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Management of Pod Borers in Pigeonpea through Biorational Approaches

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ABSTRACT

The field experiment for evaluation of efficacy of biorational insecticides against major pod borers (gram pod borer, plume moth and pod fly) in pigeonpea was carried out at MARS, UAS Dharwad during 2011-12 and 2012-13. The results revealed that the treatment sequence comprising of nimbecidine 0.03 EC (3ml/l), *Ha*NPV (250 LE/ha) and flubendiamide 480 SC (0.1 ml/l) was found promising against gram pod borer by recording least pod damage (21.33 and 19.52 %) during both the years of study. The same treatment was found very effective in increasing the grain yield (888 kg/ha) of pigeonpea and recorded highest B:C ratio (1.89). Similarly the pod damage by plume moth and pod fly was lowest in the sequence, nimbecidine 0.03 EC (3ml/l)-*Beauveria bassiana* (2x10^8 spores/g) (2g/l)-flubendiamide 480 SC (0.1 ml/l). The foregoing study indicated that these treatments can be incorporated in the management of pod borers and for harnessing higher yields in pigeonpea ecosystem.

Key words *Pod borers, pigeonpea, grain yield, C:B ratio, biorational approaches*

Pigeonpea [*Cajanus cajan* (L.) Millsp.], is fifth prominent pulse crop in the world and second most important pulse crop after chickpea in India accounting for about 12 per cent of total pulse area and 20 per cent of total pulse production of the country (Sharma, *et al.*, 2010). In Karnataka, it is cultivated over an area of 0.89 million hectare with a production of 0.53 million tones and productivity of 596 kg per hectare (Anon., 2012). One of the major constraints for low productivity of pigeonpea is due to the damage by insect pests with an avoidable losses extending up to 78 per cent in India (Lateef and Reed, 1983). The total pod damage due to borer complex has been reported to be 33.80 to 49.90 per cent in India (Lateef and Reed, 1981). The unilateral approach of controlling the insect pest by using only synthetic chemical insecticides has become increasingly expensive and unreliable over the last two decades. Thus, keeping this view, an experiment was conducted to test the efficacy of various biorational insecticides against major pod borers [Gram pod borer, *Helicoverpa armigera* (Hubner); plume moth, *Exelastis atomosa* (Mayr) and pod fly; *Melanagromyza obtusa* (Malloch)] in pigeonpea for two consecutive years.

MATERIALS AND METHODS

To determine the efficacy of different biorational insecticides against major pod borers (gram pod borer, plume moth and pod fly) in pigeonpea an experiment was laid down in a randomized block design (RBD) with nine treatments replicated thrice under field conditions for two successive years at Main Agricultural Research Station (MARS), University of Agricultural Sciences (UAS), Dharwad, Karnataka. The variety, ICP 8863 (*Maruti*) was sown in plots of 5.4 x 4.5 m size maintaining the spacing of 90 cm between rows and 30 cm from plant to plant. The treatment details were as follows,

Tr. No.	Treatments with dosage (ml or g per litre)
T1:	Nimbecidine 0.03 EC (3 ml/l) - *Ha*NPV (250 LE) - *Bacillus thuringiensis* (*B.t.*) (2 kg/ha)
T2:	Nimbecidine 0.03 EC (3 ml/l) - *Beauveria bassiana* (2x10^8 spores/g) (2 g/l) - *B.t* (2 kg/ha)
T3:	Nimbecidine 0.03 EC (3 ml/l) - *Nomuraea rileyi* (2 x10^8 spores/g) (2 g/l) – *B.t.* (2 kg/ha)
T4:	Nimbecidine 0.03 EC (3 ml/l) - *Metarhizium anisopliae* (2 x10^8 spores/g) (2g/l) - *B.t.* (2 kg/ha)
T5:	Nimbecidine 0.03 EC (3 ml/l) - *Ha*NPV (250 LE/ha) - Flubendiamide 480 SC (0.1 ml/l)
T6:	Nimbecidine 0.03 EC (3 ml/l) – *B. bassiana* (2x10^8 spores/g) (2 g/l) - Flubendiamide 480 SC (0.1 ml/l)
T7:	Nimbecidine 0.03 EC (3 ml/l) – *N. rileyi* (2 x10^8 spores) (2 g/l) - Flubendiamide 480 SC (0.1 ml/l)
T8:	Nimbecidine 0.03 EC (3 ml/l) - *B. t.* (2 kg/ha) - Flubendiamide 480 SC (0.1 ml/l)
T9:	Untreated check

Note: Inanimate bird perches were erected in treatments from one to eight at the rate of 20 per hectare.

Each treatment comprised of three insecticides which were sprayed in sequence. The first insecticide of the treatment was sprayed at flowering stage and subsequent insecticides were sprayed at 15 days interval. Observations on damaged pods were recorded from randomly collected 100 pods from each treatment and per cent pod damage by each pod borer was worked out separately on the basis

Table 1. Efficacy of different treatments on the pod damage by major pod borers in pigeonpea during 2011-12

Tr. No.	Treatments	Per cent pod damage*		
		Gram pod borer	Plume moth	Pod fly
T_1	Nimbecidine 0.03 EC (3ml/l) - *Ha*NPV (250 LE) - *Bacillus thuringiensis* (*B.t.*) (2 kg/ha)	33.74 (35.51)c	14.40 (22.27)bc	9.48 (17.92)c
T_2	Nimbecidine 0.03 EC (3ml/l) - *Beauveria bassiana* (2x10^8 spores/g) (2g/l) - *B.t* (2 kg/ha)	37.50 (37.76)cd	15.18 (22.92)bc	8.63 (17.08)bc
T_3	Nimbecidine 0.03 EC (3ml/l) - *Nomuraea rileyi* (2 x10^8 spores/g) (2g/l) – *B.t.* (2 kg/ha)	38.96 (38.59)d	13.15 (21.25)b	8.83 (17.28)bc
T_4	Nimbecidine 0.03 EC (3ml/l) - *Metarhizium anisopliae* (2 x10^8 spores/g) (2g/l) - *B.t.* (2 kg/ha)	37.70 (37.87)cd	15.60 (23.26)c	8.18 (16.61)b
T_5	Nimbecidine 0.03 EC (3ml/l) - *Ha*NPV (250 LE/ha) - Flubendiamide 480 SC (0.1 ml/l)	21.33 (27.51)a	10.41 (18.80)a	6.92 (15.25)a
T_6	Nimbecidine 0.03 EC (3ml/l) – *B. bassiana* (2x10^8 spores/g) (2g/l) - Flubendiamide 480 SC (0.1 ml/l)	29.06 (32.60)b	9.59 (18.04)a	6.78 (15.06)a
T_7	Nimbecidine 0.03 EC (3ml/l) – *N. rileyi* (2 x10^8 spores) (2g/l) - Flubendiamide 480 SC (0.1 ml/l)	28.00 (31.94)b	10.47 (18.88)a	7.10 (15.45)a
T_8	Nimbecidine 0.03 EC (3ml/l) - *B. t.* (2 kg/ha) - Flubendiamide 480 SC (0.1 ml/l)	23.47 (28.97)a	9.67 (18.11)a	6.88 (15.21)a
T_9	Untreated check	47.83 (43.76)e	17.88 (25.02)d	12.58 (20.75)d
	SEm±	0.90	0.55	0.34
	CD (0.05)	2.70	1.65	1.01

*Mean of three replications

Values in parentheses are arc sine transformations

In a column, means followed by same letter are not significantly different at P = 0.05 as per DMRT.

of damaged pods to total pods observed. The grain yield was recorded at harvest from net plot and computed to hectare basis. The data pertaining to per cent pod damage was subjected to arc sine transformation prior to statistical analysis for the test of significance of difference.

RESULTS AND DISCUSSION

Pod damage:

The data on impact of various biorational insecticides on pod damage was recorded at harvest and presented in Table 1 and 2.

Gram pod borer: The pod damage by gram pod borer, among the treatments, varied significantly (21.33 to 38.96 %) over control (47.83 %) during the year 2011-12. The treatment, T_5 found superior by recording least per cent pod damage (21.33 %), which was statistically *on par* with T_8 (23.47 %). Similar tread was noticed during second year (2012-13) and pod damage was ranged between 19.52 per cent in T5 and 43.89 per cent in T9.

Plume moth: The plume moth caused least pod damage of 9.59 per cent in the treatment T_6 during the first year, which was statistically *on par* with the treatments T_5 (10.41%), T_7 (10.47%) and T_8 (9.67%). Significantly higher pod damage of 17.88 per cent was noticed in the treatment T_9. Similar trend was followed during the second year of study and the treatments T_5 (8.51%), T_6 (7.51%), T_7 (7.62%) and T_8 (8.63%) performed as superior over rest of the treatments.

Pod fly: The pod fly inflicted minimum pod damage of 6.78 per cent in the treatment T_6 during the first year, which was statistically *on par* with T_5 (6.92 %), T_7 (7.10 %) and T_8 (6.88 %). Significantly higher pod damage of 12.58 per cent was recorded by the treatment T_9. Same trend was noticed during the second year and pod damage, among the treatments, varied significantly (6.67 to 10.07 %) over control (13.18 %).

Grain yield and B:C ratio:

The grain yield of pigeonpea and cost effectiveness of various biorational treatments is presented in Table 3. It is evident from the data that all the treatments gave significantly higher grain yield than control. The higher grain yield of 887 and 890 kg per hectare was recorded in T5 during first and second year, respectively; however it was statistically *on par* with treatment, T_8. On the basis of two year mean data the highest grain yield of 888 kg per hectare was obtained in the treatment T_5 and lowest (452 kg/ha) in

Table 2. Efficacy of different treatments on the pod damage by major pod borers in pigeonpea during 2012-13

Tr. No.	Treatments	Per cent pod damage*		
		Gram pod borer	Plume moth	Pod fly
T_1	Nimbecidine 0.03 EC (3ml/l) - *Ha*NPV (250 LE) - *Bacillus thuringiensis* (*B.t.*) (2 kg/ha)	31.93 (34.40)b-d	12.89 (20.98)d	9.44 (17.87)b
T_2	Nimbecidine 0.03 EC (3ml/l) - *Beauveria bassiana* (2x10^8spores/g) (2g/l) - *B.t* (2 kg/ha)	32.19 (34.56)cd	10.40 (18.81)c	9.12 (17.55)b
T_3	Nimbecidine 0.03 EC (3ml/l) - *Nomuraea rileyi* (2 x10^8 spores/g) (2g/l) – *B.t.* (2 kg/ha)	30.48 (33.49)b-d	9.80 (18.24)bc	10.07 (18.50)b
T_4	Nimbecidine 0.03 EC (3ml/l) - *Metarhizium anisopliae* (2 x10^8 spores/g) (2g/l) - *B.t.* (2 kg/ha)	33.21 (35.19)d	10.21 (18.62)c	9.55 (18.00)b
T_5	Nimbecidine 0.03 EC (3ml/l) - *Ha*NPV (250 LE/ha) - Flubendiamide 480 SC (0.1 ml/l)	19.52 (26.21) a	8.51 (16.94)a-c	6.72 (15.01)a
T_6	Nimbecidine 0.03 EC (3ml/l) – *B. bassiana* (2x10^8 spores/g) (2g/l) - Flubendiamide 480 SC (0.1 ml/l)	27.93 (31.90)bc	7.51 (15.88)a	6.67 (14.95)a
T_7	Nimbecidine 0.03 EC (3ml/l) – *N. rileyi* (2 x10^8 spores) (2g/l) - Flubendiamide 480 SC (0.1 ml/l)	27.51 (31.60)b	7.62 (16.03)a	7.03 (15.37)a
T_8	Nimbecidine 0.03 EC (3ml/l) - *B. t.* (2 kg/ha) - Flubendiamide 480 SC (0.1 ml/l)	22.81 (28.52)a	8.63 (17.06)a-c	6.81 (15.12)a
T_9	Untreated check	43.89 (41.48)e	16.26 (23.76)e	13.18 (21.24)c
	SEm±	0.89	0.64	0.66
	CD (0.05)	2.68	1.93	1.98

* Mean of three replications

Values in parentheses are arc sine transformations

In a column, means followed by same letter are not significantly different at P = 0.05 as per DMRT.

Table 3. Grain yield and Cost effectiveness of various biorational insecticides in the management of major pod borers in pigeonpea

Sl. No.	Treatments	Grain yield (Kg/ha)*			Mean B:C ratio
		2011-12	2012-13	Mean	
T_1	Nimbecidine 0.03 EC (3ml/l) - *Ha*NPV (250 LE) - *Bacillus thuringiensis* (2 kg/ha)	612c	640c	626	1.20
T_2	Nimbecidine 0.03 EC (3ml/l) - *Beauveria bassiana* (2x10^8spores/g) (2g/l) - *B.t* (2 kg/ha)	590c	653c	622	1.18
T_3	Nimbecidine 0.03 EC (3ml/l) - *Nomuraea rileyi* (2 x10^8 spores/g) (2g/l) – *B.t.* (2 kg/ha)	550d	650c	600	1.13
T_4	Nimbecidine 0.03 EC (3ml/l) - *Metarhizium anisopliae* (2 x10^8 spores/g) (2g/l)- *B.t.* (2 kg/ha)	603c	627c	615	1.16
T_5	Nimbecidine 0.03 EC (3ml/l) – *Ha*NPV (250 LE/ha) - Flubendiamide 480 SC (0.1 ml/l)	887a	890a	888	1.89
T_6	Nimbecidine 0.03 EC (3ml/l)- *B. bassiana* (2g/l)- Flubendiamide 480 SC (0.1 ml/l)	770b	782b	776	1.63
T_7	Nimbecidine 0.03 EC (3ml/l) – *N. rileyi* (2g/l) - Flubendiamide 480 SC (0.1 ml/l)	783b	802b	793	1.67
T_8	Nimbecidine 0.03 EC (3ml/l) - *B. t.* (2 kg/ha) - Flubendiamide 480 SC (0.1 ml/l)	884a	872a	878	1.85
T_9	Untreated check	472e	431d	452	1.08
	SEm±	12.74	8.44	-	-
	CD (0.05)	38.19	25.29	-	-

* Mean of three replications

In a column, means followed by same letter are not significantly different at P = 0.05 as per DMRT

Note: Sale price of pigeonpea: Rs. 4000 per quintal

T_9. The B:C ratio based on the yield was worked out and highest B:C ratio (1.89) was found in case of T5 as against 1.08 in control.

The present study revealed that the treatment sequence comprising of nimbecidine 0.03 EC (3ml/l), *Ha*NPV (250 LE/ha) and flubendiamide 480 SC (0.1 ml/l) was found effective against gram pod borer by recording least pod damage, whereas the sequence nimbecidine 0.03 EC (3ml/l)-*B. bassiana* ($2x10^8$ spores/g) (2g/l)-flubendiamide 480 SC (0.1 ml/l) performed better against plume moth and pod fly. The effectiveness of flubendamide in minimizing the pod damage due to *H. armigera* was proved by Dodia, *et al.,* 2009 and Ameta, *et al.,* 2011. The effectiveness of *Ha*NPV in reducing the pod damage by *H. armigera* was proved by Srinivasan and Philip Sridhar, 2008 and Gajendran, *et al.,* 2006 and Bijjur, 1990. Ameta, *et al.,* 2011 and Dodia, *et al.,* 2009 recorded highest grain yield (12.15 q/ha) and B:C ratio (1.45), respectively when flubendamide (480 SC @ 100 ml/ha and 20 WDG @ 50 g a.i./ha) was used in the management of pod borers in pigeonpea.

The sequential spraying of biorational insecticides involving botanicals, entomopathogens and synthetic insecticides, therefore, forms a better option for managing the resistant insect species, achieving the higher yield and ecological sustainability in pigeonpea ecosystem instead of using synthetic chemical insecticides alone.

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