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P Thilagam
Assistant Professor, Agricultural Entomology, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu, India

A Gopikrishnan
Assistant Professor, Plant Breeding and Genetics, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu, India

D Dinakaran
Professor, Plant Pathology & Head, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu, India

Corresponding Author:
P Thilagam
Assistant Professor, Agricultural Entomology, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu, India

Evaluation of chemical insecticides for the management of podbug, *Clavigralla gibbosa* Spinola in pigeonpea

P Thilagam, A Gopikrishnan and D Dinakaran

Abstract
Two field experiments were conducted during *Kharif*, 2018 and 2019 to evaluate the efficacy of chemical insecticides against podbug, *Clavigralla gibbosa* (Spinola) in pigeonpea. Among the chemical insecticides tested, the plots treated with Acephate 75 SP @ 750 g a.i ha^{-1} was found to be effective and recorded 3.00 Nos per plant at 3 DAT after first spray. The second effective chemical insecticides *viz*., Acetamiprid 20 SP @ 20 g a.i ha^{-1} (3.44 Nos / plant) and Qunialphos 25 EC @ 250 g a.i ha^{-1} (4.00 Nos / plant) were found to be on par with each other at 3 DAT. This was followed by the next two treatments *viz*., Chlorpyriphos 20 EC @ 250 g a.i ha^{-1} and Fipronil 80 WG @ 50 g a.i ha^{-1} (4.33 Nos / plant) which were on par with each other. The fourth effective treatment was Profenophos 50 EC @ 500 g a.i ha^{-1} (4.67 Nos / plant) treated plots, The highest population of podbug was recorded in Deltamethrin 2.8 EC@ 12.5 g a.i. ha^{-1} (5.78 Nos./plant) treated plots. In relation to the grain damage, the lowest was recorded in Acephate 75 SP @ 750 g a.i. ha^{-1} treated plots with the highest grain yield of 1143.3 kg ha^{-1} and contributes 58.1 per cent of yield increase over untreated check (723.3 kg ha^{-1}).

Keywords: Field efficacy, chemical insecticides, Pod bug, *Clavigralla gibbosa*, Pigeonpea

Introduction
Pigeonpea (*Cajanus cajan* L.) is an important pulse crop in the semi-arid tropics and sub-tropics which provides high quality vegetable protein, animal feed and firewood (Mittal and Ujagir, 2005) [4]. In India, pigeonpea is grown in 4.42 million ha with an annual production of 2.89 million tonnes with 655 kg ha^{-1} of productivity. Several insects have been reported to infest pigeonpea crop at different stages during its growth period in different parts of the country (Reddy *et al*., 2001) [8]. The three most important groups of pests: flower and pod feeding Lepidoptera, pod-sucking hemiptera and seed feeding Diptera and Hymenoptera. In pigeonpea, pod-sucking bug, *Clavigralla gibbosa* Spinola which feeds on pods is restricted to India and Srilanka (Dolling, 1978). The tur podbug, *Clavigralla gibbosa* (Spinola) is one the important pod damaging insects of pigeonpea. This is the most serious pest causing losses to pigeonpea next to gram podborer, *Helicoverpa armigera* (Odak *et al*., 1976) [7]. The feeding behavior of the nymphs and adults of this bug results in premature shedding of flowerbuds, flowers and pods, deformation of pods and shriveling of grains which results in substantial losses to pigeonpea. Among all, podsucking bug, *C.gibbosa* is predominant in Vellore district of Tamil Nadu which contributes yield loss equivalent to that of other podborer complex. Thus, attempts were made in the present investigation to study the effect of chemical insecticides against podbug.

Materials and Methods
Two field experiments were conducted at Agricultural Research Station, Virinjipuram during *Kharif* 2018 and 2019. The experiment was laid out in a randomized block design (RBD) using pigeonpea var. CO Rg7 with eight treatments and three replications in a plot size of 5.0 m x5.0m with a spacing of 90x30 cm. The crop was raised with recommended agronomic practices. Totally, two sprays were given at 15 days interval commenced from pod formation stage using hand operated knapsack sprayer with a spray volume of 500L/ha. The population of *C. gibbosa* was recorded on five randomly selected plants in each plot before 24 hours of spraying which will be further converted in to per plant population and subsequent observations will be recorded at 3 and 7 days after treatment (DAT) on same plants. Five plants in each plot will be selected randomly and all the pods from five plants were pooled together and finally 100 pods were picked up for grain damage assessment and yield was recorded. The data, thus obtained were subjected to RBD analysis using AGRES package (Gomez and Gomez, 1984) [2].

Per cent grain damage was calculated by using the following formula (Naresh and Singh, 1984) [6].

$$\text{Percent grain damage} = \frac{\text{Number of damaged grains}}{\text{Total number of grains}} \times 100$$

Results and Discussion

The results on the population of podbugs after the application of treatments during *Kharif* 2018 and 2019 were presented in Table 1. During *Kharif* 2018, the precount population of podbugs was taken from each treatment before the application of treatments and ranged from 6.56 – 6.78 Nos. per plant. Among the eight treatments tested, T_7. Acephate 75 SP @ 750 g a.i ha^{-1} was found to be effective and recorded 3.00 and 3.33 Nos per plant, respectively at 3 and 7 DAT after first spray. This treatment was also found to be effective even after second spray also. The second effective treatments *viz*., T_6- Acetamiprid 20 SP @ 20 g a.i ha^{-1} (3.44 Nos / plant) and T_5- Qunialphos 25 EC @ 250 g a.i ha^{-1} (4.00 Nos / plant) were found to be on par with each other at 3 DAT. This was followed by the next two treatments *viz*., T_2- Chlorpyriphos 20 EC @ 250 g a.i ha^{-1} and T_3- Fipronil 80 WG @ 50 g a.i ha^{-1} (4.33 Nos / plant) were on par with each other. The fourth effective treatment was T_4- Profenophos 50 EC @ 500 g a.i ha^{-1} (4.67 Nos / plant) treated plots. The highest population of podbug was recorded in T_1: Deltamethrin 2.8 EC@ 12.5 g a.i. ha^{-1} (5.78 Nos./plant) treated plots, whereas the untreated plots recorded 7.78 Nos per plant. The similar trend in the efficacy of the treatments tested was noticed at 7 DAT of first spray. The observations on 3 and 7 DAT after the second round of application of treatments also followed the similar trend showing the consistency and efficacy of the treatments.

During *Kharif* 2019, the precount population of podbugs was taken from each treatment before the application of treatments and ranged from 6.56 – 7.11 Nos. per plant. The observations taken after first spray at 3 DAT showed that there was a reduction in the podbug population in all the treatments tested. Among the eight treatments tested, T_7: Acephate 75 SP @ 750 g a.i. ha^{-1} showed effective and recorded with 3.11 Nos. per plant followed by T_6:Acetamiprid 20 SP @ 20 g a.i. ha^{-1}(3.89 Nos./plant) and T_5: Quinalphos 25 EC@ 350 g a.i. ha^{-1} (4.44 Nos./plant). The highest population of podbug was recorded in T_1: Deltamethrin 2.8 EC@ 12.5 g a.i. ha^{-1} (5.56 Nos./plant) treated plots, whereas the untreated plots recorded 7.44 Nos per plant. The same trend of population reduction was noticed even after second spray also. In the efficacy on the study of grain damage assessment, the lowest was recorded in T_7: Acephate 75 SP @ 750 g a.i. ha^{-1} treated plots with the highest grain yield of 1143.3 kg ha^{-1} with 58.1 per cent of yield increase over untreated check (723.3 kg ha^{-1}). All the treatments tested were found effective and superior when compared with untreated plots.

Bhuvaneswari and Balagurunathan (2002) [1] showed that under field condition four round of Endosulfan 35 EC at 35 g a.i. per ha recorded less damage compared with untreated control. Narasimhamurthy and Ram Keval (2013) [5] reported that there was a significant difference in the relative performance of various insecticides was found in order of spinosad 45% SC at 73 g a.i/ha>indoxacarb 14.5 SC at 60 g a.i/ha> monocrotophs 36 SL> endosulfan 35 EC> Dimethoate 30 EC> NSKE 5%. The results are also in concordance with the findings of Gopali *et al*., 2013 [3] who reported that methomyl 40 SP @ 1.0 g/l was found to be significantly superior followed by chlorpyriphos 20 EC @ 2.5 ml/l and acephate 75 SP @ 1.0 g/l indicating that broad spectrum insecticides are effective in suppressing the pod bug population and recorded higher grain yield with higher net profit and B: C ratio. They also reported that new molecules such as Indoxacarb 14.5 SC @ 0.3 ml/l, spinosad 45 SC @ 0.1 ml/l, emamectin benzoate 05SC @ 0.2 g/l, rynaxypyr 18.5 SC @ 0.15 ml/l and *Verticillium lecanii* @ 1× 10 10 conidia were found ineffective in reducing pod bug population. Whereas insecticides, *viz* dichlorvos 76 EC @ 0.5 ml/l and NSKE (5%) were moderately effective in minimizing the pod bug population. The order of efficacy of in case of pod bug and pod fly was monocrotophos > endosulfan > cypermethnn > fenvalerate > deltametnn > carbaryl (D) > malathion (D) > control reported by Kumar and Nath (2003) [9]. Hence, the chemicals viz., Acephate 75 SP @ 750 g a.i. ha^{-1}, Acetamiprid 20 SP @ 20 g a.i. ha^{-1} and Quinalphos 25 EC@ 350 g a.i. ha^{-1} may be considered for reduction for managing the podbugs in pigeonpea ecosystem.

Table 1: Efficacy of chemical insecticides for the management of podbugs, *C. gibbosa* in pigeonpea

Treatments	Dose g a.i/ha	Kharif 2018					Kharif 2019					Grain damage (%)	Yield (Kg/ha)	Increase over check (%)
			I spray		II spray			I spray		II spray				
		Pre count	3 DAT	7 DAT	3 DAT	7 DAT	Pre count	3 DAT	7 DAT	3 DAT	7 DAT			
T_1 : Deltamethrin 2.8 EC	12.5	6.78	5.78 (2.40)	5.67 (2.38)	5.56 (2.36)	5.22 (2.28)	6.66	5.56 (2.36)	5.67 (2.38)	5.33 (2.30)	5.00 (2.20)	10.67 (18.99)	993.3	37.32
T_2:Chlorpyriphos 20 EC	250	6.56	4.33 (2.08)	4.56 (2.13)	4.56 (2.13)	4.44 (2.11)	6.44	4.67 (2.16)	5.67 (2.38)	4.55 (2.13)	4.44 (2.11)	9.33 (17.71)	991.7	37.10
T_3:Fipronil 80 WG	50	6.67	4.33 (2.08)	4.22 (2.05)	4.33 (2.08)	4.11 (2.03)	6.67	4.89 (2.21)	4.78 (2.19)	4.11 (2.03)	3.67 (1.91)	6.67 (14.80)	996.6	37.78
T_4 :Profenophos 50 EC	500	6.56	4.67 (2.16)	4.44 (2.11)	4.44 (2.11)	4.44 (2.11)	6.78	5.56 (2.36)	5.67 (2.38)	4.55 (2.13)	4.44 (2.11)	9.33 (17.71)	951.7	31.57
T_5:Quinalphos 25 EC	250	6.56	4.00 (2.00)	4.11 (2.03)	4.11 (2.03)	3.67 (1.92)	6.78	4.44 (2.11)	4.33 (2.08)	4.11 (2.03)	3.67 (1.91)	5.33 (13.17)	1073.3	48.38
T_6 :Acetamiprid 20 SP	20	6.67	3.44 (1.85)	3.78 (1.94)	3.33 (1.82)	3.44 (1.86)	7.11	3.89 (1.97)	3.66 (1.91)	3.67 (1.91)	3.67 (1.91)	4.00 (9.51)	1103.3	52.53
T_7:Acephate 75 SP	750	6.67	3.00 (1.80)	3.33 (1.82)	2.67 (1.62)	3.11 (1.76)	6.78	3.11 (1.76)	3.44 (1.86)	2.56 (1.60)	3.22 (1.79)	2.67 (7.88)	1143.3	58.06
T_8:Untreated check		6.56	7.78 (2.62)	7.56 (2.75)	7.22 (2.69)	6.56 (2.56)	6.56	7.44 (2.73)	7.44 (2.73)	7.11 (2.67)	6.66 (2.58)	18.67 (25.39)	723.3	-
SED		NS	0.31	0.33	0.29	0.45	NS	0.39	0.34	0.42	0.52	2.80	30.54	
CD<0.5%			0.67	0.72	0.63	0.98		0.84	0.74	0.90	1.12	6.08	65.51	

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