foliar insect pests. *Ann. Pl. Protec. Sci.* **15**: 219-222.

Satyanarayana, N.V.V., G. Ramachandra Rao and P. Arjuna Rao (2010). Incidence and management of *Spodoptera litura* (Fab.) on post rainy season of groundnut. *Ann. Pl. Protec. Sci.* **18**: 22-25.

Seal, D.R., V.K. Jha, and T.X. Liu (2010). Potential of various strains of entomopathogenic nematodes in combination with insecticides for suppression of black cutworm, *Agrotis ipsilon* (Lepidoptera: Noctuidae). *Ann. Pl. Protec. Sci*. **18**: 293-300.