JBiopest 6(2):144-148

Evaluation of microbial pesticides against major foliage feeders on soybean [*Glycine max* (L.) Merrill]

K. C. Ahirwar*, R. S. Marabi, A. K. Bhowmick and S.B. Das

ABSTRACT

Field trial was conducted during *Kharif* season with six microbial treatments against foliage feeders of soybean crop. On the basis of overall mean the differences in larval population of *Chrysideixis acuta* among different treatments were found significant over control. Among these treatments, *Bacillus thuringiensis* var. *kurstaki* (4.26 larvae/mrl) was found to be most effective followed by *Beauveria bassiana* (5.06 larvae/mrl), *Metarhizium anisopliae* (6.06 larvae/mrl), Spinosad 45 SC (6.40 larvae/mrl) and Dipel (7.56 larvae/mrl). *Verticillium lecanii* (8.03 larvae/mrl) was found to be the least effective treatment. Similarly, overall mean larval population of *Spodoptera liura* among different treatments also varied significantly after 3rd, 7th and 10th days of spraying. Among various treatments, *B. thuringiensis* var. *kurstaki* was found to be most effective as it recorded the lowest larval population (3.63 larvae/mrl) followed by *B. bassiana* (3.93 larvae/mrl), *M. anisopliae* (4.53 larvae/mrl), Spinosad 45 SC (4.66 larvae/mrl), Dipel (5.80 larvae/mrl). All the treatments exhibited significantly higher yield as compared to control. It was maximum in treatment, *B. thuringiensis* var. *kurstaki* (26.97 q/ha) followed by *B. bassiana* (24.04 q/ha), *M. anisopliae* (20.92 q/ha), Spinosad (20.83 q/ha), Dipel (20.72 q/ha) and *V. lecanii* (16.21 q/ha). The lowest grain yield was recorded in the control plot (14.88 q/ha).

MS History: 29.11.2013 (Received)-12.12.2013 (Revised)-20.12.2013 (Accepted)

Key words: *Chrysodeixis acuta*, foliage feeders, microbial pesticides, soybean, *Spodoptera litura*

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] ranks first in the world for production of edible oil, while India ranks third in the world in respect of area and fifth in terms of production (Padiwal *et al.,* 2008). Soybean is the most useful and the cheapest source of protein (42%), fat (21%) carbohydrates (4.6%) and phospholipids (2%). In Indian scenario, Madhya Pradesh alone contributes about 67 per cent and 56 per cent in total area and production of soybean, respectively, hence this state is usually referred to as Soybean State (William and Akiko, 2009; Jaiswal, 2011). Soybean crop having a luxuriant growth with succulent leaves attracts a number of insect pests for feeding, oviposition and shelter. About 150 insect pests cause damage to soybean in various parts of Madhya Pradesh, out of which about a dozen of insect pests cause serious damage to the crop from sowing to harvest (Singh and Singh, 1992). Among them green semilooper, *Chrysodeixis acuta* (Walker) and tobacco caterpillar, *Spodoptera litura* (Fabricius) are major foliage feeder insects which voraciously feed on foliage, flower and pods causing significant yield loss (Singh and Singh, 1990). To control these insect pests the number of chemical insecticides are used injudiciously which results in resistance in the insects, pest resurgence, adverse effect on natural enemies and creation of other residual effect on environment. Thus, it is an urgent need to advocate ecofriendly insecticides to mitigate the adverse effects of chemical pesticides causing environmental problems. Entomopathogens as biocontrol agents offer good and effective alternative to conventional insecticides. Keeping the above facts in mind this study was carried out to evaluate some eco-friendly microbial insecticides against foliage feeder insect pests to minimize the infestation and making the soybean cultivation more profitable without environmental hazard.

MATERIALS AND METHODS

A field experiment was conducted on soybean crop during *Kharif* season 2009 using variety JS-335 at Breeding Seed Production Unit, Live Stock Farm, Tank area, J.N.K.V.V., Jabalpur (M.P.). The experiment was laid out in a randomized block design with seven treatments and three replications (Table 1). Three sprays of microbial pesticides (commercial formulation) were applied on test crop on 25, 40 and 55 days after germination. The plot size was kept 18 m^2 with a spacing of 40 × 10 cm between rows and plants respectively and recommended agronomical practices were followed. Observations of larval population were recorded at 24 hours before treatment and 3rd, 7th and 10th days after treatment on one meter row length (mrl) at 5 different places in each plot by placing half meter scale between two rows. The seed yield was recorded for each treatment and computed for hectare in q/ha.

Data recorded on insect pest population was tested by ‘F’ test. When ‘F’ test showed the significance difference between the treatment mean values were further tested with critical difference (CD) at 5% level of significance. Similarly, data on seed yield were also subjected to statistical analysis.

RESULTS AND DISCUSSION

Chrysodeixis acuta

The data obtained from three sprays against larval population of *C. acuta* and *S.litura*/mrl at 24 hrs before and 3rd, 7th and 10th days after treatments were analyzed (Table 1). The mean larval population *C. acuta*/mrl before treatment was varied from 6.80 to 9.43. On the third day after treatment the differences in mean larval population among different treatments were not significant, whereas on the seventh day after the treatment mean larval population among different treatments were significantly reduced over control plots. Among these treatments, *Bacillus thuringiensis* var. *kurstaki* @ 10^{13} spores/ha was found to be the most effective as it recorded the lowest larval population (3.20 larvae/mrl) followed by *Beauveria bassiana* @ 10^{13} spores/ha, *M. anisopliae* @10^{13} spores/ha, Spinosad 45% SC @ 73g. *a.i.*/ha and Dipel @ 1 kg/ha. The least effective treatment was found to be that of *Verticillium lecanii* @10^{13} spores/ha. On tenth day after treatment all the treatments exhibited significantly less population over control plots (9.56 larvae/mrl) in which *B. thuringiensis* var. *kurstaki* @ 10^{13} spores/ha was found to be the most effective followed by *B. bassiana*, *M. anisopliae*, Spinosad, Dipel

Table 1. Efficacy of microbial insecticides on green semilooper, *C. acuta* infesting soybean crop

Treatments	Pre-treatment	Mean of *C. acuta* larvae/mrl			
		3 DAS**	7 DAS**	10 DAS**	Overall mean
T_1- *Beauveria bassiana**	8.00	7.80	4.80	2.66	5.06
T_2- *Metarhizium anisopliae **	6.80	7.66	6.43	4.13	6.06
T_3- *Verticillium lecanii**	7.90	8.13	9.10	7.76	8.03
T_4- *Bacillus thuringiensis* var. *kurstaki**	8.43	8.33	3.20	1.26	4.26
T_5- Dipel @ 1 Kg / ha	9.43	8.56	7.80	6.33	7.56
T_6- Spinosad 45 SC @ 73 g *a.i.* /ha	8.76	8.10	6.66	4.43	6.40
T_7- Control (Untreated)	7.33	7.66	10.66	9.56	9.26
SEm ±	0.28	0.08	0.03	0.02	0.02
CD (P=0.05)	NS	NS	0.08	0.78	0.07

* Dose = 10^{13} spores/ha + 0.2% Edible oil + 0.01% Sticker, DAS= Days after spraying, ** Mean of three sprays, NS= Non- significant

and *V. lecanii*. On the basis of overall mean the differences in larval population among different treatments were significant as compared to control plot. Among these treatments, *B. thuringiensis* var. *kurstaki* was found to be the most effective as it recorded the lowest larval population, followed by *B. bassiana*, *M. anisopliae*, Spinosad, Dipel and *V. lecanii*. Similar findings of effectiveness of *Bt* have been reported against American boll worm in cotton, castor semilooper, tobacco caterpillar, diamond back moth and paddy stem borer by (Ranga Rao *et al.,* 2007; Selvaraj and Kaushik, 2013), whereas the best efficacy of *B. bassiana* was reported against *C. acuta* in soybean (Sharma and Ansari, 2007).

Spodoptera litura

In case of *S.litura* also the initial mean larval population was reduced over control on the third day after spraying (Table 2). The lowest mean larval population was recorded in both *B. bassiana* and *V. lecanii* treatments followed by *M. anisopliae*, Spinosad 45 SC and Dipel. The least effective treatment was *B. thuringiensis* var. *kurstaki*. At 7th and 10th days after treatment mean larval population between the treatments were significantly reduced as compared to control plots. Among these treatments, *B. thuringiensis* var. *kurstaki* @ 10^{13} spores/ha was found to be the most effective with the lowest larval population 2.00, 0.76 followed by *B. bassiana* @ 10^{13} spores/ha 3.10, 1.76, *M. anisopliae* @10^{13} spores/ha 4.00, 2.53, Spinosad 45 SC @ 73g. *a.i.*/ha 4.00, 2.76 and Dipel @ 1 kg/ha 5.46, 4.10 larvae/mrl at 7th and 10th days after spraying respectively. *Verticillium lecanii* @10^{13} spores/ha was observed to be least effective. Similarly result on significant larval mortality of lepidopteran insects was reported by Singh *et al.* (2000) by increasing the concentration of *B. thuringiensis*. On the basis of overall mean of 3rd, 7th and 10th day after spraying all the microbial treatments exhibited significantly low mean larval population of *S. litura* as compared to control. Among these treatments, *B. thuringiensis* was found to be most effective as it recorded the lowest larval population. This was followed by *B. bassiana*, *M. anisopliae*, Spinosad 45, Dipel @ 1kg/ha with significant differences between the treatments. *Verticillium lecanii* again proved to be least effective. The high relative humidity (>80%) and temperature of 23-31^{o}C prevailing in August were the most favourable for the rapid multiplication of the microbial control agents. Weather parameters like temperature, pH and light significantly affected the efficacy of *Bacillus thuringiensis* (*Bt*) resulting

Table 2. Efficacy of microbial insecticides on tobacco caterpillar, *S. litura* infesting soybean crop

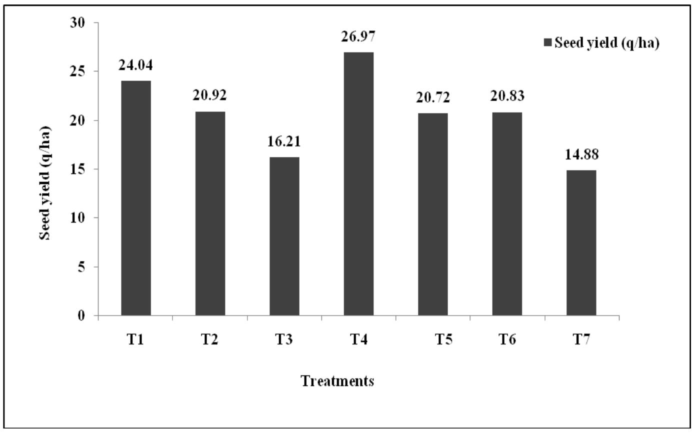
Treatments	Pre-treatment	Mean of *S. litura* larvae/mrl			
		3 DAS**	7 DAS**	10 DAS**	Overall mean
T_1- *Beauveria bassiana* *	5.13	6.90	3.10	1.76	3.93
T_2- *Metarhizium anisopliae* *	5.40	7.00	4.00	2.53	4.53
T_3- *Verticillium lecanii* *	5.53	6.90	6.80	5.20	6.26
T_4- *Bacillus thuringiensis* var. *kurstaki* *	6.20	8.10	2.00	0.76	3.63
T_5- Dipel @ 1 Kg / ha	6.96	7.76	5.46	4.10	5.80
T_6- Spinosad 45 SC @ 73 g *a.i.* /ha	5.26	7.23	4.00	2.76	4.66
T_7- Control (Untreated)	6.13	8.43	8.33	7.10	8.03
SEm ±	0.08	0.06	0.02	0.05	0.01
CD (P=0.05)	NS	NS	0.07	0.15	0.05

* Dose = 10^{13} spores/ha + 0.2% Edible oil + 0.01% Sticker, DAS= Days after spraying, ** Mean of three sprays, NS= Non- significant.

in feeding inhibition and malformation during adult emergence of *S. litura* reported by (Somasekhar and Krishnayya, 2004). Similarly, best pathogenicity of entomopathegenic fungus, *B. bassiana* was reported rather than *M. anisopliae* to *S. litura* (Dayakar and Kanaujia, 2003; Purwar and Sachan, 2005; Bhaduria *et al.,* 2011). Although, the fungus *B. bassiana* acts gradually on insect pests through cuticle infection (Qin *et al.,* 2010).

Although, *Bacillus thuringiensis* var. *kurstaki* and Dipel both were applied as *Bt* microbial agents against foliage feeders wherein efficacy of *Bacillus thuringiensis* var. *kurstaki* was recorded best as compared to Dipel. The study revealed that *Bacillus thuringiensis* var. *kurstaki* was most effective against *C. acuta* and *S.litura* followed by *B. bassiana* and *M. anisopliae*. However, these microbial bio-agents requir~~ed~~ congenial environmental conditions for its swift inoculation/multiplication in the host insect and in nature.

Fig. 1. Efficacy of different treatments *viz;* T_{1-} *Beauveria bassiana,* T_{2-} *Metarhizium anisopliae;* T_{3-} *Verticillium lecanii;* T_{4-} *Bacillus thuringiensis* var. *kurstaki;* T_{5-} Dipel @ 1 Kg / ha; T_{6-} Spinosad 45 SC @ 73 g *a.i.* /ha and T_{7-} Control (Untreated) on seed yield of soybean in q/ha.



Soybean seed yield

The seed yield of net plot area of each plot was recorded and converted into q/ha. All the treatments exhibited positively significant effect on yield (Fig. 1). The lowest yield was recorded in the control plot (14.88 q/ha) which was significantly less than rest of the treatments. The highest seed yield was obtained in the treatment, *B. thuringiensis* var. *kurstaki* followed by *B. bassiana*, *M. anisopliae*, Spinosad, Dipel and *Verticillium lecanii*. These treatments were effective not only in reducing the foliage feeder larval population but also recorded higher seed yield as compared to control. Similarly, findings were reported by (Kamala Jayanthi and Padmavathamma, 2001). In the present study the best treatment in terms of seed yield was *Bacillus thuringiensis* var. *kurstaki*, application of which resulted in an additional yield of 12.08 q/ha which was 81 % higher than the control.

REFERENCES

Bhaduria, B. P., Singh, P.K., Zaidi, N. W. and Kumar, J. 2011. Biocontrol efficacy of *Beauveria bassiana* against *Spodoptera litura. Annals of Plant Protection Sciences*, **19**(1):216-218.

Dayakar, S. and Kanaujia, K. R. 2003. Evaluation of the pathogenicity of *Beauveria bassiana, Metarhizium anisopliae* and *Nomuraea rileyi* on different larval stages of tobacco caterpillar, *Spodoptera litura* (Fabricius). *Indian Journal Plant Protection,* **31**(2): 9-12.

Jaiswal, A. and Hugar, L. B. 2011. An economic analysis of soybean cultivation vis-à-vis its competing cropsin Madhya Pradesh. Karnataka Journal of Agricultural Sciences, **24** (4):591-592.

Kamala Jayanthi, P. D. and Padmavathamma, K. 2001. Joint action of microbial and chemical insecticides on *Spodoptera litura* (Fabricius.) (Lepidoptera: Noctuidae). *Journal of Tropical Agriculture,* **39**(2):142-144.

Padiwal, N. K., Rana, B. S. and Ameta, O. P. 2008. Assessment of losses caused by insect pests of soybean. *Indian Journal of Plant Protection,* **36**(1):121-122.

Purwar, J. P. and Sachan, G. C. 2005. Biotoxicity of *Beauveria bassiana* and *Metarhizium anisopliae* against *Spodoptera litura* and *Spilarctia oblique. Annals of Plant Protection Sciences,* **13**(2):360-364.

Ranga Rao, G. V., Rupela, O. P., Rao V. R. and Reddy, Y.V.R. 2007. Role of biopesticides in crop protection: present status and future prospects. *Indian Journal of Plant Protection,* **35** (1):1-9.

Selvaraj, K. and Kaushik, H. D. 2013. Entomopathogenicity of *Beauveria bassiana* (Balsamo) Vuillemin against *Hyadaphis coriandri* (Das). *Annals of Plant Protection Sciences*, **21**(1): 24-26.

Sharma, A. N. and Ansari, M. M. 2007. Potential of naturally occurring bio-control agents of Lepidopteran defoliators infesting soybean. *Soybean Research,* **5**:84-86.

Singh, A. P., Arora, R. and Battu, G. S. 2000. Laboratory evaluation of three *Bacillus thuringiensis* Berliner based biopesticides against the diamondback moth, *Plutella xylostella* (Linnaeus). *Pesticide Research Journal*, **12** (1): 54-62.

Singh, K. J. and Singh, O. P. 1992. Influence of stem tunnelling by the maggots of *Melanagromyza sojae* (Zehnt.) on yield of soybean. *Journal Insect Science,* **5**(2): 198-200.

Singh, O. P. and Singh, K. J. 1990. Insect pests of soybean and their management. *Indian Farming,* **39**(10): 9-14.

Somasekhar, M. V. N. S. and Krishnayya, P. V. 2004. Effect of temperature, light and pH on feeding inhibition. Pupation and adult Emergence of *Spodoptera litura* (Fabricius) feed with *Bacillus thuringiensis. Indian Journal of Plant Protection,* **32** (1):63-66.

Qin, Y., Ying S. H., Chen, Y., Shen, Z. C., and Feng, M. G. 2010. Integration of insecticidal protein Vip3Aa1 into *Beauveria bassiana* enhances fungal virulence to *Spodoptera litura* larvae by cuticle and per os infection. *Applied and Environmental Microbiology*, **76**(14):4611-4618.

William Shurtleff and Akiko Aoyagi. (2009). History of soybeans and soyfoods in Africa (1857-2009): *Extensively Annotated Bibliography and Sourcebook*. Soyinfo Center, Lafayette, CA 94549-0234 USA, 485 **PP**. (www.soyinfocenter.com).

K. C. Ahirwar*, R. S. Marabi, A. K. Bhowmick and S.B. Das

Department of Entomology, College of Agriculture, Jawaharlal Nehru Agricultural University, Jabalpur– 482 004, M.P., India

*Communication author

Mobile No. : + 91 09584322687;

E mail: ahirwarkc@gmail.com

SIX SUCCESSFUL YEAR OF PUBLICATION

****

We are pleased to inform all our readers, authors, members and subscribers that we are entering into 7th year of our publication. Because of the best wishes of you all, we had been able to publish this journal regularly from a small place Palayamkottai. On this occasion we thank you all for your kind co-operation and sincere contributions.