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Research Note

Efficacy of microbial insecticides and their combinations against *Helicoverpa armigera* (Hübner) on chickpea

S. N. KALE and U. B. MEN
Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth,
Akola - 444001, Maharashtra, India.

ABSTRACT: **A field experiment was conducted at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, to study the performance of microbial insecticides either alone or in combination against *Helicoverpa armigera* on chickpea for two consecutive post-rainy seasons in 2003-04 and 2004-05. Amongst the treatments, spinosad (0.01%) was most efficacious and recorded the lowest larval population and highest grain yield. Other effective microbial insecticides were HaNPV (250LE ha^{-1}) and Bt (750ml ha^{-1}), which stood only next to endosulfan (0.06%). *Metarhizium anisopliae* (2.5kg ha^{-1}) and *Beauveria bassiana* (2.5kg ha^{-1}) were less efficacious, but performed better than their combinations with either HaNPV or Bt and combination of HaNPV with Bt at reduced doses. Analysis of incremental cost-benefit ratio showed that endosulfan was the most economical treatment, followed by HaNPV, Bt and HaNPV + Bt.**

KEY WORDS: Chickpea, *Helicoverpa armigera*, microbial insecticides

Pulses are inseparable ingredients of vegetarian diet and one of the cheapest sources of dietary protein in India. Like any other pulses, supplementation of chickpea with cereal-based diets is considered one of the possible solutions to the problem associated with protein energy malnutrition (Ali and Kumar, 2003). Worldwide, chickpea is cultivated on 9.94 million hectares area with production of 7.85 million tonnes and India's share is 61.31% and 67.07%, respectively (Anonymous, 2003). Chickpea is reported to be attacked by about 57 insect pests amongst which gram pod borer is the only major pest (Sarode and Sarnaik, 1996). Several chemical insecticides are found effective against this pest. However, due to their adverse effects more effective and eco-friendly alternatives need to be searched. Keeping this in view, the present study was made to evaluate the efficacy of microbial insecticides and their combinations against *H. armigera*.

A field experiment was conducted at the research farm of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, for two consecutive *rabi* seasons in 2003-04 and 2004-05. An experiment was laid out in randomised block design with three replications and 12 treatments. Chickpea cultivar Chaffa was sown at 30x10cm spacing by hand dibbling. Before sowing, seeds were treated with *Trichoderma* @ 4 gm/kg seeds. Recommended dose of fertilizer (25: 50: 00 NPK kg ha^{-1}) was applied at the time of sowing before

A part of Ph. D. thesis of first author submitted to Dr. PDKV, Akola (MS) irrigation. Gap filling was done to maintain uniform plant population. Inter-culture operations and subsequent irrigations were applied when required. The treatments imposed were *Metarhizium anisopliae* (2.5kg ha^{-1}), *Beauveria. bassiana* (2.5kg ha^{-1}), HaNPV (250LE ha^{-1}), Bt (750ml ha^{-1}), *M. anisopliae* (1.25kg ha^{-1}) + HaNPV (125LE ha^{-1}), *M. anisopliae* (1.25kg ha^{-1}) + Bt (375ml ha^{-1}), *B. bassiana* (1.25kg ha^{-1}) + HaNPV (125LE ha^{-1}), *B. bassiana* (1.25kg ha^{-1}) + Bt (375ml ha^{-1}), HaNPV (125LE ha^{-1}) + Bt (375ml ha^{-1}), endosulfan (0.06%) and spinosad (0.01%). The crop was sprayed when the larval population of *H. armigera* attained economic threshold level (i.e.) 2 larvae / 10 plants) and compared with untreated control. The second spray was applied 15 days after first application.

Observations on larval population of *H. armigera* on 10 randomly selected plants were recorded at 3, 7, 10 and 14 days after each spray. Similarly, treatment wise yields were recorded and incremental cost-benefit ratio was calculated. The

Table 1. Effect of microbial insecticides alone or in combination on larval population of *H. armigera* on chickpea during 2003-05 (pooled)

Treatment	Average larval population of *H. armigera* / ten plants							
	3 DAIS	7 DAIS	10 DAIS	14 DAIS	3 DAIIS	7 DAIIS	10 DAIIS	14 DAIIS
M. anisopliae @2.5 kg ha^{-1}	4.33 (2.06)	4.00 (2.04)	2.83 (1.74)	3.83 (1.95)	3.67 (1.97)	3.17 (1.91)	1.83 (1.51)	1.83 (1.51)
B. bassiana @2.5kg ha^{-1}	4.67 (2.14)	4.33 (2.12)	3.17 (1.83)	4.17 (2.03)	3.83 (2.02)	3.50 (1.99)	2.17 (1.63)	2.33 (1.68)
HaNPV @250LE ha^{-1}	3.67 (1.91)	2.83 (1.75)	2.33 (1.59)	3.50 (1.85)	2.67 (1.70)	1.83 (1.52)	1.50 (1.40)	1.67 (1.45)
Bt @750ml ha^{-1}	3.83 (1.94)	3.33 (1.88)	3.00 (1.78)	4.17 (2.03)	3.00 (1.78)	2.50 (1.73)	2.17 (1.62)	2.50 (1.72)
M. anisopliae @1.25kg ha^{-1} + HaNPV@ 125LE ha^{-1}	4.67 (2.14)	4.50 (2.17)	4.17 (2.09)	5.00 (2.23)	4.67 (2.21)	4.17 (2.15)	3.50 (1.99)	3.33 (1.94)
M. anisopliae @1.25kg ha^{-1} + Bt @375ml ha^{-1}	4.83 (2.18)	5.00 (2.28)	4.33 (2.12)	5.33 (2.30)	5.00 (2.29)	4.67 (2.27)	3.83 (2.07)	3.83 (2.08)
B. bassiana @ 1.25kg ha^{-1} +Ha NPV@125LE ha^{-1}	5.00 (2.21)	4.67 (2.20)	4.33 (2.13)	5.17 (2.26)	4.83 (2.25)	4.50 (2.23)	3.83 (2.08)	3.50 (1.99)
B. bassiana @ 1.25kg ha^{-1} + Bt @ 375ml ha^{-1}	5.00 (2.22)	5.00 (2.28)	4.67 (2.21)	5.50 (2.34)	5.17 (2.32)	4.83 (2.30)	4.17 (2.15)	4.00 (2.12)
HaNPV @ 125 LE ha^{-1} + Bt @ 375 ml ha^{-1}	4.33 (2.06)	3.67 (1.96)	3.33 (1.88)	4.50 (2.11)	3.67 (1.97)	3.00 (1.86)	2.50 (1.72)	2.67 (1.77)
Endosulfan @ 0.06%	2.00 (1.37)	1.50 (1.28)	1.17 (1.16)	2.17 (1.45)	1.17 (1.15)	0.50 (0.97)	0.50 (0.97)	0.67 (1.03)
Spinosad @ 0.01%	1.83 (1.31)	1.17 (1.16)	1.00 (1.07)	1.83 (1.33)	0.83 (1.03)	0.50 (0.97)	0.33 (0.88)	0.17 (0.79)
Untreated Control	6.83 (2.60)	7.33 (2.75)	7.50 (2.78)	2.67 (2.77)	7.33 (2.75)	7.00 (2.73)	6.50 (2.64)	6.33 (2.61)
SEM ±LSD (P=0.05) C.V. (%)	0.08 0.25 10.27	0.08 0.22 9.38	0.10 0.30 13.46	0.07 0.21 8.55	0.08 0.24 10.41	0.07 0.22 9.55	0.11 0.33 15.93	0.10 0.29 14.22

Figures in parentheses are corresponding square root transformed values; DAIS - Days after first spray; DAIIS - Days after second spray data on larval population were subjected to appropriate transformation and statistically analyzed.

All the treatments significantly reduced the larval population of *H. armigera* compared to untreated control. Amongst the various treatments, spinosad (0.01%) recorded the lowest larval population at all the intervals after both the sprays followed by endosulfan (0.06 %) and HaNPV (250LE ha^{-1}). Treatments with Bt (750ml ha^{-1}), HaNPV (125LE ha^{-1}) + Bt (375ml ha^{-1}), *M. anisopliae* (2.5kg ha^{-1}), and *B. bassiana* (2.5kg ha^{-1}) exerted moderate effect against this pest. *M. anisopliae* and *B. bassiana* in combination with HaNPV and Bt proved less effective.

Perusal of the data on the yield of chickpea grains and ICBR (Table 2) indicated that though spinosad recorded the highest grain yield (15.59q ha^{-1}), it gave less ICBR (1: 2.50) than endosulfan (1: 6.87), HaNPV (1: 3.67), HaNPV + Bt (1: 3.01) and Bt (1: 2.93).

Dhonde *et al.* (2005) reported that spinosad and endosulfan were more effective in reducing larval population of *H. armigera* on chickpea and also recorded more grain yield than Bt and HaNPV.

Table 2. Effect of microbial insecticides alone or in combination on grain yield of chickpea and incremental cost-benefit ratio during 2003-05 (pooled)

Treatment	2003-04		2004-05		Pooled	
	Grain yield (q ha^{-1})	ICBR	Grain yield (q ha^{-1})	ICBR	Grain yield (q ha^{-1})	ICBR
M. anisopliae @ 2.5kg ha^{-1}	13.92	1: 1.70	12.06	1: 1.17	12.99	1: 1.39
B. bassiana @ 2.5kg ha^{-1}	13.72	1: 1.76	11.76	1: 1.20	12.74	1: 1.47
HaNPV @ 250LE ha^{-1}	14.51	1: 4.07	12.94	1: 3.27	13.73	1: 3.67
Bt @ 750ml ha^{-1}	14.31	1: 3.31	12.64	1: 2.57	13.48	1: 2.93
M. anisopliae @ 1.25kg ha^{-1} + HaNPV @ 125LE ha^{-1}	12.16	1: 1.17	11.12	1: 1.09	11.64	1: 1.13
M. anisopliae @ 1.25kg ha^{-1} + Bt @ 375ml ha^{-1}	11.76	1: 0.88	10.39	1: 0.65	11.08	1: 0.77
B. bassiana @ 1.25kg ha^{-1} + HaNPV @ 125LE ha^{-1}	11.86	1: 1.09	10.69	1: 0.93	11.28	1: 1.01
B. bassiana @ 1.25kg ha^{-1} + Bt @ 375ml ha^{-1}	11.08	1: 0.54	10.19	1: 0.60	10.63	1: 0.57
HaNPV @ 125LE ha^{-1} + Bt @ 375ml ha^{-1}	14.02	1: 3.32	12.55	1: 2.70	13.29	1: 3.01
Endosulfan @ 0.06%	15.88	1: 7.45	14.41	1: 6.29	15.15	1: 6.87
Spinosad @ 0.01%	16.27	1: 2.68	14.90	1: 2.31	15.59	1: 2.50
Untreated Control	10.20	-	9.12	-	9.66	-
SEM ±LSD (P= 0.05) C.V. (%)	0.26 0.78 3.43	- - -	0.33 0.97 4.81	- - -	0.33 0.97 4.81	- - -

ICBR – incremental cost-benefit ratio; *M. anisopliae* – *Metarhizium anisopliae*; *B. bassiana* – *Beauveria bassiana*; HaNPV – *Helicoverpa armigera* Nuclear Polyhedrosis Virus; Bt – *Bacillus thuringiensis*

Similarly, Singh and Yadav (2005) reported that amongst different microbial insecticides, *B. bassiana* and HaNPV were most effective against this pest and stood next to endosulfan. Efficacy of different fungal pathogens along with other biopesticides was evaluated by Kulkarni *et al.* (2005) and Sidde Gowda and Suhas Yelshetty (2005) against this pest. Bhatt and Patel (2002) found that endosulfan (0.07%) was economically the most viable treatment, followed by HaNPV, HaNPV + Bt and Bt. All these findings support the results obtained in this study.

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