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Interaction between entomopathogenic nematodes and granulosis viruses of *Chilo infuscatellus* Snellen and *Chilo sacchariphagus indicus* (Kapur)

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ABSTRACT: ***Steinernema feltiae*** **Filipjev,** ***S. glaseri*** **Steiner and** ***Heterorhabitis indica*** **(Poinar, Karunakar, David) developed and reproduced in sugarcane shoot borer,** ***Chilo infuscatellus*** **Snellen and** ***Chilo sacchariphagus indicus*** **(Kapur) larvae infected with granuloviruses (GV). The mean percent infectivity of the three nematode species showed no significant difference among the diseased and healthy larvae of both shoot and internode borers. The multiplication of dauer juveniles was significantly higher in healthy larvae of** ***C. infuscatellus*** **and** ***C. sacchariphagus indicus*** **compared to GV infected larvae.**

KEY WORDS: Granuloviruses, *Heterorhabditis indica, interactive effects, Steinernema feltiae, S. glaseri*

Three species of entomopathogenic nematodes (EPNs) are under consideration for possible use in the management of sugarcane white grub, *Holotrichia serrata* Fabr. a serious pest of sugarcane (David and Ananthanarayana, 1986). At present these nematodes are multiplied in the laboratory on various insect pests including sugarcane shoot borer, *Chilo infuscatellus* Snellen and internode borer *Chilo sacchariphagus indicus* (Kapur). Larvae of *C. infuscatellus* are known to be infected by a granulovirus (GV) (Easwaramoorthy and David, 1979) and that of *C. sacchariphagus indicus* by another GV (Mehta and David, 1980). Earlier, Kaya and Brayton (1978) showed that *Steinernema feltiae* (= *Neoaplectana carpocapsae*) could develop and reproduce on larvae of armyworm, *Pseudaletia unipuncta* How. infected with a GV. In the present study an attempt has been made to find out the infectivity and multiplication of two steinernematids and one heterorhabditid on GV infected *C. infuscatellus* and *C.sacchariphagus indicus* larvae

MATERIALS AND METHODS

Culture of *Steinernema feltiae* Filipjev (DD-136 strain) obtained from CAB Institute of Biological control, Bangalore, India, *S. glaseri* Steiner obtained from Dr. Bedding, CSIRO, Tasmanian Research Laboratory, Tasmania, Australia and *Heterorhabiditis indica* (Poinar, Karunakar, David) collected in the vicinity of

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Coimbatore (Poinar *et al.*, 1992) were used in this study. Final instar larvae of shoot and internode borers were field collected and characterised as healthy and GV- infected based on external symptoms (Easwaramoorthy, 1984). The larvae were weighed individually and surface sterilised once in 1 percent formalin followed by 0.1 percent formalin thrice. Each larva was placed on a Whatman 1 filter paper in a 5.5 x 1.25 cm Petri- plate and 1 ml of the nematode suspension containing 20 infective juveniles (IJs) was evenly distributed on the filter paper. It was covered with a Petri- plate of equal size and sealed with cellotape. The Petri- plates were incubated at 24±1° C. The experiment was replicated thrice with 10 larvae per replication. Observations were made on the mortality of larvae due to nematode infection up to 4 days. The infective juveniles were trapped from cadavers on 5-7 days using appropriate trap (Woodring and Kaya, 1988). The trapped nematodes were harvested on alternate days until no more nematodes emerged.

RESULTS AND DISCUSSION

All the three species of nematodes developed and reproduced in healthy and GV- infected sugarcane shoot and internode borer larvae. The mean percent infectivity of the nematode species showed no significant difference among the diseased and healthy larvae of both shoot and internode borer (Table1). However, the infectivity varied significantly among the three nematode species tried on shoot borer. *S. glaseri* recorded significantly high mean percent infectivity (86.7) compared to *S. feltiae* (76.7) and *H.indica* (68.3). Such a difference was not noticed in the case of internode borer.

Table 1. Infectivity of three species of entomopathogenic nematodes to healthy and GV infected shoot and internode borer larvae

Host	Larval status	Percent kill due to			
		S. feltiae	*S. glaseri*	*H. indica*	Mean
Shoot borer	Healthy	80.0 (63.4)	96.7 (83.7)	70.0 (57.0)	82.2 (68.1)
	GV infected	72.3 (59.2)	76.7 (61.9)	66.7 (55.4)	72.2 (58.8)
	Mean	76.7 (61.3)	86.7 (72.9)	68.3 (56.2)	
Internode borer	Healthy	70.0 (58.1)	90.0 (71.6)	90.0 (75.0)	83.3 (68.2)
	GV infected	70.0 (64.7)	73.3 (59.0)	86.7 (72.8)	76.7 (65.5)
	Mean	70.0 (61.4)	81.7 (65.3)	80.0 (66.7)	

Figures in parantheses are arcsine transformed values.

		SE±	CD (P=0.05)
Shoot borer	Larval status	3.06	NS
	Nematode species	3.75	11.55
	Larval status x Nematode	5.30	NS
Internode borer	Larval status	4.97	NS
	Nematode species	6.09	NS
	Larval status x Nematode	8.61	NS

Table 2. Multiplication of three species of entomopathogenic nematodes in healthy and GV infected shoot and internode borer lrvae

Host	Larval status	Percent kill due to			
		S. feltiae	*S. glaseri*	*H. indica*	Mean
Shoot borer	Healthy	372.5 (2.57)	82.9 (1.92)	324.4 (2.51)	259.9 (2.33)
	GV infected	298.4 (2.47)	52.0 (1.71)	267.1 (2.42)	205.8 (2.20)
	Mean	335.4 (2.52)	67.4 (1.81)	295.7 (2.47)	
Internode borer	Healthy	1325.1 (3.12)	166.6 (2.21)	1202.1 (3.08)	897.9 (2.80)
	GV infected	692.3 (2.83)	105.5 (2.02)	855.4 (2.93)	551.1 (2.59)
	Mean	1008.7 (2.98)	136.1 (2.11)	1028.7 (3.00)	

Figures in parantheses are log transformed values.

		SE±	CD (P=0.05)
Shoot borer	Larval status	0.02	0.05
	Nematode species	0.02	0.07
	Larval status x Nematode	0.03	NS
Internode borer	Larval status	0.03	0.08
	Nematode species	0.03	0.09
	Larval status x Nematode	0.04	NS

Significant difference was observed with regard to IJ multiplication per mg body weight between the diseased and healthy host larvae. The mean multiplication was significantly higher in healthy larvae of both shoot and internode borers (259.9 and 897.9 IJs, respectively) than diseased larvae (205.8 and 551.1 IJs, respectively) (Table 2). On shoot borer the multiplication rate of *S.feltiae* was significantly higher (335.4 IJs) and it was on par with the multiplication rate of *H.indica* (295.7 IJs). The least multiplication was recorded by *S.galseri* (67.4 IJs). On internode borer maximum multiplication rate was obtained in case of *H.indica* (1028.7 IJs) and it was on par with *S. feltiae* (1008.7 IJs). The least multiplication was recorded by *S. glaseri* (136.1 IJs).

Development and reproduction of *S. feltiae* in GV- infected armyworm, *Pseudaletia unipuncta* How. was reported by Kaya and Brayton (1978). Kaya (1985) reported that the entomopathogenic nematodes can also develop and reproduce in nuclear polyhedrosis virus (NPV) infected host larvae. However, the mean IJ multiplication per mg body weight was lower in GV- infected larvae. The reduction in IJ multiplication on diseased larvae may be attributed to the reduction in the availability of food material for the bacterial symbiont as the virus and the bacterium compete for the same nutrients in the diseased host larvae. According to Kaya and Brayton (1978), on the basis of body weight the healthy armyworms (which were lighter than the GV infected armyworms) produced significantly more juveniles per mg than the GV- infected host. In support of this conclusion, Sandner and Stanuszek (1971) found that dauer juvenile production of *S.feltiae* per mg of *Galleria* larvae and pupae was highest in the lightest hosts.

The GV - infected hosts did not inhibit the growth, development or reproduction of *S.feltiae*, *S.glaseri* and *H.indica*. The mean multiplication of

the three nematode species was higher on internode borer compared to shoot borer. Similar results were reported earlier by Razak (1989) and Karunakar *et al.* (1999). According to Kaya and Brayton (1978) addition of insect viruses to the nematode cultures may result in sufficient acquisition of the virus in the lumen of its intestine. Because entomopathogenic nematodes have a wide host range, it can be used in situations where there are two or more insect pests and where one of the pests is susceptible to the virus. Further studies are required in this direction to ascertain the possibility of using GVs against shoot and internode borers of sugarcane and entomopathogenic nematodes against white grubs.

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