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BIO EFFICACY OF ENTOMOPATHOGENIC FUNGUS *BEAUVERIA BASSIANA* AND CERTAIN INDIGENOUS PRODUCTS AGAINST *PLUTELLA XYLOSTELLA* (LINN) INFESTING CABBAGE

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ABSTRACT
Studies were conducted to know the comparative bio-efficacy of Entompathogenic fungus *Beauveria bassiana* and certain indigenous products against the larvae of diamond back moth, *Plutella xylostella* (Linn) on Cabbage (Brassica Oleracea). A lab trial was conducted during the 2008-2010 at Allahabad Agriculture Institute Deemed University. All the treatments were found significantly superior over control. Among the treatments the highest larval mortality of 100% with the treatment Ts (DDVP O.05%) and the minimum larval mortality of 21.429% was recorded with the treatment (NL+CBM 4%). The extent of mortality of *Plutella xylostella* (Linn) appeared to be affected by the number of conidia striking on the insect body. Each episode of treatment was replicated three times and percent net mortality of different larval instar (1st, 3rd, 5th) was recorded after the interval of 24, 48 and 72h, percent net mortality at 72h was recorded highest over 48 and 24h and at the same time mortality in 1st instar was found more in comparison to 3rd and 5th instar larvae.

INTRODUCTION

Cabbage (Brassica oleracea Var. Capitata) is one of the most important cruciferous vegetable grown all over the country with 0.27 million hector areas and 5.9 million tones production. India is next to China in cabbage production (Chaddha *et al.,* 2001). It covers about 4% of total area under vegetables in India. Among the pest complex of cabbage, diamond back moth (DBM) *Plutella Xylostella* (Linn) is the most destructive and dreaded pest. Kumar *et al.,* 1983. reported 63 percent loss in marketable yield of cabbage due to attack of *Plutella Xylostella*. Indigenous products Viz. Neem products are not only effective against the crop pest but also ecologically safe and free from residual problems. Neem oil 1% water extract of neem leaves 40% and neem kernel extract 2% have been found effective against bridjly in linseed Gupta *et al.,* 2000) and so, attention is now being focused on the use of *biopesticides Beauveria bassiana* Constituting on the important component to supplement or as on alternate to synthetic chemicals. Keeping these facts in view, present study was conducted to evaluate the efficacy of Indigenous products and Entomopathogenic fungus *Beauveria bassiana* against *Plutella Xylostella* under laboratory condition.

MATERIALS AND METHODS

The trial was carried out for the management of *Plutella Xylostella* at the Department of plant protection Allahabad Agriculture Deemed University for determining the efficacy of different treatments against the 1st instar, 3rd instar and 5th instar larvae. The larvae of the test insect were collected from infested cabbage field of Allahabad Agriculture Deemed University. To maintain laboratory culture, larvae collected from field were confided to glass jars with filter paper on the bottom, mouth closed with muslin cloth. They were provided with fresh cabbage leaves as food and reared until adult emerges. Adult moths were fed with 10% honey solution by cotton swab soaked inside the jar and fortified with multivitamin and were allowed to lay eggs on cabbage leaves. The weather conditions recorded in the laboratory were, maximum temperature 22ºC to 32ºC and minimum temperature 8ºC to

List of treatments used in the experiment

	Treatments
T_1	*Beauveria bassiana* 4 %
T_2	*Beauveria bassiana* 8 %
T_3	Neem Leaf + Cow Butter Milk 4 %
T_4	Neem Leaf + Buffalo Butter Milk 4 %
T_5	Neem Leaf + cow urine 4 %
T_6	Neem Leaf + Buffalo urine 4 %
T_7	Neem Seed Kernel Extract + Cow Butter Milk 4 %
T_8	DDVP 0.05 %
T_9	DDVP 0.025% + *Beauveria bassiana* 2 %
T_{10}	DDVP 0.025% + *Beauveria bassiana* 4%
T_{11}	DDVP 0.025%+ Neem Leaf + Cow Butter Milk 2 %
T_{12}	DDVP 0.025% + Neem Leaf + Buffalo Butter Milk 2%
T_{13}	DDVP 0.025% + Neem Leaf + cow urine 2%
T_{14}	DDVP 0.025% + Neem Leaf + Buffalo urine 2%
T_{15}	DDVP 0.025% + Neem Seed Kernel Extract + Cow Butter Milk 2%
T_0	Distilled water

15ºC and relative humidity 69% to 75%. Total 15 oral feeding treatments including control were given at different intervals (24, 48 and 72h). A group of 10 larvae in each treatment were taken and this was replicated three times. A parallel-untreated control was also run for each replicate.

Statistical analysis: The percent mortality and percent net mortality caused by different treatments on different instars in the three methods was calculated by using Abborts (1925) formula:

$$\text{Percent mortality} = \frac{\text{Mortality in test}}{\text{Mortality in control}} \times 100$$

$$\text{Percent net mortality} = \frac{\text{Percent mortality in test - percent mortality in control}}{\text{100-Percent mortality in control}} \times 100$$

For comparing the effects of instars, time periods and treatments all together, three-way analysis of variance technique (Gomez and Gomez, 1984) was used.

RESULTS AND DISCUSSION

The data on Bio-efficacy of Indigenous product applied in combination with insecticide in the control of larvae *Plutella Xylostella* are presented in the Table 1, 2, 3 and 4.

Result from Table 4 revealed that there was significant of instars on the larval mortality. The trend of the mortality was continuously in decreasing order as the age of larval stage increases. The percent net mortality in 1st instar larvae and 3rd instar larvae were significantly more as compared to 5th instar larvae. It was observed that the 1st instar larvae showed highest mortality followed by 3rd instar then 5th instar respectively. It was also found that the percent net 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.

Percent Net Mortality of *Plutella xylostella* treated with all treatments was significantly more as compared to T_0 (control). The results presented in the Table 4. Revealed that all the treatments showed significant effect on the larval percent net mortality, the treatment T8 (0.5% DDVP) gave 90 to 100 per cent larval net mortality, followed by the treatment T_2, treatment T_2 showed maximum larval net mortality, followed by the treatment T_1. Among the indigenous products, the treatment T_7 (NSKE + CBM4%) showed maximum larval percent net mortality followed by the treatment T_4 (NL + BU 4%), respectively. Among the treatments the T_{10} was found to be most effective and gave larval net mortality, followed by the treatment T_9 and T_{15} respectively. The effect of *Beauveria bassiana* was found to be superior over control and average net mortality of 70 to 100% was recorded when the larvae treated with *Beauveria bassiana*. There was significant effect showed in 4% and 8% of *Beauveria bassiana*.

The result of the present study corroborate the finding of Yoon (1999) while evaluating *Beauveria bassiana* against *Plutella xylostella* observed larval net mortality of 86.2 and 66.5 per cent under laboratory and net house condition respectively. Also similar studies conducted by Fuentes and Carballo (1995). This finding is in conformity with the finding of ferron (1981) who found the *Beauveria bassiana* to give adequate pest control. Similar findings were observed by Leite *et al.* (1988); Gascia *et al.* (1990) Fernandes and Alves (1992) found a mortality rate of 100 per cent was observed at 48h after application in the laboratory. The data on bioefficacy of *Beauveria bassiana* applied in combination with chemical insecticide (DDVP 0.025%) in the control of *Plutella xylostella*. Under laboratory condition it is expected to enhance effectiveness through joint action of *Beauveria bassiana* and chemical insecticide, which reduce the larval population. These observation are in agreements with the findings of Anderson and Robertson (1989) studied that combinations of *Beauveria bassiana* and insecticide were assessed for

Table 1: Percent net mortality of 1st instar larvae of *Plutella xylostella* when treated by oral feeding method for the different time period of 24 h, 48 h and 72 h

Treatments		24 h	48 h	72 h	Mean
T_1	*Beauveria bassiana* 4%	92.857	96.429	96.429	95.238
T_2	*Beauveria bassiana* 8%	96.429	100.000	100.000	98.810
T_3	Neem Leaf + CU 4%	39.286	39.286	53.571	44.048
T_4	Neem Leaf + BU 4%	39.286	39.286	53.571	44.048
T_5	Neem Leaf + CBM 4%	32.143	35.714	46.429	38.095
T_6	Neem Leaf + BBM 4%	32.143	39.286	46.429	39.286
T_7	NSKE + CBM 4%	46.429	50.000	57.143	51.191
T_8	DDVP 0.05%	100.000	100.000	100.000	100.000
T_9	DDVP 0.025% + *Beauveria bassiana* 2%	75.000	78.571	78.571	77.381
T_{10}	DDVP 0.025% + *Beauveria bassiana* 4%	78.571	82.143	82.143	80.952
T_{11}	DDVP 0.025% + Neem Leaf + CBM 2%	46.429	53.571	57.143	52.381
T_{12}	DDVP 0.025% + Neem Leaf + BBM 2%	50.000	53.571	57.143	53.571
T_{13}	DDVP 0.025% + Neem Leaf + CU 2%	53.571	57.143	60.714	57.143
T_{14}	DDVP 0.025% + Neem Leaf + BU 2%	53.571	60.714	64.286	59.524
T_{15}	DDVP 0.025% + NSKE + CBM 2%	67.857	71.429	71.429	70.238
T_0	Control	0.000	0.000	0.000	00.00
Mean	56.47	59.82	64.06		

Comparisons	S. Ed.	C.D. at 5%
Hours	0.652	1.331
Treatments	1.506	3.075

Table 2: Percent net mortality of 3rd instar larvae of *Plutella xylostella* when treated by oral feeding method for the different time period of 24 h, 48 h and 72 h

Treatments		24 h	48 h	72 h	Mean
T_1	*Beauveria bassiana* 4%	89.286	89.286	92.857	90.476
T_2	*Beauveria bassiana* 8%	92.857	92.857	96.429	94.048
T_3	Neem Leaf + CU 4%	35.714	35.714	42.857	38.095
T_4	Neem Leaf + BU 4%	35.714	35.714	46.429	39.286
T_5	Neem Leaf + CBM 4%	32.143	28.571	46.429	35.714
T_6	Neem Leaf + BBM 4%	35.714	28.571	42.857	35.714
T_7	NSKE + CBM 4%	46.429	39.286	50.000	45.238
T_8	DDVP 0.05%	39.286	100.000	100.000	79.762
T_9	DDVP 0.025% + *Beauveria bassiana* 2%	75.000	71.429	75.000	73.810
T_{10}	DDVP 0.025% + *Beauveria bassiana* 4%	78.571	75.000	78.571	77.381
T_{11}	DDVP 0.025% + Neem Leaf + CBM 2%	50.000	42.857	53.571	48.809
T_{12}	DDVP 0.025% + Neem Leaf + BBM 2%	50.000	46.429	53.571	50.000
T_{13}	DDVP 0.025% + Neem Leaf + CU 2%	53.571	50.000	60.714	54.762
T_{14}	DDVP 0.025% + Neem Leaf + BU 2%	57.143	50.000	60.714	55.952
T_{15}	DDVP 0.025% + NSKE + CBM 2%	64.286	64.286	67.857	65.476
T_0	Control	0.000	0.000	0.000	0.000
Mean	52.23	53.13	60.49		

Comparisons	S.Ed.	C.D. at 5%
Hours	1.862	3.803
Treatments	4.301	8.783

compatibility and efficacy for the control of CPB. Similar finding were observed by Oliveira *et al*. (2003); Phadtore *et al*. (2004) and Prabhu *et al*. (2007)

Further the chemical insecticide dichlorous (0.05% DDVP) recorded highest net mortality 70 to 100% on all the larval instars. Gupta *et al*. (2000) also reported the effective toxicity of dichlorous against *Nephotellix* sp. This finding is in the present findings are in accordance with Sadaworte and Sarode (1997) who reported that Sole application of cow urine was found ineffective against *H. Armigera* conformity with the finding of Min Ling *et al*. (1999).

Later it was found that among the indigenous products, NSKE + CBM 4% showed 30 to 60% mortality on all the larval instars. On the other hand it was found that their efficacy was enhanced when they were combined with half dose of chemical insecticide (0.025% DDVP) showed tremendous increase in the rate of larval mortality on all the larval instars viz 1st 3rd and 5th. Toxicity of indigenous products and their combination with half dose of chemical insecticide (0.025%) is also supported by the reports of Das, 1998. Singh, 2003 and Shukla *et al.,* 2003 Kumar *et al.,* 2004, respectively.

Considering all the aspects *i.e.* Different time periods, different treatments and different instars it was noted that percent net mortality 100 per cent was recorded in case of 1st instar when treated with 0.05% DDVP for the period of 72h.

Now if I take the method oral feeding and considering all three instars *i.e.* 1st, 3rd, and 5th. It was noted that the maximum percent net mortality was (60.11) seen in case of 1st instar larvae of *Plutella xylostella* and minimum percent net mortality (54.39) was recorded in case of 5th instar.

Table 3: Percent net mortality of 5th instar larvae of *Plutella xylostella* when treated by oral feeding method for the different time period of 24 h, 48 h and 72 h

Treatments		24 h	48 h	72 h	Mean
T_1	*Beauveria bassiana* 4%	85.714	85.714	92.857	88.095
T_2	*Beauveria bassiana* 8%	89.286	92.857	96.429	92.857
T_3	Neem Leaf + CU 4%	28.571	32.143	42.857	34.524
T_4	Neem Leaf + BU 4%	35.714	35.714	46.429	39.286
T_5	Neem Leaf + CBM 4%	21.429	28.571	42.857	30.952
T_6	Neem Leaf + BBM 4%	25.000	28.571	42.857	32.143
T_7	NSKE + CBM 4%	35.714	42.857	50.000	42.857
T_8	DDVP 0.05%	96.429	100.000	100.000	98.810
T_9	DDVP 0.025% + *Beauveria bassiana* 2%	71.429	71.429	75.000	72.619
T_{10}	DDVP 0.025% + *Beauveria bassiana* 4%	75.000	75.000	75.000	75.000
T_{11}	DDVP 0.025% + Neem Leaf + CBM 2%	39.286	50.000	50.000	46.429
T_{12}	DDVP 0.025% + Neem Leaf + BBM 2%	46.429	50.000	53.571	50.000
T_{13}	DDVP 0.025% + Neem Leaf + CU 2%	42.857	50.000	57.143	50.000
T_{14}	DDVP 0.025% + Neem Leaf + BU 2%	46.429	53.571	60.714	53.571
T_{15}	DDVP 0.025% + NSKE + CBM 2%	60.714	60.714	67.857	63.095
T_0	Control	0.000	0.000	0.000	0.000
	Mean	50.00	53.57	59.60	

Comparisons	S.Ed.	C.D. at 5%
Hours	0.716	1.463
Treatments	1.654	3.378

Table 4: Percent net mortality of 1st, 3rd and 5th instar larvae of when *plutella xylostella* treated by oral feeding method for the different time period of 24 h, 48h and 72 h

Treatments	1st Instars			3rd Instars			5th instars			Overall
	24 h	48 h	72 h	24 h	48 h	72 h	24 h	48 h	72 h	mean
T_1	92.857	96.429	96.429	78.571	85.714	89.286	85.714	85.714	92.857	89.286
T_2	96.429	100.000	100.000	85.714	89.286	96.429	89.286	92.857	96.429	94.048
T_3	39.286	39.286	53.571	32.143	35.714	39.286	28.571	32.143	42.857	38.095
T_4	39.286	39.286	53.571	35.714	35.714	42.857	35.714	35.714	46.429	40.476
T_5	32.143	35.714	46.429	28.571	32.143	32.143	21.429	28.571	42.857	33.333
T_6	32.143	39.286	46.429	28.571	32.143	35.714	25.000	28.571	42.857	34.524
T_7	46.429	50.000	57.143	39.286	35.714	39.286	35.714	42.857	50.000	44.048
T_8	100.000	100.000	100.000	85.714	89.286	96.429	96.429	100.000	100.000	96.429
T_9	75.000	78.571	78.571	64.286	71.429	71.429	71.429	71.429	75.000	73.016
T_{10}	78.571	82.143	82.143	71.429	75.000	82.143	75.000	75.000	75.000	77.381
T_{11}	46.429	53.571	57.143	39.286	42.857	46.429	39.286	50.000	50.000	47.222
T_{12}	50.000	53.571	57.143	42.857	46.429	46.429	46.429	50.000	53.571	49.603
T_{13}	53.571	57.143	60.714	46.429	53.571	50.000	42.857	50.000	57.143	52.381
T_{14}	53.571	60.714	64.286	46.429	57.143	57.143	46.429	53.571	60.714	55.556
T_{15}	67.857	71.429	71.429	57.143	57.143	64.286	60.714	60.714	67.857	64.286
T_0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Overall Mean		60.11			55.28		54.39			

Comparisons	S.Ed.	C.D. at 5%	Overall mean
Instars	1.177	2.318	24 h 52.90
Hours	1.177	2.318	48 h 55.51
Treatments	2.718	5.354	72 h 61.38

Likewise when I considered all three periods *i.e.* 24 h. 48h and 72h, but the maximum percent net mortality was (61.38) was recorded in case of 72h, when treated with different treatment, but minimum percent net mortality was (52.90) was recorded in case of 24h, when treated with different treatments.

The data revealed that mortality rate increases with the increase in time interval viz., 24, 48 and 72h. The findings are supported by Shivankar and Rao (2003), Barapatra and Lingappa (2003) who reported that mortality rate increased with increase in time period.

With present study, this has become evident that the efficacy of none of the indigenous products was comparable with the chemical insecticides and in combination with different cone. of *Beauveria bassiana*. Results also revealed that the efficacy of indigenous products could be enhanced up to certain extent if combined with half dose of chemical insecticide with however caused less net mortality as compared to chemical insecticide combined with however caused less net mortality as compared to chemical insecticide combined with *Beauveria bassiana*. Present studies revealed that entomopathogenic fungus *Beauveria bassiana* and chemical insecticides is an effective treatment method against *Plutella xylostella* and can be exploited as an effective component in integrated pest management.

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