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Effectiveness of Newer Insecticides Against Pigeonpea (*Cajanus cajana* (L.) Millsp) Pod Borers

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ABSTRACT

Insecticides indoxacarb 15.8 SC, chlorantraniliprole 18.5 SC and flubendiamide 480 SC were effective in suppressing the population of the pigeonepea pod borers. The sequential application of chlorantraniliprole - chlorantraniliprole 18.5 SC - indoxacarb 15.8 EC @ 73g a.i./ha was effective and recorded significantly least population of 0.27 larvae per plant. The gram pod borer *H. armigera* and the pod fly *M. obtusa* were registered least per cent damage of 5.34 and 3.82, respectively. The least pod damage of 2.21 per cent by the bruchid *C. chinesis* was observed in chlorantraniliprole – chlorantraniliprole - indoxacarb treated plot. Maximum yield of 1411 kg/ha with C:B ratio of 1:2.19 was recorded in chlorantraniliprole - chlorantraniliprole - indoxacarb treated plots. The next best sequence was chlorantraniliprole 15.8 EC - flubendiamide 480 SC - dimethoate 30 EC (1398kg/ha and 1:2.19 respectively).

Keywords: Pigeonpea, Pod borers and Insecticides

Low productivity of Pigeonpea *Cajanus cajana* (L.) is due to infestation of insect pests. About 250 insect species belonging to 8 orders and 61 families have been found to infest pigeonpea from seedling to harvesting stage and virtually no plant part is free from insect infestation. The gram pod borer *Helicoverpa armigera* is the major borer insect pest on pigeonpea. Insecticides are still the front line defence and vital component of the integrated pest management strategy. Farmers largely relay on use of insecticides for the management of the pod borers. This unilateral approach of controlling insect pests with only insecticides has necessitated the development of the cost effective, eco-friendly and safe management strategy for better management of these wide arrays of destructive insect pests. The knowledge on crop pest population fluctuation, natural enemy complex and the information on the effective biorationals are pre-requisite for the successful management of wide array of insect pests. A study was conducted to knew the efficacy of different insecticides against the Pigeonpea pod borers.

MATERIAL AND METHODS

A field experiment to evaluate the effectiveness of different molecules against pod borer complex on pigeonpea was carried out at the Gangdhi Krishi Vignana Kendra, Bengaluru during *Kharif*-2016. The experiment comprised of eight treatments including an untreated check and each treatment was replicated thrice. Pigeonpea entry BRG-2 was sown in a plot size of 6.30 x 5.0 m at the spacing of 90 cm between rows and 30 cm from plant to plant. Recommended package of practices were followed except plant protection measures. For each treatment of three insecticides were applied in sequence. Quantity of insecticide was determined for a plot size of 6.30 x 5.0 m. Calculated quantity of insecticide was sprayed

Particulars of the Treatments

Treat-ments	Insecticides
T_1	Indoxacarb – indoxacarb - indoxacarb 15.8 EC @73g .i./ha
T_2	: Acetamiprid – acetamiprid – acetamiprid 20 SP @ 20 g a.i./ha
T_3	Chlorantraniliprole 18.5 SC @ 30 g *a.i.*/ha - chlorantraniliprole 18.5 SC @ 30 g *a.i.*/ha - acephate 75 SP @ 750 g *a.i.*/ha
T_4	Chlorantraniliprole 18.5 SC @ 30 g *a.i.*/ha - chlorantraniliprole 18.5 SC 30 g *a.i.*/ha - acetamiprid 20 SP @ 20 g *a.i.*/ha

Treat-ments	Insecticides
T_5	Chlorantraniliprole 18.5 SC @ 30 g *a.i.*/ha - chlorantraniliprole 18.5 SC @30 g *a.i.*/ha - indoxacarb 15.8 EC @ 73 g *a.i.*/ha
T_6	Chlorantraniliprole 18.5 SC @ 30 g *a.i.*/ha - flubendiamide 480 SC @ 30 g*a.i.*/ha -dimethoate 30 EC @ 600 g *a.i.*/ha
T_7	: Dimethoate- dimethoate – dimethoate 30 EC @600g a.i./ha
T_8	Untreated

with the help of hand operated Knapsack sprayer. First treatment was imposed at flowering stage and subsequent treatments were given at 15 days interval based on thresh hold level of targeted insect pests.

The observations were recorded on larval count from each plot at a day prior and at three, five and seven days after treatment. Data thus obtained were subjected to (“x +0.5) transformation prior to statistical analysis. Pod damage due to the pigeonpea pod borer *H. armigera*, was recorded at harvest by observing randomly plucked 100 pods from five tagged plants. Grain yield was recorded from net plot and computed to hectare basis and economics was worked out.

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

Results and Discussion

Mean larval count during third spray after third day of treatment recorded significantly least population of 0.27 larvae per plant in chlorantraniliprole - chlorantraniliprole - indoxacarb treated plot, followed by indoxacarb - indoxacarb - indoxacarb sequential treatment (0.43 larvae/plant). Similar trend was observed at fifth and seventh days after treatment in sequence of chlorantraniliprole -chlorantraniliprole - indoxacarb treatments that recorded 0.05 and 0.03 larvae per plant. The next best treatment was indoxacarb – indoxacarb – indoxacarb, that recorded least larval number of 0.13 and 0.03 larvae per plant at fifth and seventh days after treatment (Table 1). Similar effect of these molecules were also observed by the earlier workers Naresh *et al.* (2012), Sreelakshmi *et al.* (2016), Carneiro *et al.* (2014), Babar *et al.* (2011) and Biradar and Jagginavar (2016). The effectiveness of these molecules may be due to their quick knockdown effect and longer residual toxicity.

The gram pod borer *H. armigera* inflicted least pod damage of 5.34 per cent in chlorantraniliprole - chlorantraniliprole - acetamaprid treated plots. Significantly, higher pod damage of 32.94 per cent was noticed in the untreated plots, followed by dimethoate - dimethoate - dimethoate treated plot where, the pod damage was 25.52 per cent (Table 2).

Significantly, least per cent pod damage by the pod fly *M. obtusa* (3.82 and 3.90) was recorded in chlorantraniliprole - chlorantraniliprole - acetamiprid and dimethoate - dimethoate - dimethoate treated plots. Higher pod damage of 9.09 and 8.06 per cent was recorded in untreated plot and indoxacarb - indoxacarb-indoxacarb treated plots respectively. The least pod damage of 3.78 per cent by the bruchid *C. chinesis* was observed in chlorantraniliprole – chlorantraniliprole - indoxacarb treated plot, which was statistically on par with indoxacarb - indoxacarb - indoxacarb treated plot (2.65%). Higher per cent pod damage of 4.99 was noticed in the untreated plots, which was statistically on par with the chlorantraniliprole - chlorantraniliprole - acetamiprid treated plot (4.18%) (Table 2). The effectiveness of these molecules are similar to the findings of Babar *et al.* (2011), Deshmukh *et al.* (2005), Hanumantharaya *et al.* (2013) and Sreekanth *et al.* (2015).

Higher grain yield of (1411 kg/ha) was recorded from chlorantraniliprole - chlorantraniliprole - indoxacarb treated plots. Which were on par with chlorantraniliprole - flubendiamide - dimethoate and indoxacarb - indoxacarb - indoxacarb treated plots which registered the grain yield of 1398 kg/ha and 1256 kg/ha, respectively (Table 3). The chlorantraniliprole - chlorantraniliprole - indoxacarb and chlorantraniliprole - flubendiamide - dimethoate treated plots were recorded higher B:C ratio of (1:2.19). These

TABLE 1

Effectiveness of insecticides against *H. armigera* on pigeonpea

Treatments	Number of larvae per plant											
	1st Spray				2nd Spray				3rd Spray			
	3 DAT	5 DAT	7 DAT	Mean	3 DAT	5 DAT	7 DAT	Mean	3 DAT	5 DAT	7 DAT	Mean
Indoxacarb - indoxacarb indoxacarb 15.8 EC @73g .i./ha	0.93 (1.38) c	0.43 (1.19) c	0.30 (1.14) c	0.55 (1.23)	0.63 (1.27) c	0.41 (1.18) c	0.23 (1.11) c	0.42 (1.18)	0.43 (1.20) bc	0.13 (1.06) bc	0.03 (1.02) c	0.19 (1.09)
Acetamiprid - acetamiprid - acetamiprid 20 SP@ 20 g a.i./ha	4.00 (2.23) b	3.00 (1.99) b	2.33 (1.82) b	3.11 (2.01)	2.73 (1.91) b	2.00 (1.72) b	1.43 (1.55) b	2.05 (1.72)	1.87 (1.68) b	1.20 (1.47) b	0.97 (1.40) b	1.34 (1.51)
Chlorantraniliprole - chlorantraniliprole -18.5 SC @30ga.i./ha -acephate 75SP	0.90 (1.37) c	0.37 (1.17) c	0.10 (1.05) c	0.45 (1.19)	0.57 (1.25)c	0.30 (1.14) c	0.17 (1.08) c	0.34 (1.15)	0.97 (1.40) bc	0.67 (1.29) bc	0.28 (1.13) bc	0.64 (1.27)
Chlorantraniliprole chlorantraniliprole 18.5 SC - acetamiprid 20 SP@20 g	0.77 (1.32) c	0.30 (1.14) c	0.10 (1.05) c	0.39 (1.17)	0.23 (1.11) c	0.13 (1.06) c	0.07 (1.03) c	0.14 (1.06)	1.20 (1.48) bc	0.83 (1.35) bc	0.47 (1.21) bc	0.83 (1.34)
Chlorantraniliprole 18.5 SC - chlorantraniliprole -indoxacarb 15.8 EC @73g a.i./ha	0.80 (1.33) c	0.33 (1.15) c	0.13 (1.06) c	0.42 (1.18)	0.50 (1.22) c	0.26 (1.12) c	0.10 (1.05) c	0.28 (1.13)	0.27 (1.12) c	0.05 (1.02) c	0.03 (1.02) c	0.11 (1.05)
Chlorantraniliprole 18.5 SC - flubendiamide 480 SC @ 30g a.i./ha -dimethoate 30 EC @600g a.i./ha	1.03 (1.43) c	0.53 (1.24) c	0.27 (1.13) c	0.61 (1.26)	0.64 (1.27) c	0.33 (1.15) c	0.13 (1.06) c	0.36 (1.16)	1.10 (1.42) bc	0.63 (1.26) bc	0.38 (1.17) bc	0.70 (1.28)
Dimethoate- dimethoate - dimethoate 30 EC @600g a.i./ha	4.17 (2.26) b	3.33 (2.08) b	2.33 (1.82) b	3.27 (2.05)	3.83 (2.16) b	2.57 (1.86) b	1.53 (1.59) b	2.64 (1.87)	1.80 (1.65) b	1.08 (1.43) bc	0.87 (1.35) bc	1.25 (1.47)
Untreated	6.40 (2.70) a	7.00 (2.81) a	7.33 (2.85) a	6.91 (2.78)	7.80 (2.94) a	8.30 (3.02) a	9.00 (3.14) a	8.36 (3.03)	10.20 (3.33) a	10.67 (3.40) a	11.20 (3.48) a	10.69 (3.40)
S. Em±	0.08	0.06	0.07	-	0.10	0.09	0.07	-	0.09	0.07	0.06	-
CD at 5 %	0.24	0.19	0.21	-	0.32	0.28	0.21	-	0.27	0.22	0.19	-
CV (%)	13.64	11.69	14.08	-	13.00	11.11	14.62	-	13.06	12.48	12.62	-

TABLE 2

Effectiveness of insecticides on pod damage and grain yield of pigeonpea

Treatments	Per cent pod damage			Yield kg/ha
	*H. armigera**	*M. obtusa**	*C. chinensis**	
Indoxacarb - indoxacarb - indoxacarb 15.8 EC @73g .i./ha	7.69 (16.07) [ef]	8.06 (16.47) [b]	2.65 (9.35) [cd]	1256 [ab]
Acetamiprid - acetamiprid - acetamiprid 20 SP@ 20 g a.i./ha	19.76 (26.32) [c]	5.43 (13.42) [cd]	2.96 (9.85) [bcd]	96 [b]
Chlorantraniliprole - chlorantraniliprole -18.5 SC @30ga.i./ha - acephate 75SP	12.20 (20.42) [d]	6.73 (15.01) [bc]	2.91 (9.79) [bcd]	1164 [b]
Chlorantraniliprole 18.5 SC - chlorantraniliprole - acetamiprid 20 SP@20 g	5.34 (13.34) [f]	3.82 (11.24) [e]	4.18 (11.78) [a]	1166 [b]
Chlorantraniliprole - chlorantraniliprole 18.5 SC - indoxacarb 15.8 EC @73g a.i./ha	5.86 (13.97) [ef]	4.72 (12.53) [de]	3.78 (11.20) [abc]	1411 [a]
Chlorantraniliprole 18.5 SC - flubendiamide 480 SC @ 30g a.i./ha -dimethoate 30 EC @600g a.i./ha	8.23 (16.66) [e]	5.15 (13.06) [de]	3.99 (11.50) [ab]	1398 [a]
Dimethoate-dimethoate-dimethoate 30EC@600g a.i./ha	25.52 (30.31) [b]	3.90 (11.36) [e]	2.21 (8.42) [d]	928 [b]
Untreated	32.94 (34.99) [a]	9.09 (17.53) [a]	4.99 (10.59) [a]	649 [c]
S. Em±	0.50	0.33	0.33	35.46
CD at 5 %	1.51	1.00	0.99	107.53
CV (%)	12.50	14.17	11.24	12.21

*Figures in parenthesis are arcsin transformed values

TABLE 3

Cost effectiveness of insecticides against *H. armigera*

Treatments	Cost of Production (Rs/ha)	Cost of Protection (Rs/ha)	Totalcost	Mean yield (kg/ha)	Gross Return (Rs)	Net Return (Rs)	B:Cratio
Indoxacarb - indoxacarb - - indoxacarb 15.8 EC @73g .i./ha	19,700	3660	23360	1256 [ab]	50240	26880	1:2.10
Acetamiprid - acetamiprid - acetamiprid 20 SP@ 20 g a.i./ha	19,700	546	20246	961 [b]	38440	18194	1:1.89
Chlorantraniliprole - chlorantraniliprole -18.5 SC @30ga.i./ha -acephate 75SP	19,700	5086	24785	1164 [b]	46560	21775	1:1.87
Chlorantraniliprole - chlorantraniliprole 18.5 SC - acetamiprid 20 SP @ 20 g	19,700	4980	24680	1166 [b]	46640	21960	1:2.12
Chlorantraniliprole 18.5 SC - chlorantraniliprole-indoxacarb 15.8 EC @73g a.i./ha	19,700	6020	25720	1411 [a]	56440	30720	1:2.19
Chlorantraniliprole 18.5 SC - flubendiamide 480 SC @ 30g a.i./ha - dimethoate 30 EC @ 600g a.i./ha	19,700	5830	25530	1398 [a]	55920	20390	1:2.19
Dimethoate- dimethoate - dimethoate 30 EC @ 600g a.i./ha	19,700	1290	20990	928 [b]	37120	18530	1:1.76
Untreated	19,700	0	19700	649 [c]	25960	6260	1:1.30

finding were in accordance with Deshmukh *et al*. (2005) and Kambrekar *et al*. (2012).

The sequential spray of Chlorantraniliprole - Chlorantraniliprole 18.5 SC - Indoxacarb 15.8 EC @ 73g a.i./ha was effective compared to the treatments evaluated during the studies. Pod damage by gram pod borer *H. armigera* and by the pod fly *M. obtusa* was least in chlorantraniliprole - chlorantraniliprole - acetamaprid treated plots. Maximum yield of 1411 kg/ ha with C:B ratio of 1:2.19 was recorded in chlorantraniliprole - chlorantraniliprole - indoxacarb treated plots. The next best treatment was Chlorantraniliprole 15.8 EC - Flubendiamide 480 SC - Dimethoate 30 EC.

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