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# Influence of Dosage of *Steinernema carpocapsae* (Weiser), *S. glaseri* Steiner and *Heterorhabditis indicus* (Poinar, Karunakar and David) on Mortality of the Host and Multiplication of Infective Juveniles in Sugarcane Internode Borer, *Chilo sacchariphagus indicus* (Kapur)

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***Steinernema carpocapsae*** **(Weiser),** ***S. glaseri*** **(Steiner) and** ***Heterorhabditis indicus*** **(Poinar, Karunakar and David) at an inoculum level of 40 infective juveniles (IJ) per larva caused 97.5 - 100 per cent mortality of** ***Chilo sacchariphagus indicus*** **(Kapur) larvae and the mortality decreased with decrease in dosage levels. There was no significant difference in the mortality caused by the three species of nematodes. The multiplication of infective juveniles (IJ) per unit body weight of the host was higher in** ***H. indicus*** **than in** ***S. carpocapsae*** **and** ***S. glaseri*** **. The dosage level of 20 IJ/larva yielded significantly high nematode multiplication in** ***S. glaseri*** **(37,335.8 IJ/larva) and** ***H. indicus*** **(2,10,283.3 IJ/larva) while** ***S. carpocapsae*** **multiplied to the maximum at a dosage of 10 IJ/larva (1,35,894.3 IJ).**

KEY WORDS : Dosage-mortality, multiplication, *Steinernema glaseri, S. carpocapsae, Heterorhabditis indicus, Chilo sacchariphagus indicus*

Nearly 250 insect species belonging to ten orders are reported to serve as hosts for *Steinernema feltiae* Filipjev and the host range of other steinernematids and heterorhabditids is probably no less extensive (Gaugler, 1981). Recently attempts are being made to evaluate the efficacy of these nematodes in the control of white grubs infesting sugarcane. An essential requirement in the utilisation of any entomophilic nematode for biocontrol is the possibility of propagating large number of infective juveniles (IJ) at an acceptable cost. Earlier studies carried out (Karunakar, 1990) showed that among the nine laboratory hosts tried, the sugarcane internode borer *Chilo sacchariphagus indicus* (Kapur) is the most suitable host for the multiplication of *Steinernema carpocapsae* (Weiser), *S. glaseri* Steiner and *Heterorhabditis indicus* (Poinar, Karunakar and David). Studies conducted to determine the optimum inoculum level for maximum production of these nematodes on *C. sacchariphagus indicus* are presented in this paper.

## MATERIALS AND METHODS

Nucleus stock of *S. glaseri* was obtained from Dr.Bedding, CSIRO, Tasmanian Research Laboratory, "Stowell" Hobar, Tasmania, Australia and Mrs. Woodring, University of California, Davis, USA, while *S. carpocapsae* (DD-136 strain) was obtained from C.A.B. Institute of Biological Control, Bangalore and a native species *Heterorhabditis indicus* isolated from coimbatore were used in the investigation.

The last instar larvae of greater wax moth *Galleria mellonella* (L.) (Galleridae:

Lepidoptera) reared on artificial diet (David and Kurup, 1988) and healthy larvae of sugarcane top borer, *Scirpophaga excerptalis* Walker (Pyralidae: Lepidoptera) collected from infested canes were used as hosts for the multiplication of *S. glaseri* and *H. indicus*. *S. carpocapsae* was subcultured on larvae of rice meal moth, *Corcyra cephalonica* Staint. (Galleridae: Lepidoptera) and *G. mellonella*. The basic *in vivo* production method outlined by Woodring and Kaya (1988) was followed for multiplication, storage and quantification of the population of the entomophilic nematodes.

Full grown larvae of *C. sacchariphagus indicus* were selected for the study. These were surface-sterilised once with 1% formalin and thrice with 0.1% formalin solution. Four inoculum levels of entomophilic nematodes *viz.*, 5, 10, 20, and 40 IJ/larva were used with four replications for each level. Each replication consisted of ten larvae in a Petri dish (9 x 1.5 cm) to which nematode inoculum was added as per the method described by Woodring and Kaya (1988). Then the Petri plate was covered with an equal size plate and sealed with cellotape. The Petri dishes were incubated at controlled temperature (24±1°C). Upon death, *S. carpocapsae* and *H. indicus* infected larvae were placed on White's trap (White, 1927). The larvae infected by *S. glaseri* were placed on the plaster of paris trap described by Woodring and Kaya (1988). The IJ of *S. glaseri* start emerging 8-10 days after infection, while that of *S. carpocapsae* and *H. indicus* in 10-12 days after infection. After the first emergence, the IJ were harvested daily until the production dwindled. The production of IJ was determined using the formula given by Woodring and Kaya (1988). The experiment was conducted in a factorial randomised block design (Panse and Sukhatme, 1967). The statistical analyses were carried out through BDP-100 micro processor computer.

## RESULTS AND DISCUSSION

There was no significant difference in the mortality of larvae caused by the three species of nematodes (Table 1). Significantly high mortality of 99.2 per cent was obtained at the highest dosage level of 40 IJ/larvae and the mortality decreased with decrease in dosage levels. The least mortality of 54.2 per cent was obtained at 5 IJ/larva when all the species of nematodes were considered together. Similar results were obtained in the preliminary laboratory evaluation of these nematodes against white grubs infesting sugarcane.

**Table 1. Influence of nematode inoculum levels on mortality of *C. sacchariphagus indicus***

| Inoculum levels (IJ/larva) | Per cent mortality due to | | | |
|---|---|---|---|---|
| | *S. carpocapsae* | *S. glaseri* | *H. indicus* | Mean |
| 5 | 50.0$^{d}$ | 62.5$^{d}$ | 50.0$^{d}$ | 54.2$^{d}$ |
| 10 | 60.0$^{c}$ | 80.0$^{bc}$ | 72.5$^{c}$ | 70.8$^{c}$ |
| 20 | 95.0$^{b}$ | 87.5$^{b}$ | 82.5$^{b}$ | 88.3$^{b}$ |
| 40 | 97.5$^{a}$ | 100.00$^{a}$ | 100.0$^{a}$ | 99.2$^{a}$ |
| Mean | 75.6 | 82.5 | 76.3 | |

In vertical columns, means followed by same letters are not different statistically (P=0.05) by L.S.D.

Among the four dosage levels, 20 IJ/larva yielded significantly more number of nematodes (1,24,803.0 IJ) followed by 10, 40 and 5 IJ per larva (1,21,647.8, 1,11,418.8 and 94,280.3 IJ) respectively (Table 2). Among the nematode species, *H. indicus* multiplied significantly in higher numbers (1,87,867.3 IJ/larva) followed by *S. carpocapsae* (1,19,517.7 IJ) and *S. glaseri* (31,727.3 IJ).

**Table 2. Multiplication of IJ on *C. sacchariphagus indicus* at different inoculum levels**

| Inoculum levels (IJ/larva) | Production of IJ/larva | | | |
|---|---|---|---|---|
| | *S. carpocapsae* | *S. glaseri* | *H. indicus* | Mean |
| 5 | 1,03,998.5[b] | 28,346.5[c] | 1,50,495.8[c] | 94,280.3[d] |
| 10 | 1,85,984.3[a] | 29,576.5[bc] | 1,99,472.5[ab] | 1,21,647.8[b] |
| 20 | 1,26,790.0[a] | 37,335.8[a] | 2,10,283.3[a] | 1,24,803.0[a] |
| 40 | 1,11,388.0[b] | 31,650.5[b] | 1,91,217.8[b] | 1,11,418.8[c] |
| Mean* | 1,19,517.7 | 31,727.3 | 1,87,867.3 | |

In vertical columns, means followed by same letters are not different statistically (P=0.05) by L.S.D.

* Differences between the means significant (P=0.05) by L.S.D.

*H. indicus* multiplied significantly higher in number at the dosage level of 20 IJ/larva (2,10,283.3 IJ) which was on par with 10 IJ per larva (1,99,472.5 IJ). Similar to *H. indicus, S. glaseri* too multiplied in larger numbers at the dosage level of 20 IJ/larva (37,335.8 IJ) followed by 40 IJ/larva. *S. carpocapsae* multiplied significantly higher in number at the dosage of 10 (1,35,894.3 IJ) and 20 IJ/larva (1,26,790.0 IJ). Razak (1989) also stated that 10 IJ of *S. feltiae* was the optimum dosage for maximum harvest (42,756 IJ/larvae) of this nematode species on *C. cephalonica.* The lowest multiplication was observed at 5 IJ/larva in all the species of nematodes.

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