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Research Note

Bioformulations for management of pod borer, *Helicoverpa armigera* (Hübner) in Mungbean (*Vigna radiata* L.)

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Abstract: Effectiveness of bioformulations was tested against pod borer, *Helicoverpa armigera* (Hübner) in mungbean during *Kharif* 2015 and 2016 at Punjab Agricultural University, Ludhiana. Among the bioformulations the per cent pod damage and yield varied from 21.43 to 24.49 per cent and 5.50 to 8.53 q/ha respectively. During *Kharif* 2016, per cent pod damage and yield varied from 12.00 to 15.69 per cent and 6.30 to 9.33 q/ha respectivley. The chemical treatment Chlorpyrifos 20 EC (3.75 l/ha) was most effective in terms of pod damage reduction and yield of mungbean. The Bt formulations PDBC-BT1 and NBAIR-BTG4 (2%) and both doses of Delfin WG (1 and 2Kg/ha) were equally effective in controlling the *H. armigera* pod damage when compared to Chlorpyrifos 20EC. Myco Jaal (commercial formulation of *Beauveria bassiana*) was not effective in controlling the pod borer as compared to *B. thuringiensis* formulations in mungbean. The *B. thuringiensis* formulations Delfin (commercial) and PDBC/NBAIR (2%) effectively reduced the pod damage by *H. armigera* in mungbean and can be integrated in IPM programme for pulse crop protection.

Keywords: Bioformulations, *Helicoverpa armigera*, mungbean, pod damage

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INTRODUCTION

Mungbean (*Vigna radiata* L.) is one of the important legume crops which is suitable for dry land farming and is predominantly used as an intercrop with other crops. It is a rich source of protein (25%) and is used as an important source of human food and animal feed. In addition, it also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen (Lal, 1985). Mungbean suffers from a large number of biotic and abiotic stresses. Among the biotic stresses, insect pests are the most important yield reducing factor. Nearly 60 insect species have been reported on mungbean, urdbean and pigeonpea (Lal and Ahmad, 2002; Yadav and Singh, 2016; Jagdish *et al*., 2014). Among the insects pests, pod borers *Helicoverpa armigera* (Hübner) is a serious pest of mungbean (Chandrayudu, 2008). It attacks the crop right from the pre-flowering to pod maturing stage causing huge yield loss. Spraying of chemical insecticides for controlling the borer is costly and results in environmental pollution and other health hazards. With organic farming gaining importance, microbial biopesticides can provide an alternative safe option for the control of this insect pest. The present study was therefore conducted to evaluate the efficacy of different bioformulations for the management of pod borer in mungbean.

Field experiments were conducted during *Kharif* season with ten different treatments replicated thrice in an experimental plot of 5x4 m at Entomological Research Farm, Punjab Agricultural University, and Ludhiana for two consecutive years, 2015 and 2016. The mungbean variety, PAU 911 was raised with standard agronomic practices except plant protection measures. There were ten treatments viz. two liquid formulations of *Bacillus thuringiensis* (Bt) (supplied by NBAIR, Bangalore), PDBC-BT1 (1% and 2%) and NBAIR-BTG4 (1% and 2%), commercial formulation of *B. thuringiensis* Delfin WG (1 and 2Kg/ha), commercial formulation of *Beauveria bassiana* (Myco Jaal) (1.5 and 2.0 Kg/ha), chemical control Chlorpyrifos 20 EC (3.75 l/ha) and untreated control. First spray was given 40 days after sowing (at flowering stage). There were three sprays of biopesticides at ten days interval and two sprays of chemical control at fifteen days interval. Pod damage was recorded from randomly selected pods from 15 plants per plot and per cent pod damage was recorded at monthly intervals. To differentiate the damage by these pod borers the following criteria were adopted as given by Yadav and Dahiya (2004).

1. Healthy clear pods without any external damage symptom.

2. Pods attacked by *H. armigera* having big circular holes without larval exuviae on the pods.

The total number of pods and number of damaged pods infested by pod borer were recorded from each sample and converted into percent pod damage as indicated below:

$$\text{Per cent pod damage} = \frac{\text{Number of damaged pods} \times 100}{\text{Total number of pods}}$$

Yield was recorded on whole plot basis and was then extrapolated to hectare basis. After harvesting the grains were dried in open sunlight to stabilize the moisture content. The weight of grains per plot was also recorded. The data on pod damage and yield was then subjected to statistical analysis as ANOVA in randomized block design. Least significant differences were used to separate the effect of the various treatments at p = 0.05.

Mungbean pods infested with *H. armigera* showed circular holes which were recorded to calculate per cent pod damage. During *Kharif* season 2015, per cent pod damage in mungbean varied from 19.68 to 27.49 per cent. Percent pod damage in plants treated with PDBC-BT1 (2%) and Delfin (2 Kg/ha) was 21.36 and 21.43 percent, respectively. Both these treatments were statistically at par with each other and with Chlorpyrifos 20 EC (3.75l/ha) which recorded the lowest pod damage (19.68 %) and was significantly better than other treatments. This was followed by pod damages in Delfin WG (1Kg/ha), PDBC-BT1 (1%), NBAIR-BTG4 (1% and 2%) which recorded 21.73, 22.95, 22.46 and 23.53 per cent respectively and were statistically at par with each other (Table 1). Further, commercial formulation of *B. bassiana* (Myco Jaal @ 2 and 1.5 Kg/ha) recorded 23.85 and 24.49 percent pod damage which were at par with each other and better than the untreated control. Maximum percent reduction in pod damage over control (22.05%) was recorded in Delfin WG (2%) and NBAIR-BTG4 (2 Kg/ha) (22.29%). However minimum per cent reduction in pod damage over control was in Myco Jaal (10.91%) (Fig. 1). During *Kharif* 2016, per cent pod damage in mungbean varied from 11.30 to 18.57 per cent. Lowest per cent pod damage (11.30%) was recorded in Chlorpyrifos 20 EC (3.75 l/ha). The biopesticide treatments, Delfin WG (1% and 2%), PDBC-Bt1 (1% and 2%), NBAIR-BTG4 (1% and 2%) and higher dose of Myco Jaal (2 Kg/ha) recorded 12.89, 12.20,13.33,12.40,12.32,12.00 and 14.95 per cent pod damage respectively. The highest pod damage among the biopesticidal treatments was recorded in Myco Jaal (1.5 Kg/ha) (15.69%) which was at par with the untreated control (18.57 %). Per cent reduction in pod damage was maximum (35.37 %) in the higher dose of Delfin WG andPDBC-BT1 (34.30%). Minimum percent reduction in pod damage over control was recorded in Myco Jaal (15.50%) (Fig. 1).

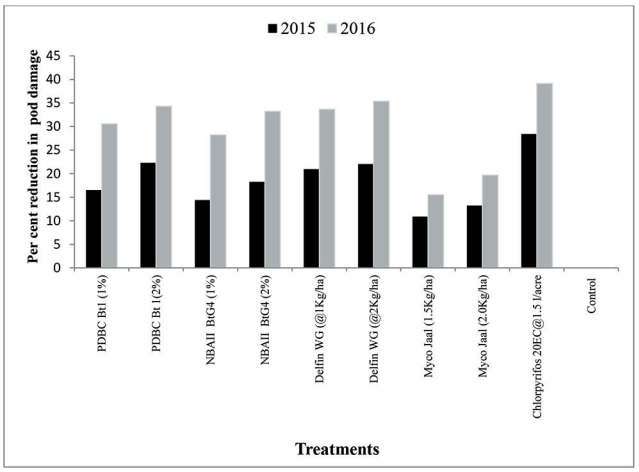

Fig. 1. Per cent reduction in pod damage over control in mungbean.

So, it can be concluded that among the bioagents, PDBC-Bt1 (2%) and both doses of Delfin WG (1.5 and 2.0 Kg/ha) were equally effective in controlling *H. armigera* larvae as the synthetic chemicals. These results have been corroborated by other workers. Evaluation of biopesticides against pod borer in pigeonpea indicated that the pod damage was lowest in spinosad (17.38%), followed by Bt1 (27.57%) and *B. bassiana* SC formulation @ 300 mg/lt (33.82%) as against control (45.84%) with 62.1, 39.9 and 26.2 percent reduction over control, respectively (Sreekanth & Seshamahalakshmi, 2012).

Yield of mungbean varied significantly with the level of pest infestation depending on the efficacy of the biopesticides. In *Kharif* 2015, among the bioformulations treated plots, commercial formulation of *B. thuringiensis* Delfin WG (1 and 2Kg/ha), PDBC-BT1(2%) recorded an yield of 8.53, 8.15 and 8.40 q/ha and these formulations were statistically at par with Chlorpyrifos 20EC (3.75 l/ha) which recorded the highest yield of 9.68 q/ha. However, the lowest yield of 5.50 q/ha was recorded in Myco Jaal (1.5 Kg/ha) which was at par with the yield in untreated control (5.03 q/ha).

During *Kharif* 2016, highest yield (9.68q/ha) was recorded in Chlorpyrifos 20EC (3.75 l/ha) which was at par with the yield recorded in both the dosages of Delfin WG (9.33 and 9.03 q/ha) and PDBC-BT1 (2%) (8.95q/ha). However, lowest yield was recorded in untreated control (6.38 q/ha) which was at par with both the dosages of Myco Jaal (1.5 and 2.0 Kg/ha) which recorded6.30 and 6.33q/ha, respectively. Yadav and Singh (2016) recorded maximum grain yield in mungbean under chemical control, indoxacarb

Table 1. Evaluation of microbial agents for the management of *Helicoverpa armigera* on Mung bean during *Kharif* (2015 and 2016)

Treatments	Per cent pod damage		Per cent pod damage reduction over control		Yield (q/ha)	
	2015	2016	2015	2016	2015	2016
PDBC-BT1 (1%)	22.95^{bc} (4.89)	12.89^{b} (3.72)	16.51	30.58	7.93^{b}	7.93^{c}
PDBC-BT1 (2%)	21.36^{ab} (4.72)	12.20^{ab} (3.63)	22.29	34.30	8.40^{ab}	8.95^{a}
NBAIR-BTG4 (1%)	23.53^{bc} (4.95)	13.33^{b} (3.78)	14.40	28.21	7.80^{b}	8.80^{b}
NBAIR-BTG4 (2%)	22.46^{b} (4.84)	12.40^{ab} (3.65)	18.29	33.22	7.93^{b}	8.90^{b}
Delfin WG @1Kg/ha (commercial *Bt* formulation)	21.73^{b} (4.76)	12.32^{ab} (3.64)	20.95	33.65	8.15^{ab}	9.03^{a}
Delfin WG@2Kg/ha (commercial *Bt* formulation)	21.43^{ab} (4.73)	12.00^{b} (3.60)	22.05	35.37	8.53^{ab}	9.33^{a}
Myco Jaal @ 1.5Kg/ha (commercial formulation of *B. bassiana*)	24.49^{cd} (5.18)	15.69^{bc} (4.06)	10.91	15.50	5.50^{c}	6.30^{d}
Myco Jaal @ 2.0Kg/ha (commercial formulation of *B. bassiana*)	23.85^{d} (5.04)	14.95^{b} (3.97)	13.24	19.70	6.33^{bc}	6.33^{d}
Chlorpyrifos 20 EC @ 3.75 l/ha	19.68^{a} (4.54)	11.30^{a} (3.30)	28.41	39.14	9.68^{a}	9.53^{a}
Control (untreated)	27.49^{d} (5.33)	18.57^{c} (4.42)	-	-	5.03^{c}	6.28^{d}
CD (0.05)	0.21	0.39			1.67	0.62

Figures in parentheses are arc sine transformed values.

(12.04 q/ha) while lowest yield was recorded in azadirachtin (9.44 q/ha). In terms of the cost: benefit ratio, acetamiprid (1:7.91) and lamda cyhalothrin (1:7.56) yielded maximum benefit whereas, lowest cost: benefit ratio was obtained in spinosad (1:2.12) followed by Bt (1:3.81) and indoxacarb (1:4.57). Sreekanth and Seshamahalakshmi (2012) recorded the highest grain yield in spinosad 45% SC @ 73g a.i/ha treated plots (831.0 kg/ha), followed by Bt1 @ 1.5 kg/ha (743.1 kg/ha) and *B. bassiana* SC formulation @ 300mg/L (694.4 kg/ha) with 104.0, 82.4 and 70.5 per cent increase over control, respectively as against the minimum yield of 407.4 kg/ha in the untreated check. It can be concluded from our studies that based on the pod damage (per cent) and yield, Delfin WG (2 Kg/ha) and PDBC-BT1 (2%) have the potential to reduce the pod damage by *H. armigera*.

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