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Comparative field efficacy of microbial and conventional insecticides against bollworms of cotton

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ABSTRACT: Field efficacy of microbial and conventional insecticides against bollworms on cotton was evaluated in 2004–05. All the treatments reduced the bollworm infestation on squares, green bolls and open bolls and consequently increased the seed cotton yield significantly over untreated control during both the years. Spinosad 45 SC 75 g a.i. ha^{-1} proved most effective in reducing the bollworm infestation and increasing the seed cotton yield. It recorded the lowest infestation of bollworms on squares (10.24 and 9.56%), green bolls (9.56 and 8.31%) and open bolls (6.22 and 4.86%) and the highest seed cotton yield (1687 and 1695 kg ha^{-1}) followed by indoxacarb 14.5 SC 75 g a.i. ha^{-1}, endosulfan 35EC 560 g a.i. ha^{-1} and *Bacillus thuringiensis* var. *kurstaki* 1.5 kg ha^{-1}. Among the microbials, *B. thuringiensis* var. *kurstaki* 1.5 kg ha^{-1} was significantly better than *Ha* nuclear polyhedrosis virus 250 LE ha^{-1} only in respect of bollworm infestation on open boll basis during both the years and was found comparable to spinosad 45 SC 75 g a.i. ha^{-1} in respect of bollworm infestation on green and open bolls during the first year and on squares during the second year and seed cotton yield during both the years.

KEY WORDS: Bollworms, cotton, insecticides, microbials

INTRODUCTION

Cotton is an important fiber crop which is grown in Madhya Pradesh approximately in 5.80 lakh ha. Among various factors responsible for its low yield, insect pests are major ones. Pest management, therefore, becomes an important functional component in cotton production. Considering the hazardous effects of indiscriminate use of chemical insecticides, recent trends in pest management clearly demonstrate the scope for the use of microbial pesticides in integrated pest management system.

However in case of severe infestation, these measures fail miserably and farmers are left with no choice. Chemicals do act fast and effectively but due to faulty planning and use of wrong chemicals, incorrect dosage and time of application, these become a curse rather than boon. Several insecticides have been reported to minimize the infestation of bollworms. But *Helicoverpa armigera* has developed resistance to several of these insecticides. Therefore, the present study was carried out to evaluate the efficacy of certain newer insecticides along with bio–insecticides in order to evolve optimal need based insecticidal schedule without causing any deleterious effect on the ecosystem.

MATERIALS AND METHODS

A field experiment was laid to work out the efficacy of microbial agents and compared with conventional insecticides against bollworms of cotton during 2004–05 and 2005–06 on var. Jkh 4 (plot size 4.2 x 6.0m; spacing 60 x 60cm). The experiment was laid out under randomized block design and replicated thrice. A high volume knapsack hand compression sprayer was used for each insecticide as foliar spray @ 800 lit. ha^{-1} during both the years. The spray was calibrated on the basis of required quantity of solution / plot. The treatments comprised of foliar spray with (i) Hear nuclear polyhedrosis virus (@ 250LE ha^{-1}), (ii) Hear nuclear polyhedrosis virus (@ 500LE ha^{-1}), (iii) *B. thuringiensis* var. *kurstaki* (1.5kg ha^{-1}), (iv) endosulfan 35EC (560g. a.i. ha^{-1}), (v) spinosad 45SC (75g. a.i. ha^{-1}) and (vi) indoxacarb 14.5 SC (75g. a.i. ha^{-1}) along with a control (water spray check). In all, two sprays were scheduled. The first and second sprays were given at 60 and 75 days after sowing. Healthy and damaged bolls/ locules per plant were recorded and the damage percentage was calculated. Seed cotton yield/ plot was recorded at each picking and subjected to statistical analysis. Five plants from each plot were selected randomly and tagged. The number of squares, flowers, green and open bolls (damaged and healthy) were also recorded, percentage of damage computed and subjected to statistical analysis. Seed cotton yield / plot was also recorded separately at each picking, converted to kilogram ha^{-1} and subjected to statistical analysis.

RESULTS AND DISCUSSION

The influence of microbial agents on infestation of bollworms in comparison with recommended insecticides is presented in Table 1 along with seed cotton yield.

Square basis

Spinosad 45 SC 75g a.i. ha^{-1} was relatively more effective against bollworms than rest of the treatments during both the years. However, it was on par with indoxacarb 14SC 75g a.i. ha^{-1} in 2004-05 and indoxacarb 14.5SC 75g a.i. ha^{-1}, endosulfan 35EC 560g a.i. ha^{-1}, *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} and *Ha* nuclear polyhedrosis virus 500LE a.i. ha^{-1} in 2005-06. Among the treatments of microbial agents, *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} recorded numerically lowest bollworm infestation on square basis followed by Hear nuclear polyhedrosis virus 500LE a.i. ha^{-1} and all these treatments were on. Further, none of the treatments of microbial agents was found comparable to spinosad 45SC 75g a.i. ha^{-1} during 2004–05, but during 2005-06, Ha nuclear polyhedrosis virus 500LE a.i. ha^{-1} and *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} were comparable to spinosad 45SC 75g a.i. ha^{-1} having lowest bollworm infestation.

Green boll basis

A marked variation in the bollworm infestation was noted in both the years due to different treatments of biological control agents and recommended insecticides (Table 1). All the treatments reduced the infestation of bollworms significantly over untreated control during both the years. The minimum bollworm infestation was recorded with spinosad 45SC 75g a.i. ha^{-1} during both the years. However, it was on par with endosulfan 35 EC 560 g. a.i. ha^{-1} and indoxacarb 14.5SC 75g a.i. ha^{-1} during both the years. Among treatments of biological control agents, lowest infestation was observed in the plots treated with *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1}. However all the microbial treatments were on par with each other and did not exhibit superiority over insecticidal treatments during both the years.

Open boll basis

The infestation of bollworms on open boll basis was significantly reduced due to all treatments during both the years except Hear nuclear polyhedrosis virus 250LE a.i. ha^{-1}, which was comparable to untreated control having highest bollworm infestation during first year only. Among the treatments, spinosad 45 SC 75g a.i. ha^{-1} being on par with indoxacarb 14.5 SC 75g a.i. ha^{-1} and endosulfan 35EC 560g. a.i. ha^{-1} in 2004-05 and indoxacarb 14.5SC 75g a.i. ha^{-1} in 2005-06 resulted in significantly lower infestation of bollworms on open boll basis than the rest of the treatments. Among microbial agent treatments, lowest infestation of bollworm was observed with the treatment *B. thuringiensis* var. *kurstaki* 1.5 kg a.i. ha^{-1}. However, all microbial agent treatments were on par with each other during both the years except the significant difference between *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} and Hear nuclear polyhedrosis virus 250LE a.i. ha^{-1} during 2004-05. Further, none of the microbial agents was found comparable to spinosad 45 SC 75g a.i. ha^{-1} having lowest bollworm infestation during both the years.

Seed cotton yield

All the treatments increased the seed cotton yield over untreated control during both the years . The maximum seed cotton yield (1687 and 1695 kg ha^{-1}) was obtained with spinosad 45 SC 75g a.i. ha^{-1} followed in decreasing order by indoxacarb 14.5 SC 75g a.i. ha^{-1} (1654 and 1678 kg ha^{-1}), endosulfan 35EC 560 g. a.i. ha^{-1} (1632 and 1642 kg ha^{-1}) and *B. thuringiensis* var. *kurstaki* 1.5 kg a.i. ha^{-1} (1621 and 1633 kg ha^{-1}) and all these treatments being on par to each other resulted in 67.80 to 73.56% increase in seed cotton yield over untreated control during 2004–05 and 2005–06, respectively. The unchecked bollworm population of untreated plot reduced the seed cotton yield by 40.44 and 48.14 per cent when compared to yield of spinosad 45SC 75g a.i. ha^{-1} and by 40.04 and 46.17 per cent when compared to yield of *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1}. Among the treatments of microbial agents, *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} resulted in highest seed cotton yield and was comparable to spinosad 45SC 75g a.i. ha^{-1} having maximum seed cotton yield during both the years. However, the treatment *B. thuringiensis* var. *kurstaki* 1.5kg a.i. ha^{-1} was found significantly superior to *Ha* nuclear polyhedrosis virus 250 LE a.i. ha^{-1} during both the years.

All the treatments of both microbial and conventional insecticides reduced the bollworm infestation on square, green boll and open boll basis and consequently increased the seed cotton yield significantly over untreated control during both the years. Spinosad 45 SC 75g a.i. ha^{-1} proved to be the most effective treatment in reducing bollworm infestation and increasing seed cotton yield, as it recorded the lowest infestation of bollworm on squares (10.24 and 9.56%), green bolls (9.56 and 8.31%) and open bolls (6.22 and 4.86%) and the highest seed cotton yield (1687

Table 1. Effect of microbial and conventional insecticides on bollworm infestation (%) on square, green boll and open boll basis and seed cotton yield

Treatment	Bollworm infestation (%)						Seed cotton yield (kg ha^{-1})	
	Square basis		Green boll basis		Open boll basis		2004-05	2005-06
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06		
Hear nuclear polyhedrosis virus 250LE ha^{-1}	15.36 (23.08)	14.27 (22.18)	13.11 (21.22)	13.12 (21.14)	10.39 (18.80)	9.59 (18.03)	1503	1517
Hear nuclear polyhedrosis virus 500LE ha^{-1}	14.40 (22.28)	13.00 (21.11)	12.33 (20.55)	12.08 (20.30)	9.28 (17.69)	8.56 (17.01)	1593	1588
Bacillus thuringiensis var. *kurstaki* 1.5kg ha^{-1}	13.60 (21.61)	12.20 (20.41)	11.54 (19.86)	11.15 (19.49)	8.47 (16.90)	7.89 (16.29)	1621	1633
Endosulfan 35EC 560g. a.i. ha^{-1}	13.43 (21.47)	11.69 (19.98)	11.25 (19.57)	10.20 (18.61)	7.82 (16.11)	7.18 (15.50)	1632	1642
Spinosad 45SC 75g a.i. ha^{-1}	10.24 (18.65)	9.56 (18.81)	9.56 (17.99)	8.31 (16.74)	6.22 (14.43)	4.86 (12.73)	1687	1695
Indoxacarb 14.5SC 75g a.i. ha-1	11.16 (19.52)	10.84 (19.21)	10.04 (18.43)	9.17 (17.61)	7.14 (15.48)	5.74 (13.87)	1654	1678
Control (untreated)	23.78 (29.18)	23.78 (29.15)	20.40 (26.81)	20.40 (26.83)	11.34 (19.65)	15.26 (23.00)	972	879
SEM ±	0.84	0.99	0.78	0.85	0.60	0.78	30.47	31.71
C.D. (P = 0.05%)	2.59	3.06	2.41	2.61	1.86	2.41	93.90	97.70

Figures in parentheses indicate angular transformed values and 1695kg ha^{-1}) followed by indoxacarb, endosulfan and *B. thuringiensis* var. *kurstaki* during both the years. Among microbials agents, *B. thuringiensis* var. *kurstaki* was significantly better than Hear nuclear polyhedrosis virus only in respect of bollworm infestation on open boll basis during both the years and was found comparable to spinosad

Pan *et al*. (2002) and Udikeri *et al*. (2001) recorded lowest bollworm incidence with spinosad. Lowest bollworm incidence with indoxacarb has also been recorded by Saini *et al*. (2004). Young *et al*. (1997), Mahapatro and Gupta (1999) and Yadav *et al*. (2004) also recorded lowest infestation of bollworm complex in the plots treated with *B. thuringiensis* var. *kurstaki.* Lowest bollworm incidence was also reported by Biradar *et al*. (2002) using *Ha* nuclear polyhedrosis virus. Yadav *et al*. (2004) recorded higher seed cotton yield in plots treated with spinosad and indoxacarb while Udikeri *et al*. (2004) and Biradar *et al*. (2002) recorded higher seed cotton yield with *B. thuringiensis* and Hear nuclear polyhedrosis virus sprays against bollworm complex on cotton.

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