Evaluation of entomopathogens against lepidopteran defoliators infesting soybean.

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ABSTRACT

A field trial was conducted in *kharif* seasons of 2011-2012 to study the efficacy of certain entomopathogens *viz.*, *Beauveria bassiana*, *Metarhizium anisopliae*,*Verticilium lecanii*, *Bacillus thuringiensis* var. *kurstaki* @ 5 g/l along with standard check - Quinalphos 25 EC @ 1.5 g/L and Spinosad 45%SC @ 73 g a.i. /ha against lepidopteran defoliators. *Bacillus thuringiensis* @ 10^{13} spores/ha followed by *B. bassiana* @ 10^{13} spores/ha were the most effective treatments when applied as foliar sprays at 38, 41 and 45 days old crop. These treatments were effective in reducing the foliage feeder larval population. The highest grain yield was obtained also in the treatment, *B. thuringiensis* var. *kurstaki* (474.77 kg/ha). The lowest yield was recorded in the control (215.23 kg/ha) which was significantly inferior to the rest of the treatments.

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Key words: Soybean, entomopathogens, lepidopteran defoliators, *Bacillus thuringiensis*.

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] belongs to the family Leguminaceae and sub family Papilionaceae, and ranks first in the world for production of edible oil. The crop is mainly cultivated in USA, China, Brazil, Argentina and India. India ranks third in world in respect of area and fifth in terms of production (Padiwal *et al*., 2008). In India in the year 2010-11, soybean cultivation reached to 93.03 lakh ha, recording production of 101.28 lakh tonnes with an average production of 1089 kg per ha (Anonymus 2011). But subsequent to rapid growth in area the pest complex started steering up and now over 275 insect species are known to feed on various growth stages of soybean (Singh *et al*., 1989). The pest has developed resistance against a variety of insecticides belonging to almost all the insecticide groups used (Kranthi *et al*., 2002). Adverse effects due to synthetic pesticides on pests and their subsequent impact on ecological imbalance (Zadoks and Waibel, 1999) demands eco-friendly alternatives (Parmar, *et al.,* 1993). Changing scenario in pest management concept has brought the natural products to the forefront as an effective and reliable pesticidal molecule in the control of pests among crops. Botanical pesticides are one such alternative and an important component in Integrated Pest Management (IPM) due to its advantages such as availability, less toxicity to beneficial fauna, quick degradation and multiple functions (Isman, 2006). More than 700 species of fungi, mostly *Dueteromycetes* and *Entomophorales* from about 90 genera are pathogenic to insects (Rombach *et al*,1986). Considering the importance of ecofriendly approaches to manage the pests, the present study wasintended to evaluation of entomopathogens against lepidopteran defoliators infesting soybean.

MATERIALS AND METHODS

Field trials were conducted in the experimental field of Department of Entomology, College of Agriculture, JNKVV, Jabalpur during *kharif* 2011-12 in a randomized block design with seven treatments *i.e.,* four entomopathogenic fungi – (*Beauveria bassiana, Metarhizium anisopliae, Verticilium lecanii, Bacillus thuringiensis* var. *kurstaki*@ 5 g/l), two standard check insecticide (Quinalphos 25 EC @ 1.5 g/l and Spinosad 45%SC @ 73 g a.i. /ha) and an untreated control (Table 1). There were three replicates. The soybean variety, JS-335 was used. The entomopathogens were obtained from Biological Control Unit, Department of Entomology, College of Agriculture, JNKVV, Jabalpur.

The treatments were applied twice at 10 days interval with knapsack sprayer using 500 l/ha spray fluid. Larval population of major defoliators were recorded 24 hours before spraying and 3, 7 and 10 days after spraying, on one meter row length at 5 sites in each plot. The yield per plot was recorded and computed on hectare basis. The cost effectiveness in terms of benefit: cost ratio was also calculated.

Table 1. Details about entomopathogens used in the treatment.

Tr. Nos.	Treatments*
T_1	*Beauveria bassiana*
T_2	*Metarhizium anisopliae*
T_3	*Verticilium lecanii*
T_4	*Bacillus thuringiensis* var. *kurstaki*
T_5	Quinalphos 25 EC @ 1.5 l/ha
T_6	Spinosad 45%SC @ 73 g a.i. /ha
T_7	Control

* = Dose = 10^{13} spores / ha + 0.2% sunflower oil + 0.01% sticker

Table 2. Evaluation of entomopathogens against green semilooper infesting soybean.

Treatment Nos	Treatment details	Pre-treatment	Green semilooper larvae/mrl. Days after spraying *			Overall Mean
			3	7	10	
T_1	*Beauveria bassiana**	1.83	1.63*	1.57	1.37	1.52
T_2	*Metarhizium anisopliae**	2.17	1.87	1.73	1.40	1.67
T_3	*Verticilium lecanii**	1.83	1.83	1.93	1.77	1.78
T_4	*Bacillus thuringiensis* var.*kurstaki**	2.17	1.53	1.00	0.57	1.03
T_5	Quinalphos *25 EC @ 1.5 l/ha*	2.17	1.70	2.03	1.73	1.82
T_6	Spinosad 45%SC @ 73 g *a.i.* /ha	2.83	1.93	1.87	1.57	1.79
T_7	Control	2.83	2.20	3.70	2.83	2.91
SEm ±		0.10	0.08	0.04	0.06	0.06
CD at 5%		NS	NS	0.12	0.17	0.19
*=Dose= 10^{13} sore/ha+ 0.2% Edible oil + 0.01%Sticker						

* Mean of three spraying, NS= Non-significant

RESULTS AND DISCUSSIONS

Against Green semilooper, *Chrysodeixis acuta* Walker

There was no significant difference in larvae population among the treatments one day before the application of the treatments. After three days of application treatment *Metarhizium anisopliae* @10^{13} spores / haw as found to be the most effective and recorded minimum larval population (4.97 larvae/mrl). After seven days spraying all the treatments significantly reduced the larval population. The minimum larval population (3.07 larvae/mrl) was observed in *Bacillus thuringiensis* var. *kurstaki* @ 10^{13} spores/ha which was significantly superior to all other treatments. At ten days after spraying all the treatments significantly reduced the larval population. The minimum population (0.57 larvae/mrl) was observed in *Bacillus thuringiensis* @ 10^{13} spore/ha which was significantly superior to all other treatments. The maximum population (2.83 larvae/mrl) was observed in control which was significantly inferior to all other treatments.

Table 3. Evaluation of entomopathogens against tobacco caterpillar infesting soybean.

Treatment Nos	Treatment details	Pre-treatment	Tobacco caterpillar larvae/mrl. Days after spraying*			Overall Mean
			3	7	10	
T_1	*Beauveria bassiana**	4.67	5.33*	3.97	0.67	3.32
T_2	*Metarhizium anisopliae**	5.00	4.97	4.80	2.13	3.97
T_3	*Verticilium lecanii**	6.00	5.67	5.67	2.23	4.52
T_4	*Bacillus thuringiensis* var. *kurstaki**	5.67	5.50	3.07	0.63	3.07
T_5	Quinalphos 25 EC @ 1.5 l/ha	5.67	5.67	5.50	2.33	4.50
T_6	Spinosad 45%SC @ 73 g *a.i.* /ha	5.67	5.67	5.17	2.33	4.39
T_7	Control	5.33	6.83	6.83	6.17	6.28
SEm ±		0.09	0.08	0.03	0.05	0.13
CD at 5%		NS	NS	0.10	0.17	0.40
*=Dose= 10^{13} sore/ha+ 0.2% Edible oil + 0.01% Sticker						

* Mean of three spraying, NS= Non-significant

On the basis of overall mean of three sprays, against green semilooper the difference in larval population among different treatments were significant. The minimum larval population was observed in *Bacillus thuringiensis* @ 10^{13} spore/ha which was significantly superior to all other treatments but at par with Beauveriabassiana @ 10^{13} spore/ha. The maximum larval population was observed in control which was significantly inferior to all other treatments.

Table 4. Evaluation of entomopathogen on grain yield of soybean.

Treatment Nos	Treatments	Grain yield (kg/ha)
T1	*B. bassiana* *	415.97
T_2	*M. anisopliae* *	352.83
T_3	*V. lecanii* *	286.90
T_4	*B. thuringiensis* var. *kurstaki* *	474.77
T_5	Quinalphos 25 EC @ 1.5 l/ha	285.93
T_6	Spinosad 45 SC @ 73 g *a.i.* /ha	305.00
T_7	Control (Untreated)	215.23
SEm ±		19.26
CD at 5 %		59.39

* Dose = 10^{13} spores / ha + 0.2% Edible oil + 0.01% Sticker

Against Tobacco caterpillar, *Spodoptera litura* Fabricius

The larval population 24 hrs before application of different treatments ranged from 4.67 to 5.67 larvae/mrl was found to be non significant which indicated that there was uniform distribution of larval population among the crop. After three days of application treatment *Metarhizium anisopliae* @10^{13} spores / ha was found to be the most effective and recorded minimum larval pulation. The highest larval population was recorded in control. However, the population did not differ significantly. At seven days after spraying all the treatments significantly reduced the larval population. The minimum larval population was observed in *Bacillus thuringiensis* var. *kurstaki* @ 10^{13} spores/ha which was significantly superior to all other treatments. At ten days after spraying all the treatments significantly reduced the larval population. The minimum larval population was observed in *Bacillus thuringiensis* var. *kurstaki* @ 10^{13} which was significantly superior to all other treatments. On the basis of overall mean of three sprayings against Tobacco caterpillar the difference in larval population among different treatments were significant. The minimum population was observed in *Bacillus thuringiensis* var.*kurstaki* @ 10^{13} which was significantly superior to all other treatments but at par with *Beauveria bassiana* @ 10^{13} spore/ha, *Metarhizium anisopliae* @ 10^{13} spore/ha and Spinosad 45% SC @ 73 g.a.i./ha.The maximum population was observed in control which was significantly inferior to all other treatments.

Grain yield of soybean

The grain yield of net plot area of each plot was recorded and converted into kg/ha. The highest grain yield was obtained in the treatment, *Bacillus thuringiensis* var. *kurstaki*. The lowest yield was recorded in the control which was significantly inferior to the rest of the treatments.

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