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Research Paper

UTILIZATION OF ENTOMOPATHOGENIC NEMATODES AGAINST WHITE GRUB, *Holotrichia serrata* FAB. INFESTING SUGARCANE

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Abstract

Bioefficacy of different entomopathogenic nematodes were tested against second instar grubs of *H. serrate* Fab. infesting sugarcane under pot culture condition. Two EPNs *viz., Heterorhabditis indica* and *Steinernema carpocapsae* were tested for their pathogenicity against second instar grubs of *H. serrata* Fab. The results indicated that *H. indica* with 450 IJs ml^{-1} concentration proved most promising treatment against *H. serrata* recording 72.67 per cent grub mortality at 15 DAT. While, *S. carpocapsae* recorded 60.56 per cent grub mortality at 450 IJs ml^{-1} at 15 DAT.

Key words: White grub, *Holotrichia serrata*, Biological control, Pot culture, EPNs, *Heterorhabditis indica* and *Steinernema carpocapsae*.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important commercial crops of the tropical countries and is the main source of sugar for hundreds of years in the world. In India, sugarcane crop occupies about 5.31 million hectares area with production of 360.00 million tones and 67.80 tons/ha productivity of sugarcane during 2012-2013. In Maharashtra, it is important commercial crop occupying 937 hectares of area with production of 62175 tones and 66.4 tones/ha productivity during 2012-13.

More than 200 insect pests have been reported causing serious damage to sugarcane crop (David *et al.*, 1986). Among them white grub has became the most important polyphagous pest causing serious damage to sugarcane since 1960 (Mohalkar *et al*., 1977). Among the white grubs, *Holotrichia serrata* Fabricious has recently been reported to threat to sugarcane, paddy, soyabean and groundnut cultivation in the western Maharashtra especially in Kolhapur and Sangli districts. The pest causing extensive damage to the number of other crops like jawar, bajra, groundnut, vegetables (Mohalkar *et al.,* 1977).

Several tactics have been adopted for the management of white grubs including cultural, mechanical, biological, chemical and integrated methods suggested by various workers. Adult collection and insecticidal applications are the major tactics of management followed against all white grub species (Veeresh, 1974; Raodeo *et al*., 1976). The entomopathogenic nematodes are potential and most promising biological agents for the control of various insect pests of different crops, those are eco friendly and cost effective (Ali *et al.,* 2005). Entomopathogenic nematodes have been described from 23 nematode families (Koppenhofer, 2007). Of all of the nematodes studied for biological control of insects, the Steinernematidae and Heterorhabditidae have received more attention because they posses many of the attributes of effective biological control agents (Grewal *et al.,* 2005). Insect pests have been found susceptible

to the species of entomopathogenic nematodes (EPNs) of family Heterorhabditidae and Steinernematidae in India and abroad, resulting in their prospective role as biological agents (Kulkarni *et al.,* 2008). EPNs have been studied extensively for the control of white grubs (Klien, 1993). Karunakar *et al.,* (2000) reported that *Steinernema glaseri* and *Heterorhabditis indica* were effective against different instars of *H. serreta.*

MATERIAL AND METHODES

For conducting pot culture experiments uninterrupted supply of grubs was essential, hence field survey was conducted around Kolhapur region at different locations to collect grubs of *Holotrichia serrata..* In pot culture experiments *H. indica* and *S. carpocapsae* were evaluated against second instar larvae at dosage of 100, 250, 350, and 450 IJs ml^{-1} prepared by serial dilution.

Different entomopathogenic nematodes *viz., H.indica* strain NBAII-104 and *S. carpocapsae* strain NBAII-04, plastic vials (4 cm × 3.5 cm), conical flasks, petriplates, forceps, sugarcane settlings, FYM and earthen pots (15 cm × 20 cm).

In pot culture experiments *H. indica* and *S. carpocapsae* were evaluated against second instar larvae at dosage of 100, 250, 350, and 450 IJs ml^{-1} prepared by serial dilution. Soil and FYM were mixed at 2:1 proportion. Before the addition of nematode suspension, the FYM was solarized. For solarization, the FYM was moistened and then spread into a 10 cm thick layer, which was covered with a polythene sheet, all sides of the sheet were covered with soil to make it leak proof. The solarization was done for 3 weeks and the temperature was recorded daily using soil thermometer. Grubs were kept in FYM with sugarcane seedlings in earthen pots. The experiment was carried out in Completely Randomized Design with four replications and five treatments. Four treatments for each nematode were carried out whereas in the fifth treatment, the pot was treated as control. Ten grubs of uniform size were used for each treatment.

The grub mortality was recorded after the treatment at an interval of 5, 10 and 15 days after treatment. The exact time required to kill the test larva was strictly recorded. The cause of larval death was confirmed by body colour change of the cadaver which being evident due to the presence of symbiotic bacteria.

Data on per cent mortality were corrected by Abbott's formula (Abbott, 1925). Data on infected grubs in laboratory and pot culture experiments were subjected to arcsine transformations, these transformed data was subjected to analysis of variance.

RESULTS AND DISCUSSION:

The treatment of *H. indica* recorded 16.69 to 27.10 per cent, 28.62 to 44.95 per cent and 47.67 to 72.67 per cent mortality of second instar grubs at 5, 10 and 15 DAT, respectively (Table 1). The treatment of *S. carpocapsae* recorded 12.36 to 26.78 per cent, 24.38 to 39.90 per cent and 34.15 to 60.56 per cent mortality of second instar grubs at 5, 10 and 15 DAT, respectively (Table 2).

The results indicated that *H. indica* with 450 IJs ml^{-1} concentration proved most promising treatment against *H. serrata* recording 72.67 per cent grub mortality at 15 DAT. While, *S. carpocapsae* recorded 60.56 per cent grub mortality at 450 IJs ml^{-1} at 15 DAT.

The present findings are in conformity with the findings of Shelter *et al*., (1988), Ansari *et al.,* (2003), Chandel *et al.,* (2005), Glazer *et al.,* (2007) and Pillay *et al.,* (2009). The Present findings were on the line with that of Chandel *et al.,* (2005) who carried out pot culture experiment with *H. indica* against second instar grubs of *B. coriaceae* showing up to 100 per cent mortality.

In the pot trials, *H. megidis* and *S. glaseri* caused more than 18% mortality of *H. philanthus* larvae infesting potted perennial ryegrass 42 days after application of 2.5 to 7.5 billion nematodes/ha (Ansari *et al.,* 2003). Shelter *et al.,* (1988) reported 73 per cent control of Japanese beetle larvae with *H. bacteriophora* in turf grass compared with 55 per cent control by *S. carpocapsae.* Similarly, Glazer *et al*., (2007) also reported 70 to 90 per cent reduction in emergence of beetles by *Heterorhabditis* sp. at highest concentration (100 IJs ml^{-1}) under green house condition. Pillay *et al*., (2009) reported that 100 per cent mortality of sugarcane stalk

borer ,*Eldana saccharina* was achieved with isolates of *Heterorhabditis* sp. and *Steinernema* sp. within 48 hours in pot and also in field trials. Due to paucity of information the present results could not be compared.

This study can speculate about the factors responsible for interaction among two species of EPNs and white grub species, *H. serrata*. As a result of their co-evaluation with the entomopathogenic nematodes and other pathogens in soil, white grub developed a variety of defence mechanisms including infrequent Co_2 out put defence and evasine behavior, sieve plates over their spiracles, dense peritrophic membrane and a strong immune response. However, such defence mechanism found in few species of Scarabies further work on interaction of diherent strains of EPNs and white grub species will definitely help in its use in the development of EPNs formulations and will form a step in ecological management of white grub.

Table 1: Evaluation of *H. indica* against second instar grubs of *H. serrata* in pot culture experiment

Treatment No	Dose IJs ml^{-1}	per cent grub mortality DAT*		
		5DAT	10DAT	15DAT
T_1	100	16.69 (24.10)**	28.62 (32.33)	47.67 (43.66)
T_2	250	19.15 (25.91)	33.43 (35.31)	54.80 (47.76)
T_3	350	23.36 (28.88)	38.50 (38.34)	65.05 (53.77)
T_4	450	27.10 (31.34)	44.95 (42.09)	72.67 (58.49)
T5	Untreated Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE±	0.91	0.80	0.94
	CDat 5%	2.89	2.53	2.99

*Days after treatment
**Figures in parentheses are arcsin transformed values

Table 2: Evaluation of *S. carpocapsae* against second instar grubs of *H. serrata* in pot culture experiment

Treatment No	Dose IJs ml^{-1}	per cent grub mortality DAT*		
		5DAT	10DAT	15DAT
T_1	100	12.36 (20.56)**	24.38 (29.58)	34.15 (35.74)
T_2	250	15.90 (23.48)	29.55 (32.92)	43.71 (41.38)
T_3	350	19.16 (25.94)	32.90 (34.99)	51.69 (45.97)
T_4	450	26.78 (31.51)	39.90 (39.15)	60.56 (51.09)
T_5	Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE±	0.61	0.88	0.78
	CD at 5%	1.94	2.78	2.47

*DAT: Days after treatment
**Figures in parentheses are arcsin transformed values

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