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JOINT ACTION OF MICROBIAL AND CHEMICAL INSECTICIDES ON *SPODOPTERA LITURA* (FAB.) (LEPIDOPTERA: NOCTUIDAE)

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Abstract: The evaluation of treatments in the control of *Spodoptera litura* (Fab.) on groundnut under glass-house conditions revealed that combinations of microbial pesticides (nuclear polyhedrosis virus @ 1 x 10^7 PIBs ml^{-1}, *Bacillus thuringiensis* subsp. *kurstaki* @ 1 x 10 spores ml^{-1} and *Beauveria bassiana* @ 1 x 10^7 spores ml^{-1}) along with chemical insecticides (fenvelerate @ 0.005% and monocrotophos @ 0.025% i.e., half of the recommended dose) and microbial pesticides themselves were superior to either microbial pesticides or recommended rates of individual chemical insecticides alone. *B. thuringiensis* 1 x 10^7 spores ml + fenvelerate 0.005 per cent was proved as the best in respect of highest larval population reduction and lowest leaf damage (20.15 per cent). The highest pod yield (15.03 g $pant^{-1}$) was recorded with the same treatment *(B. thuringiensis* 1 x 10^7 spores ml^{-1} + fenvelerate 0.005 per cent).

Key words: *Bacillus thuringiensis, Beauveria bassiana,* NPV, *Spodoptera litura*

INTRODUCTION

Tobacco caterpiller, *Spodoptera litura* (Fabricius), is one of the important polyphagous crop pests distributed throughout south and eastern world tropics infesting 112 species of plants belonging to 44 families, of which 40 species are known from India (Chari and Patel, 1983). The stock of *S. litura* from Andhra Pradesh seems to have developed resistance to some of the common insecticides like carbaryl, endosulfan and monocrotophos (Ramakrishnan *et al.,* 1983). Under these circumstances utilization of natural pathogens such as nuclear polyhedrosis virus (NPV), *Bacillus thuringiensis* Berliner and *Beauveria bassiana* (Balsamo) Vuille may prove worthy for control of tobacco caterpillar and no detailed studies have been made so far to find out the scope of utilizing them in integrated pest management (IPM) strategies. Jaques (1988) reported that the efficacy of biological component of mixtures *(B. thuringiensis* and viruses) was frequently enhanced by low concentrations of chemical components in the mixtures. Hence, in the present study, the comparative efficacy of microbial pesticides either alone or in combination with insecticides was investigated in pot culture experiment.

MATERIALS AND METHODS

The NPV inoculum obtained from the Department of Entomology, S.V. Agricultural College, Tirupathi was multiplied by feeding third and fourth instar larvae of *S. litura* with virus contaminated groundnut leaves. The purified, concentrated suspension of polyhedra isolated from the dead, diseased larvae of *S. litura* was used as infective material as described by Backwad and Pawar (1981).

'Dipel' a wettable powder formulation of *B. thuringiensis* subsp *kurstaki* obtained from Lupin Laboratories Limited, Bombay was multiplied by feeding bacteria contaminated groundnut leaves to third and fourth instar larvae of *S. litura.* The bacteria were isolated from the diseased *S. litura* larvae and pure culture was prepared from it as described by Kiraly *et al.* (1974a). Ten ml of distilled water was added to each agar slant and growth was harvested. The bacterial suspension so obtained was used as stock suspension.

The fungus inoculum obtained from the white muscardine silkworm cadavars from the Department of Sericulture, University of Agricultural Sciences, GKVK, Bangalore was isolated and multiplied as per Kiraly *et al.* (1974b). Then spores were transferred in to a conical flask containing sterile distilled water and thoroughly shaken for 10 min. The suspension was strained through double layer sterile cheese-cloth and the filtrate is used as stock suspension. A standard haemocytometer (Neubaur's improved double ruling, Germany) was used for counting the polyhedra and spores of *B. thuringiensis* and *B. bassiana* under a phase contrast microscope.

The trial was conducted as pot culture experiment, with JL-24 groundnut variety in randomized block design with 15 treatments including the control. Each treatment contained one plant per pot and replicated thrice. The NPV, *B. thuringiensis* and *B. bassiana*

Table 1: Efficacy of microbial pesticides along with chemical insecticides on larval mortality, leaf damage by S. *litura* and pod yield

Treatments	Larval mortality at 28 DAS, %	Leaf damage at 28 DAS, %	Pod yield (g plant^{-1})
1 NPV alone	66.67 (54.99)	30.71 (33.65)	8.50
2 *B. thuringiensis* alone	80.00 (63.43)	23.33 (28.83)	11.00
3 5. *bassiana* alone	46.67 (43.08)	52.86 (46.61)	5.83
4 Fenvelerate alone (0.01%)	76.67 (61.22)	15.23 (22.90)	11.83
5 Monocrotophos alone (0.05%)	60.00 (50.77)	17.14 (24.38)	10.27
6 NPV + *B. thuringiensis*	90.00 (71.57)	22.85 (28.52)	9.17
1 NPV + *B. bassiana*	70.00 (57.00)	35.95 (36.81)	6.27
8 *B. thuringiensis* + *B. bassiana*	80.00 (63.43)	28.57 (32.27)	7.33
9 NPV + fenvelerate (0.005%)	83.33 (66.14)	27.86 (31.82)	8.43
10 *B. thuringiensis* + fenvelerate (0.005%)	100.00 (89.90)	11.90 (20.15)	15.03
11 *B. bassiana* + fenvelerate (0.005%)	73.33 (59.60)	24.76 (29.77)	7.03
12 NPV + monocrotophos (0.025%)	80.00 (63.93)	20.52 (26.68)	9.53
13 *B. thuringiensis* + monocrotophos (0.025%)	83.33 (66.40)	16.47 (23.91)	12.47
14 *B. bassiana* + monocrotophos (0.025%)	76.67 (61.22)	34.28 (35.79)	6.57
15 Control	0.00 (0.02)	77.86 (61.89)	5.50
SEM	1.10	0.932	0.367
CD (0.05)	3.05	2.701	1.062

DAS = Days after spraying; All treatments of NPV, *B. thuringiensis* and *B. bassiana* carried 1 x 10^7 PIBs ml^{-1}, 1 x 10^7 spores ml^{-1} and 1 x 10^7 spores ml^{-1} respectively. Figures in parentheses are angular transformed values.

suspensions were applied with 0.1 per cent teepol and single spray was given during evening hours. Soon after treatments were applied, second instar larvae from laboratory culture were released on the plants at the rate of 5 per potted plant. After releasing the larvae, each pot was covered with polythene bag to prevent migration of larvae. Small holes were made on the polythene bags to prevent suffocation. The per cent leaf damage was assessed by counting the total number of leaves and damaged leaves in each pot at 28 days after spraying. To assess the efficacy of different treatments, the larval mortality and the total yield in individual treatments were recorded separately.

RESULTS AND DISCUSSION

The data on efficacy of microbial pesticides applied in combination with chemical pesti-. cides in the control of *S. litura* larvae are presented in Table 1. In the present study, the treatment of *B. thuringiensis* 1 x 10^7 spores ml^{-1} + fenvelerate 0.005 per cent was found to be superior in reducing larval population followed by NPV 1 x 10' PIBS ml^{-1} + *B. thuringiensis* 1 x 10^7 spores ml^{-1} which was recorded as the second best among all treatments. Salama *et al.* (1984) also found the potentiated activity of *B. thuringiensis* when applied along with fenvelerate and organophosphorus compounds against *S. littoralis*. Similar finding was reported by Justin *et al.* (1989) in the case of *S. litura*. Among all treatments, *B. bassiana* 1 x 10^7 spores ml^{-1} alone recorded least population reduction and found to be inferior in reducing the larval populations. This finding is in conformity with the findings of Ferron (1981) who found the failure of *B. bassiana* to give adequate pest control especially under field conditions. In the present investigation, the combination of microbial pesticides themselves resulted in enhanced effect than when applied individually. Similar findings were observed by Komalpith and Ramakrishnan (1978) who found that combination of NPV + *B. thuringiensis* resulted in sub-additive effect against *S. litura*.

Of all treatments, *B. thuringiensis* 1 x 10^7 spores ml^{-1} + fenvelerate 0.005 per cent recorded lowest pod yield (5.50 g plnat^{-1}) in the control (Table 1). These observations are in agreement with the findings of Iman *et al.* (1986) who observed application of *B. thuringiensis* alone or in combination with fenvelerate against *Plutella xylostella* L. resulted in significantly higher yields than when the pyrethroids were applied alone. Karel and Schoonhoven (1986) found combined application of lindane or carbaryl with *B. thuringiensis* against larvae of pod borers, *Maruca testulalis* (Geyer) and *Heliothis armigera* Hubner gave high dry seed yield in bean plants. Luo *et al.* (1986) also reported that a small amount of fenvelerate along with *B. thuringiensis* resulted in increased lint yield in cotton when used against *Pectinophora gossypiella* Saunders.

For above two parameters measured, the bacterial treatments in combination with chemical insecticides gave excellent protection against 5. *litura* damage. Apart from controlling the 5. *litura*, the yield increase recorded was remarkable. Leaf damage caused at a more rapid rate and the yield was drastically reduced in the untreated plants.

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