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EFFICACY OF ENTOMOPATHOGENIC NEMATODES AGAINST THIRD INSTAR LARVA OF WHITE GRUB, PHYLLOGNATHUS DIONYSIUS FEB.

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ABSTRACT

Pot culture experiment was conducted for study the efficacy of entomopathogenic nematodes against white grub, Phyllognathus dionysius Fab. (Coleoptera: Scarabidae). In pot culture experiment two Entomopathogenic nematodes viz., Heterorhabditis indica and Steinernema carpocapsae were tested for their pathogenicity against third instar grubs of P. dionysius. The treatments H. indica @ 350 IJs ml^{-1} for third instar grubs was found most effective in controlling P. dionysius. The treatment of H. indica recorded 37.50 to 80.00 per cent mortality of third instar grubs at 45 DAT. While, S. carpocapsae recorded 24.06 to 52.50 per cent mortality of third instar grubs at 45 DAT in pot culture experiment. Among two entomopathogenic nematodes H. indica was found more effective than S. carpocapsae in pot culture conditions.

Keywords: *Phyllognathus dionysius*, *Heterorhabditis indica*, *Steinernema carpocapsae*, Entomopathogenic nematode.

INTRODUTION

Sugarcane 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, nearly 228 insect and non-insect pests have been reported on the crop. About 125 species of insects are known to infest the sugarcane as major pests in various part of the world (Patil *et al.,* 2004). Among them white grub has became the most important polyphagous pest causing serious damage to sugarcane. Many species of the white grubs are known pests of a number of crops in India (Balasimha and Rajagopal, 2003). They were recognized as the most serious pests on sugarcane, groundnut, cereals, millets, pulses, vegetables and on plantation crops like coconut, areca nut, coffee and rubber (David and Nandgopal, 1986).

Among the white grubs, *Phyllognathus dionysius* Fabricious has recently been reported as new pest and becoming threat to sugarcane, soybean and groundnut cultivation in the Western Maharashtra especially in Kolhapur and Sangli districts (Mohite, 2014). The species is abundant during June to August. The life cycle is annual (Bhawane *et al.,* 2012). Adult collection and insecticidal application is the major tactics of management followed against all white grub species but there is lot of limitations to use higher dose of insecticides as the fear of development of resistance.

Nematodes those parasites in insects, known as entomopathogenic nematodes, have been described from 23 nematode families. 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). Heterorhabditidae and Steinernematidae species 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. Among the two entomopathogenic nematodes, *S. glaseri* and *H. indica* tested on different instars of white grubs, (Karunakar *et al.* 2000).

MATERIALS AND METHODS

Insect culture: The grubs of *P. dionysius* of the third instar grub stage were collected from infested groundnut and soybean farmer field and from endemic pockets of Kolhapur district. Immediately after the collection of grubs, they were placed in sterile plastic vials (4 cm × 3.5 cm) with soil. Only one larva put into each vial and potato pieces and sugarcane roots which are disinfected for 10 min in 0.5 per cent sodium hypochloride solution were added to each vial as a diet and avoid cannibalism. The larval culture maintained at 25±2^{0}C and 65±5 per cent R.H. were used for pot culture experiments.

Nematode culture: Different entomopathogenic nematodes *viz., H. indica* and *S. carpocapsae* were brought from National Institute of Plant Health Management, (NIPHM) Hydrabad in sponge formulation.

Method of testing: *H. indica* and *S. carpocapsae* were evaluated against third instar grub at dosage of 150, 200, 250, 300, and 350 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. The solarization was done for 3 weeks and the temperature was recorded daily. Grubs kept in FYM with sugarcane seedlings in earthen pots. The experiment was carried out in Completely Randomized Design with four replications and six treatments. Ten grubs of uniform size were used for each treatment.

Observations: The grub mortality was recorded after the treatment with an interval of 7, 15, 30 and 45 days after treatment. The cause of larval death was confirmed by body colour change of the cadaver which being evident due to the presence of symbiotic bacteria.

Statistical analysis: Data on per cent mortality were corrected by Abbott's formula (Abbott, 1925) as follows. Data on infected grubs in pot culture experiments were subjected to arcsin transformations. These transformed data were subjected to analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Response of five different concentrations of *H. indica* and *S. carpocapsae viz.*, 150, 200, 250, 300 and 350 IJs ml^{-1} were tested against third instar grub of *P. dionysius*.

Efficacy of *Heterorhabditis indica*: The data recorded at 7 DAT revealed that the treatment with concentration 350 IJs ml^{-1} was found to be significantly superior over the other treatments and recorded 20.00 per cent grub mortality at 7 DAT. The treatment with concentration 350 IJs ml^{-1} was recorded highest (34.00 per cent) grub mortality at 15 DAT. The 65.00 per cent grub mortality was recorded in the treatment with concentration 350 IJs ml^{-1} when observations were recorded at 30 DAT. The treatment with concentration 350 IJs ml^{-1} recorded highest (80.00 per cent) grub mortality which was significantly superior over all other treatments in all days of observations. Thus, the treatment with concentration 350 IJs ml^{-1} proved to be consistently superior to other treatments at all the intervals of observations. The mortality was not observed in untreated control. The results presented in table and graph in Table 1 and Fig. 1 respectivly.

Efficacy of *Steinernema carpocapsae*: At 7 DAT, the mortality of grubs ranged from 7.50 to 20.00 per cent. The treatment with concentration 350 IJs ml^{-1} was found to be most effective over other treatments and recorded 20.00 per cent grub mortality at 7 DAT. The treatment with concentration 350 IJs ml^{-1} recorded 32.50 per cent mortality which was significantly superior over the rest of treatments at 15 DAT. The maximum grub mortality (51.65 per cent) was recorded in treatment with 350 IJs ml^{-1} when observations were recorded at 30 DAT, which was superior to the rest of the treatment under test. At 45 DAT, similar results were recorded. The treatment with concentration 350 IJs ml^{-1} recorded highest (52.00 per cent) grub mortality which was significantly superior over all other treatments and all other observations also. Thus, the treatment with concentration 350 IJs ml^{-1} proved to be consistently superior to other treatments at all the intervals of observations. The mortality was not observed in untreated control. The results presented in table and graph in Table 2 and Fig. 2 respectivly.

Studies conducted under pot culture experiment revealed that the treatment of *H. indica* @ 350 IJs ml^{-1} was found to the most effective in controlling third instar grub of *P. dionysius*. Treatment of *H. indica* recorded 37.50 to 80.00 per cent grub mortality at 45 DAT. While, *S. carpocapsae* recorded 24.06 to 52.50 per cent grub mortality. The results obtained in the present studies corroborate the finding of earlier workers. Entomopathogenic nematodes *H. megidis* and *S. glaseri* caused more than 18 per cent mortality of *Hoplia philanthus* larvae

infesting potted perennial ryegrass 42 days after application of 2.5 to 7.5 billion nematodes/ha in pot trials, (Ansari *et al.,* 2003).

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.

Erbas *et al.,* (2013) tested the efficacy of *H. bacteriophora strains*. 100 per cent mortality was obtained from the ZET09 and ZET35 isolates at a consontraions of 2000IJs/ml at 25^0C. The same isolates also provided 100 per cent mortality with 100 IJs in strabery planted experiments.

Treatment No	Dose IJs ml^{-1}	per cent grub mortality DAT*			
		7DAT	15DAT	30DAT	45DAT
T_1	150	7.50 (15.86)**	17.50 (24.71)	27.50 (31.62)	37.50 (37.75)
T_2	200	10.00 (18.39)	20.00 (26.55)	37.50 (37.75)	40.00 (39.23)
T_3	250	12.50 (20.64)	23.50 (28.98)	40.00 (39.21)	42.50 (40.68)
T_4	300	16.00 (23.57)	29.00 (32.52)	47.50 (43.56)	55.00 (47.87)
T_5	350	20.00 (26.55)	34.00 (35.67)	65.00 (53.75)	80.00 (63.44)
T_6	Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	$SE_{\pm}$	0.65	0.80	0.79	0.88
	CD at 5%	1.92	2.39	2.34	2.63

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

Table 1: Evaluation of *H. indica* against third instar grubs of *P. dionysius* in pot culture experiment.

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

Table 2: Evaluation of *S. carpocapsae* against third instar grubs of *P. dionysius* in pot culture experiment.

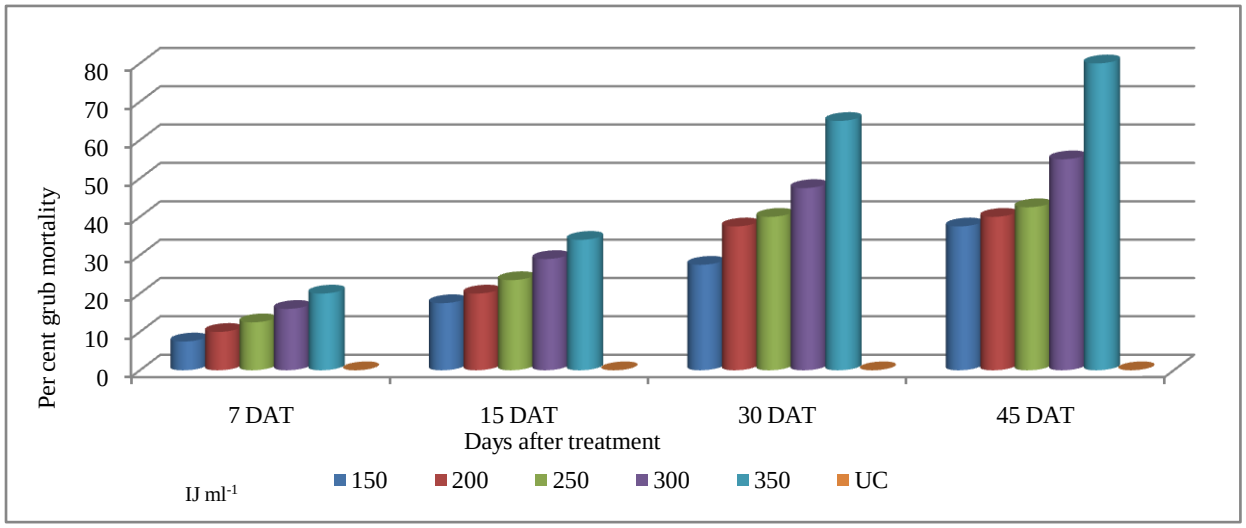

Fig. 1 Bioefficacy of *H. indica* against third instar grubs of *P. dionysius* in pot culture experiment.

Treatment No	Dose IJs ml^{-1}	per cent grub mortality DAT*			
		7DAT	15DAT	30DAT	45DAT
T_1	150	7.50 15.86)**	12.50 (20.45)	17.50 (24.72)	24.06 (29.36)
T_2	200	10.00 (18.39)	20.00 (26.55)	32.50 (34.75)	35.00 (36.26)
T_3	250	12.50 (20.64)	24.00 (29.32)	35.00 (36.27)	40.00 (39.22)
T_4	300	18.00 (25.09)	27.50 (31.62)	41.50 (40.10)	47.50 (43.57)
T_5	350	20.00 (26.55)	32.50 (34.75)	51.65 (45.95)	52.50 (46.44)
T_6	Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE±	0.64	0.97	0.44	0.74
	CD at 5%	1.91	2.87	1.30	2.19

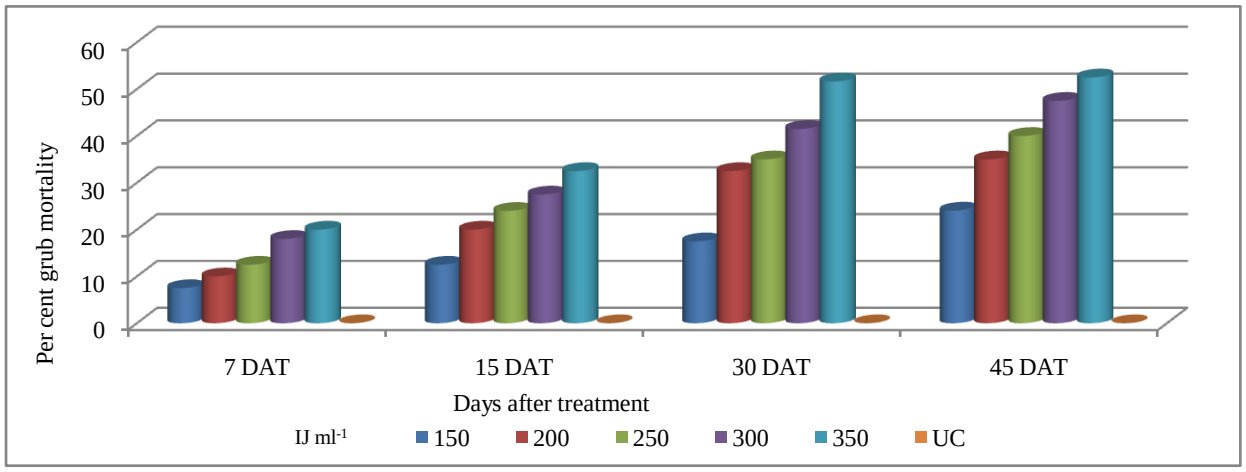

Fig. 2 Bioefficacy of *S. carpocapsae* against third instar grubs of *P. dionysius* in pot culture experiment.

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