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RESEARCH ARTICLE

UTILIZATION OF ENTOMOPATHOGENIC AGENTS IN THE MANAGEMENT OF DIAMOND BACK MOTH, *PLUTELLA XYOSTELLA* (L.) INFESTING CABBAGE

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ABSTRACT

The investigations were carried out to study the efficacy of entomopathogenic agents against third instar larvae of *Plutella xylostalla* (L.) under laboratory conditions. The experiment was laid out in a complete randomized block design with 9 treatments replicated three times. The treatments comprised of *M. anisopliae* @ 2g/L, *M. anisopliae* @ 4g/L, *M. anisopliae* @ 6g/L, *B. bassiana* @ 2g/L, *B. bassiana* @ 4g/L, *B. bassiana* @ 6g/L, *H. indica* @ 100 IJs/L, *S. carpocapsae* @100 IJs/L and untreated control. Among the various entomopathogenic agents tested for their efficacy against third instar larvae revealed that *B. bassiana* @ 6g/L was found to be most effective. The treatment with *M. anisopliae* @ 6g/L was next best treatment in order of their efficacy. Remaining treatments were equally effective. The per cent larval mortality recorded was 78.99 and 67.79 per cent against third instar larvae of *P. xylostella*.

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INTRODUCTION

India is one of the important cabbage growing country in Asia with an area of 369 thousand ha. and production of 7,949 thousand metric tonnes with a productivity of 21.5 metric tonnes per ha. India is the second leader in production of cabbage in the world followed by China. (Anonymous, 2011) Among the pest attacing the cabbage, diamondback moth, *Plutella xylostella* (L.) is the most destructive pest (Mahla *et al*., 2005, Kumar *et al*., 2007 and Vanlaldiki *et al.*, 2013) and is the limiting factor for the successful cultivation of cruciferous crops (Rai *et al*., 1992). Frequent use of chemical insecticides at higher doses results in depredation of natural enemies (Haseeb *et al*., 2004) and development of insecticide resistance in *P. xylostella* against a range of insecticides in different parts of India (Talekar *et al*., 1990, Vastrad *et al*., 2003 and Saenz, 2012). This has necessitated the use of entomopathogenic agents in the management of *Plutella xylostella*, which will be ecological safe and socially accepted. The exploration of active natural compounds to control insect pests, the monitoring technique was employed by selecting the biotypes of different microorganisms (Schulz *et al*., 2002). A promising alternative to conventional insecticides is the use of entomopathogenic agents for pest control.

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MATERIALS AND METHODS

Mass rearing of diamondback moth, *P. xylostella* (L.). For conducting various laboratory experiments uninterrupted supply of larvae was essential, hence the mass rearing of diamondback moth was carried out in the laboratory using mustard seedling and cabbage leaves. The method suggested by Liu and Sun (1984).

Larvicidal action was studied by feeding the treated cabbage leaves (leaf dip bioassay) to third instar larvae of diamondback moth with various concentrations of entomopathogenic agents as per method suggested by Kamin Alexander *et al.* (2012). The feeding of leaves treated with distilled water was considered as control . leaf disc of 7 cm diameter were cut from fully expanded cabbage leaves. The treated cabbage leaves were allowed to dry for half an hour under fan and then fed to desired instars of Diamondback moth for 24 hrs. Before releasing larvae on the treated leaves they were subjected to 6 hrs starvation. Thereafter, fresh untreated cabbage leaves were fed which were replenished every day. Each treatment consisting of 10 larvae replicated three times. observation on larval mortality during larval stages were recorded at interval of every 24 hrs, 48 hrs and 72 hrs after the treatment. From the data, per cent larval mortality was worked out.

RESULTS AND DISCUSSION

The data on efficacy of entomopathogenic fungi and nematode for the control of larvae *P. xylostella* are presented in the Table 1. Results revealed that the per cent larval mortality rate significantly increased with the increase in the time periods, being maximum at 72h with highest mean value, followed by 48h and then 24h, respectively. Per cent larval mortality of *P. xylostella* treated with all treatments was significantly more as compared to untreated control.

After 72 h of treatment there was again increase in per cent larval mortality in all treatments. The per cent larval mortality was ranged from 20.00 to 86.66 per cent. The treatment with *B. bassiana* @ 6g/L and *M. anisopliae* @ 6g/L recorded 86.66 per cent and 83.33 per cent larval mortality, respectively. Which were on par with each other. The treatment with *B. bassiana* @ 4g/L (73.33 per cent) and *M. anisopliae* @ 4g/L (56.66 per cent) were next in order of efficacy.

Table 1. Efficacy of Entomopathogenic fungi and nematode under laboratory condition

Sr. No	Treatments	Dose g/L	Total no. of larvae/plate	Percent larval mortality under lab condition			Mean
				24 hrs	48 hrs	72 hrs	
1	*M. anisopliae*	2g	10	16.66 *(19.92)	20.16 (26.56)	36.66 (37.22)	24.49 (27.90)
2	*M. anisopliae*	4g	10	23.33 (28.07)	43.33 (41.15)	56.66 (48.84)	41.10 (39.35)
3	*M. anisopliae*	6g	10	50.00 (45.00)	70.06 (56.99)	83.33 (66.14)	67.79 (56.04)
4	*B. bassiana*	2g	10	20.06 (26.07)	26.66 (30.99)	46.66 (43.07)	31.12 (33.37)
5	*B. bassiana*	4g	10	36.66 (37.14)	56.66 (48.84)	73.33 (59.01)	55.55 (48.33)
6	*B. bassiana*	6g	10	70.12 (56.99)	80.20 (63.93)	86.66 (68.85)	78.99 (63.25)
7	*H. indica*	100 IJs	10	6.66 (12.29)	10.18 (18.43)	20.00 (30.99)	12.28 (20.57)
8	*S. carpocapsae*	100 IJs	10	13.33 (21.14)	16.66 (30.78)	26.66 (33.21)	18.88 (28.37)
9	Untreated control		10	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE ±			4.25	1.93	1.95	
	CD at 5 %			12.75	5.81	5.85	

* Figures in parenthesis are arcsine transformed.

All the entomopathogenic agents found to be significantly superior over untreated control when observations were recorded 24 h after the treatment. The highest per cent larval mortality was recorded in treatment with *B. bassiana* @ 6g/L were 70.12 per cent larval mortality was recorded which was followed by *M. anisopliae* @ 6g/L (50.00 per cent) and *B. bassiana* @ 4g/L (36.66 per cent). The next best treatments in order of their efficacies were *M. anisopliae* @ 4g/L (23.33 per cent), *B. bassiana* @ 2g/L (20.06 per cent), *M. anisopliae* @ 2g/L (16.66 per cent), *S. carpocapsae* @ 100 IJs/L (13.33 per cent) and *H. indica* @ 100 IJs/L (6.66 per cent). There was no larval mortality observed in untreated control.

After 48 h of the treatment there was increase in per cent larval mortality in all treatments and ranged from 10.18 to 80.20 per cent. After 48h of treatment the treatment *B. bassiana* @ 6g/L (80.20 per cent) recorded highest larval mortality of 3rd instarss diamondback moth larvae and found to be most superior treatment. The treatment with *M. anisopliae* @ 6g/L (70.06 per cent) was next effective treatment in order of efficacy. The treatment with *B. bassiana* @ 4g/L recorded 56.66 per cent larval mortality followed by *M. anisopliae* @ 4g/L (43.33 per cent), *B. bassiana* @ 2g/L (26.66 per cent), *M. anisopliae* @ 2g/L (20.16 per cent), *S. carpocapsae* @ 100 IJs/L (16.66 per cent) and *H. indica* @ 100 IJs/L (10.18 per cent). There was no larval mortality observed in untreated plates.

The treatment with *B. bassiana* @ 2g/L (46.66 per cent), *M. anisopliae* @ 2g/L (36.66 per cent), *S. carpocapsae* @ 100 IJs/ml (26.66 per cent) and *H. indica* @ 100 IJs/L (20.00 per cent) were moderately effective in order of their efficacy their was no significant differences exist among remaining treatments.

Thus overall results on efficacy indicated that treatment with *B. bassiana* @ 6g/L (78.99 per cent) was found to be superior as compared to other treatments. However, treatment with *M. anisopliae* @ 6g/L was found to be next effective treatment in order of efficacy. Hence, the results of present study corroborate the finding of Yoon *et al*. (1999) who reported that *B. bassiana* causing larval net mortality of 86.2 and 66.5 per cent under laboratory and net house condition respectively. Similar results were also reported by Fuentes and Carballo (1995). The data revealed that mortality rate increases with the increase in time interval *viz*., 24, 48 and 72h. These results are in agreement with Shivankar and Rao (2003) who reported that mortality rate increased with increase in time period.

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