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Management of Pod Bug, *Clavigralla gibbosa* Spinola (Heteroptera: Coreidae) on Pigeonpea

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ABSTRACT

The study was carried out to evaluate some insecticides against pod bug, *Clavigralla gibbosa* Spinola in pigeonpea during *kharif* 2017-18 at Agricultural Research Station, Kalaburagi, Karnataka, India under field conditions with nine treatments and three replications. The flonicamid 50 WG recorded significantly lowest population of 0.67 bugs per plant while the bug population in acephate 75 SP and thiamethoxam 25 WG was 0.87 and 1.00 bug/plant, respectively and all the three were statistically on par. The maximum population reduction over control was registered in the plot treated with flonicamid 50 WG (94.91 %) followed by acephate 75 SP (93.22 %), tolfenpyrad 15 EC (79.37%) and fipronil 5 EC (77.97 %) at 10 days after spray. Pod damage due to pod bug was lowest in plot treated with flonicamid 50 WG (9.33%) followed by acephate 75 SP (10.67%) and highest in buprofezin 20 SC (16.33%). The grain damage was lowest in flonicamid 50 WG (6.77%) followed by acephate 75 SP (8.72%). Highest grain yield of 1313.27 kg/ha was registered in flonicamid 50 WG followed by acephate 75 SP (1270.31 kg/ha). Similarly, highest benefit: cost ratio of 2.42 in flonicamid 50 WG and 2.38 in acephate 75 SP and was higher than other treatments. Hence, these two insecticides can be suggested for effective management of pigeonpea pod bug.

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is the second most important pulse crop of the country next to chickpea. A number of factors are responsible for the lower productivity of pigeonpea of which mainly includes biotic as well as abiotic factors. Among biotic factors, insect pests are the key elements contributing for the economic loss of pigeonpea both in field and storage. A large number of insect pests (more than 300 species) attack pigeonpea (Prasad and Singh, 2004). Insects that attack the reproductive structures of plant cause maximum yield losses (Rangaiah and Sehgal, 1984). Among the pod damaging insect pests of pigeonpea next to pod borer, *Helicoverpa armigera* Hubner, *Maruca vitrata*

(Fab.) and pod fly, *Melanagromyza obtusa* (Malloch) pod bug, *Clavigralla gibbosa* Spinola is most important pest in India inflicting heavy loss to seed yield. The pod bug damage recorded 25 to 40 per cent in pigeonpea and also can reduce pod and grain weight by 27 and 30 times respectively at 12 nymphs/plant (Adati *et al.,* 2007). The economic threshold level of one nymph/plant and economic injury level of two nymphs/plant have potential to cause the yield loss.

In recent years pod bug, *C. gibbosa* causing threat to quality grain production in pigeonpea. Both nymphs and adults of the pod bug suck the sap from pods, grains, flowers and flower buds. The punctured pods exhibit reddish brown to dark brown patches on the surface of pods and premature drying of pods is noticed. When such pods are opened, shrivelled and malformed seeds are observed. Further such seeds are easily succumbed to secondary infection by fungal disease and pose problems in post harvesting processes. The main reason for outbreak of the pest is due to continuous and indiscriminate use of same insecticide, monocropping and introduction of early and extra early maturing pigeonpea genotypes (Bharathimeena and Sudharma, 2009; Hanumanthaswamy *et al.,* 2009) and also due to favourable temperature and humidity during reproductive stage of the crop (Singh *et al.,* 2008). Under these circumstances the investigation on pod bug particularly on management of this pest needs to be strengthened as the available in formation is very meagre. Keeping this point in view, present investigation was carried out for the management of pod bug, *C. gibbosa* in pigeonpea.

Materials and Methods

The present investigation was conducted at Agricultural Research Station, Kalaburagi during *kharif* 2017. The experiment was conducted in randomized block design (RBD) to measure the efficacy of different new chemistry insecticides. Nine chemical insecticides *viz.,* buprofezin 20 SC, flonicamid 50 WG, tolfenpyrad 15 EC, fipronil 5 EC, thiamethoxam 25 WG, diafenthiuron 50 WP, dinotefuran 20 SG, acephate 75 SP and untreated control (Table 1) where evaluated against *C. gibbosa* in the field conditions with three replications. The variety TS-3R was sown on 4th July 2017 in a plot size of 6.3 m x 4 m with a spacing of 90 cm between rows and 20 cm between plants were maintained.

All the package of practices (Anon. 2017) was followed, except for the management of sucking pests. Pod borer, *Helicoverpa armigera* was managed by manual collection and repeated spraying of *Ha*NPV. The treatments were imposed twice with first application at tender pod stage followed by second spray after 20 days with Knapsack sprayer fitted with hollow cone nozzle. Observations were recorded at harvest for both pod and grain damage from five randomly selected plants from each plot. For pod damage all the pods of five selected plants were assessed. Hundred pods were selected randomly among the pods of five plants for estimating grain damage. The per cent pod damage, per cent grain damage and grain yield per plot were recorded. The grain yield (kg ha^{-1}) was computed and subjected to statistical analysis.

Results and Discussion

Prior to imposition of treatments pest population count was made on one day before spray and it revealed that all the treatments including check had pod bug population ranging from 3.00 to 3.47 bugs per plant and were statistically non-significant indicating uniformity of pest population in the experimental plot (Table 1). Ten days after treatment, the effect of treatments was more prominent indicating real efficacy of chemicals. Bug population was ranged from 0.67 to 3.33 per plant. The flonicamid 50 WG recorded lowest population of 0.67 bugs per plant while the bug population in acephate 75 SP and thiamethoxam 25 WG was 0.87 and 1.00 bug/plant, respectively and all the three were statistically on par (Table 1). The treatments like tolfenpyrad 15 EC, fipronil 5 EC, dinotefuran 20 SG and diafenthiuron 50 WP recorded a population of 1.07, 1.13, 1.33 and 1.47 bugs per plant respectively and were on par with each other. The maximum bugs population (3.33 bugs/plant) was observed in untreated check. Reduction of pod bug population over control was worked out and found highest reduction in flonicamid 50 WG (79.70 %) followed by acephate 75 SP and tolfenpyrad 15 EC (73.87 %). The least reduction of bug population among chemical treatments was seen in the buprofezin 20 SC (49.87 %) sprayed plots (Table 1).

Bug population one day before second spray ranged from 2.40 to 3.40 per plant (Table 1). The minimum number of bugs recorded on flonicamid 50 WG (2.40 bugs/plant) which was significantly superior over other treatments. Significantly highest bug population (3.40 bugs / plant) was observed in untreated check. Ten days after second spray, it was drastically decreased treated plots.

The effective molecule flonicamid 50 WG recorded lowest population of 0.15 bugs per plant while the bug population in acephate 75 SP (0.20 bug/plant) and were statistically at par. The treatments like tolfenpyrad 15 EC and fipronil 5 EC recorded a population of 0.61 and 0.65 bug per plant respectively and were on par with each other. Diafenthiuron 50 WP was the least effective treatment recorded 0.85 bug per plant and it was significantly superior over control (Table 1). The maximum population reduction over control was observed in the plot treated with flonicamid 50 WG (94.91 %) followed by acephate 75 SP (93.22 %), tolfenpyrad 15 EC (79.37%) and fipronil 5 EC (77.97 %). Similarly, on Bt cotton Chandi *et al.,* (2016) found that flonicamid 50 WG was effective in managing the sucking insect pests particularly leafhoppers. Kumar and Nath (2003) demonstrated that insecticidal applications significantly controlled *C. gibbosa* on pigeonpea and all the treatments were found superior over the control.

The per cent pod damage ranged from 9.33 percent in flonicamid 50 WG to 16.33% in buprofezin 20 SC. While in control plot the damage was 19.33%. All the treatments were found to be superior over control with respect to percent pod damage. The relative performance of various insecticides on pod damage against pod bug was found in order of flonicamid 50 WG (9.33%) > acephate 75 SP (10.67%) > tolfenpyrad 15 EC (12.67%) > thiamethoxam 25 WG (13.00%) > fipronil 5 EC (13.33%) > diafenthiuron 50 WP (14.67%) > Dinotefuran 20 SG (15.00%) > buprofezin 20 SC (16.33%). Further untreated control recorded the highest pod damage of 19.33 per cent and was found to be significantly inferior to all other treatments (Table 2). The present findings on efficacy of acephate 75 SP were in corroborates with Gopali *et al.,* (2013) found that methomyl 40 SP @ 1.0g/l was superior followed by chlorpyriphos 20 EC @ 2.5 ml/l and acephate 75 SP @ 1.0g/l. They opined that broad-spectrum insecticides listed above were most effective in suppressing the pod bug population and recorded higher grain yield with maximum net profit and B: C ratio. The flonicamid 50 WG reduced 51.72 per cent pod damage over untreated control followed by acephate 75 SP, tolfenpyrad 15 EC and thiamethoxam 25 WG were 44.83, 34.48 and 32.76 per cent, respectively (Table 1). The minimum pod damage reduction over control was observed in buprofezin 20 SC (15.52 %).

Table.1 Effect of insecticides on the population of pod bugs

Treatments	bugs per plant					
	First spray			Second spray		
	1 DBS	10 DAS	Reduction over untreated check (%)	1 DBS	10 DAS	Reduction over untreated check (%)
T_1: Buprofezin 20 SC @ 200 g.a.i./ha	3.40 (1.97)[a]	1.67 (1.47)[e]	49.39	3.20 (1.92)[de]	0.82 (1.15)[b]	72.20
T_2 :Flonicamid 50 WG @ 100 g.a.i./ha	3.20 (1.92) [a]	0.67 (1.08)[a]	79.70	2.40 (1.70)[a]	0.15 (0.81)[a]	94.91
T_3:Tolfenpyrad 15 EC @ 150 g.a.i./ha	3.20 (1.92) [a]	1.07 (1.25)[bcd]	67.87	2.87 (1.83)[cd]	0.61 (1.05)[b]	79.32
T_4:Fipronil 5 EC @ 50 g.a.i./ha	3.20 (1.92) [a]	1.13 (1.27)[bcd]	66.07	2.47 (1.72)[ab]	0.65 (1.07)[b]	77.97
T_5 :Thiamethoxam 25 WG @ 50 g.a.i./ha	3.47 (1.99) [a]	1.00 (1.22)[abc]	69.97	2.80 (1.82)[bcd]	0.71 (1.10)[b]	75.93
T_6:Diafenthiuron 50 WP @ 300 g.a.i./ha	3.00 (1.87) [a]	1.47 (1.40)[de]	55.86	3.13 (1.91)[de]	0.85 (1.16)[b]	71.19
T_7:Dinotefuran 20 SG @ 40 g.a.i./ha	3.40 (1.97) [a]	1.33 (1.35)[cde]	60.06	3.07 (1.89)[de]	0.79 (1.14)[b]	73.22
T_8:Acephate 75 SP @ 750 g.a.i./ha	3.33 (1.96) [a]	0.87 (1.16)[ab]	73.87	2.53 (1.74)[abc]	0.20 (0.84)[a]	93.22
T_9:Untreated control	3.40 (1.97) [a]	3.33 (1.96)[f]	-	3.40 (1.97)[e]	2.95 (1.86)[c]	-
S.Em±	0.04	0.05		0.03	0.04	
CD at (p=0.05)	NS	0.14		0.10	0.12	

Values in parenthesis are √x+0.5 transformed
Means followed by same alphabet in columns did not differ significantly (p=0.05) by DMRT

Table.2 Influence of insecticides spray on pod damage and yield of pigeonpea due to pod bug

Treatments	Pod damage (%)	Pod damage reduction over control (%)	Grain damage (%)	Grain damage reduction over control (%)	Grain yield (kg/ha)	Increase in yield over control (%)
T_1: Buprofezin 20 SC @ 200 g.a.i./ha	16.33 $(23.82)^{e}$	15.52	13.84 $(21.84)^{e}$	19.17	1098.18^{ef}	10.23
T_2 :Flonicamid 50 WG @ 100 g.a.i./ha	9.33 $(17.78)^{a}$	51.72	6.77 $(15.07)^{a}$	60.48	1313.27^{a}	31.81
T_3:Tolfenpyrad 15 EC @ 150 g.a.i./ha	12.67 $(20.83)^{bc}$	34.48	10.06 $(18.48)^{bc}$	41.25	1239.94^{abc}	24.45
T_4:Fipronil 5 EC @ 50 g.a.i./ha	13.33 $(21.40)^{cde}$	31.03	12.51 $(20.71)^{de}$	26.96	1209.51^{bcd}	21.40
T_5 :Thiamethoxam 25 WG @ 50 g.a.i./ha	13.00 $(21.11)^{cd}$	32.76	11.46 $(19.77)^{cd}$	33.09	1154.27^{cde}	15.86
T_6:Diafenthiuron 50 WP @ 300 g.a.i./ha	14.67 $(22.50)^{cde}$	24.14	12.78 $(20.93)^{de}$	25.38	1065.94^{ef}	6.99
T_7:Dinotefuran 20 SG @ 40 g.a.i./ha	15.00 $(22.78)^{de}$	22.41	13.08 $(21.19)^{de}$	23.63	1136.65^{de}	14.09
T_8:Acephate 75 SP @ 750 g.a.i./ha	10.67 $(19.05)^{ab}$	44.83	8.72 $(17.17)^{b}$	49.06	1270.31^{ab}	27.50
T_9:Untreated control	19.33 $(26.08)^{f}$		17.12 $(24.43)^{f}$		996.30^{f}	
S.Em±	**0.61**		**0.48**		**35.23**	
CD at (p=0.05)	**1.82**		**1.45**		**105.62**	

Values in parenthesis are arcsine transformed
Means followed by same alphabet in columns did not differ significantly (p=0.05) by DMRT

Table.3 Cost economics of pod bug management through insecticides application

Treatments	Grain yield (kg/ha)	Gross returns (Rs)	Protection cost (Rs)	Crop production costs (Rs)	Total cost (Rs)	Net returns (Rs)	B:C Ratio
T_1: Buprofezin 20 SC @ 200 g.a.i./ha	1098	59841	2600	27170	29770	30071	2.01
T_2 :Flonicamid 50 WG @ 100 g.a.i./ha	1313	71559	2400	27170	29570	41989	2.42
T_3:Tolfenpyrad 15 EC @ 150 g.a.i./ha	1240	67580	8000	27170	35170	32410	1.92
T_4:Fipronil 5 EC @ 50 g.a.i./ha	1210	65945	2800	27170	29970	35975	2.20
T_5 :Thiamethoxam 25 WG @ 50 g.a.i./ha	1154	62893	1480	27170	28650	34243	2.20
T_6:Diafenthiuron 50 WP @ 300 g.a.i./ha	1066	58097	3920	27170	31090	27007	1.87
T_7:Dinotefuran 20 SG @ 40 g.a.i./ha	1137	61967	3200	27170	30370	31597	2.04
T_8:Acephate 75 SP @ 750 g.a.i./ha	1270	69215	1920	27170	29090	40125	2.38
T_9:Untreated control	996.3	54282	-	27170	27170	27112	2.00
S.Em±							
CD at (p=0.05)							

Market price of pigeonpea grains Rs. 5450 per quintal
B: C ratio = Gross returns / Total cost

The treatments applied showed significant differences in the percent grain damage by pod bug and data are given in Table 2. The percent grain damage ranged from 6.77% in flonicamid 50 WG to 13.84% in buprofezin 20 SC. While in control plot the damage was 17.12%. All the treatments were found to be superior over control with respect to percent gain damage. The minimum grain damage was recorded in plot treated with flonicamid 50 WG and it was significantly superior over all other treatments. The relative performance of various insecticides on grain damage against pod bug was found in order of flonicamid 50 WG (6.77%) > acephate 75 SP (8.72%) > tolfenpyrad 15 EC (10.06%) > thiamethoxam 25 WG (11.46%) > fipronil 5 EC (12.51%) > diafenthiuron 50 WP (12.78%) > Dinotefuran 20 SG (13.08%) > buprofezin 20 SC (13.84%). Further untreated control recorded the highest grain damage of 17.12 per cent and was found to be significantly inferior to all other treatments. The flonicamid 50 WG reduced 60.48 per cent grain damage over untreated control followed by acephate 75 SP (49.06%) and tolfenpyrad 15 EC (41.25%). The minimum grain damage reduction over control was observed in buprofezin 20 SC (19.17%). Present findings were in line with Chandi *et al.*, (2016) who found that Flonicamid 50 WG was effective against sucking insect pests of *Bt* cotton. Similarly, Chinna *et al.*, (2017) reported that flonicamid 50 WG found most effective in controlling sucking pest population in cotton and also reported modern insecticides are relatively safer to the natural beneficial fauna. These reports support our findings on efficacy of Flonicamid 50 WG in bringing the population of pod bugs in pigeonpea.

The highest grain yield was recorded from flonicamid 50 WG (1313.27 kg/ha) treated plot and minimum grain yield recorded from diafenthiuron 50 WP (1065.94 kg/ha) (Table 2). But all the insecticidal treatments recorded significantly higher grain yield as compared to untreated control (996.30 kg/ha).

Further worked out the yield protection over untreated check and found that flonicamid 50 WG was superior (31.81% more yield) followed by acephate 75 SP (27.50 %), tolfenpyrad 15 EC (24.45 %) and fipronil 5 EC (21.40 %). The present result was in accordance with Namade *et al.*, (2017) who stated flonicamid 50 WG @ 100 g a.i./ha was found very effective in controlling the cotton sucking pests and also gave higher yield.

The net profit was highest in flonicamid 50 WG (Rs. 41989/ha) followed by acephate 75 SP (Rs. 40125/ha) and fipronil 5 EC (Rs. 35975/ha). The lowest net profit was recorded in diafenthiuron 50 WP (Rs. 27007/ha) and buprofezin 20 SC (Rs. 30071/ha), respectively (Table 3). Highest benefit: cost ratio was recorded in flonicamid 50 WG (2.42) followed by acephate 75 WS (2.38).

Lowest benefit: cost ratio was recorded in diafenthiuron 50 WP (1.87) and tolfenpyrad 15 EC (1.92), respectively which were less than the untreated control (2.00).

The present study concluded that broad spectrum insecticides are effective in suppressing pod bug population with higher grain yield and B: C ratio like flonicamid 50 WG and acephate 75 SP against pod bug. Hence, these chemicals may be considered for recommendation in alternate sprays for managing the pod bug in pigeonpea.

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