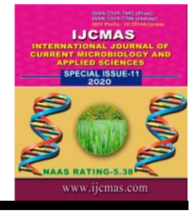
Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 374-381

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Special Issue-11 pp. 374-381
Journal homepage: http://www.ijcmas.com



Original Research Article

Studies on Bio-Efficacy of Insecticides against Pod Sucking Bug, *Clavigralla gibbosa* (Spinola) Infesting Pigeonpea, *Cajanus cajan* (L.)

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Keywords

Pigeonpea, Bio-efficacy, Pod sucking bug, *Clavigralla gibbosa* (Spinola), Pod damage, Grain damage

A B S T R A C T

Pulses are vital source of plant-based proteins and amino acids for people around the globe. Amongst pulses, pigeonpea is an important pulse-cum-grain legume crop, widely cultivated in India. Pod sucking bugs are the key impediments for the low productivity. Both Nymphs and adults of pigeonpea pod bug, *Clavigralla gibbosa* (Spinola) suck the cell sap from the tender pods and cause loss of the grain. Due to its high fecundity and wide host adaptability, it is necessary to revalidate the efficacy status of insecticides for the effective management in context of various insecticides utilized by farmers. Under this background, the present investigation was undertaken to investigate the bio-efficacy and economics of different insecticides against pigeonpea pod bug at experimental field of Department of Entomology, J.N.K.V.V., Jabalpur during *Kharif* 2009-10. The results revealed that Spinosad 45 SC @ 73 g *a.i.*/ha was most effective treatment in minimizing pod (2.72%) and grain (1.17%) damage respectively. Followed by Rynaxypyr 20 SC @ 40 g *a.i.*/ha, Flubendamide 20 WDG @ 50 g *a.i.*/ha, Endosulfan 35 EC @ 700 g *a.i*/ha, Pyridalyl 10 EC @ 100 g *a.i.*/ha and Fenpropathrin 30 EC @ 100 g *a.i*/ha which recorded (3.63%), (4.54%), (5.45%), (6.04%) and (7.27%) pod damage and (1.49%), (1.70%), (2.36%), (2.75%), and (3.33%) grain damage respectively. All the treatments were statistically significant in increasing grain yield *i.e.* (1370.80 Kg/ha to 2943.60 Kg/ha) over Untreated Control (924.30 Kg/ha). While Endosulfan 35 EC (1:25.62) recorded highest incremental cost benefit ratio followed by Spinosad 45 SC (1:12.39) and Flubendamide 20 WDG (1:12.17).

Introduction

Pigeonpea is important legume crop grown world over, mostly in tropical and subtropical countries for grains, green manuring, fodder and forage as sole crop intercrop, mixed crop and in sequential cropping systems. The countries with notable pigeonpea production are India, Nepal and Myanmar in Asia, Malawi and Uganda along with some other countries in eastern Africa and the Dominican Republic in the America (Ahlawat and Shivakumar, 2006).

In India pigeonpea occupied around 4.43 million ha area with production of 4.25 million tonnes and productivity 960 kg/ha (DAC, 2018). In the country, the crop is extensively grown in Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Gujarat. Pigeonpea is a rich source of protein (21.71%) and supplies a major share of protein requirement of the vegetarian population of the country, besides it is also a rich source of iron, iodine and essential amino acids like arginine, cystine and lysine (Singh *et al.,* 2007). Despite being the largest producer, India is the largest importer of the pigeonpea in the world. It is estimated that during 2014-15, India imported about 4.7 million tonnes of pigeonpea to satisfy the domestic consumption pressure from the countries Myanmar, Tanzania and Kenya (Anonymous, 2016).

Among the biotic stresses ravages of the insect pests is most limiting factor in pigeonpea production. Low yields of crop are due to attack of pod pest complex comprising of gram pod borer, *Helicoverpa armigera* (Hubner), pod fly, *Melanogromyza obtusa* (Malloch), plume moth, *Exelastis atomosa* (Walshingham), legume pod borer, *Maruca vitrata* (Geyer), pod sucking bug, *Clavigralla gibbosa* (Spinola) and blue butterfly *Lampides boeticus* (Linnaeus) significantly reduces the crop yield to an extent of 60 to 90 per cent (Rawat *et al.,* 2007).

In recent years pod sucking bug, *C. gibbosa* is a real threat to quality grain production in pigeonpea and has emerged as one of the major pest in pigeonpea due to favorable temperature and humidity condition during reproductive stage of the crop (Singh *et al.,* 2008 and Chakravarty *et al.,* 2016). The pest has assumed to be causing major economic losses in early and medium late pigeonpea cultivars. The pod bug alone recorded 25% to 40% damage in pigeonpea and also reported that pod and grain weight were reduced by as much as 27 and 30 times respectively at a population density of 12 nymphs/plant (Adati *et al.,* 2007 and Gopali *et al.,* 2013). The pod bug is a major factor responsible for shriveled or deformed seeds and yield losses (Nath *et al.,* 2008). Both nymphs and adults of the pod bug suck the sap from flower buds and flowers, pods and grains (Bharat *et al.,* 2019). 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, shriveled and malformed seeds are observed. Further such seeds are easily succumbed to secondary infection by fungal disease and pose problems in post harvesting processes (Das *et al.,* 2009). The main reasons for outbreak of the pest are continuous and indiscriminate use of same insecticide, monocropping and introduction of early and extra early maturing pigeonpea genotypes (Bharthimeena and Sudharma 2009 and Hanumanthaswamy *et al.,* 2009). So, an appropriate management strategy has needed to be prepared to combat against this pest. Keeping this in view, the present investigation was carried out to investigate the bio-efficacy of different insecticides against the pod bug, *C. gibbosa* infesting pigeonpea.

Materials and Methods

The field experiment on bio-efficacy of different insecticides against pod bug, *C. gibbosa* infesting pigeonpea using variety JA-4 was conducted in a randomized block design with seven treatments including untreated control. Treatments replicated three times on a plot size 4.2m X 5.0m at experimental field of Department of Entomology, Adhartal, J. N. Krishi Vishwa Vidyalaya, Jabalpur during *Kharif* season 2009-2010. Pigeonpea was grown with all recommended package of practices recommended by J.N.K.V.V., Jabalpur for raising the crop except insect-pest management.

The treatments were imposed thrice with first application at tender pod stage followed by second and third spray after 15 days consecutively. Observations were recorded at harvest by randomly selecting five plants from each plot and the pods of all selected plants were mixed; from which hundred pods were selected randomly for estimating per cent pod and grain damage (Fig. 1). Grain yield/plot was also recorded and computed to Kg/ha and later subjected to statistical analysis (Table 1). Further cost economics was worked out based on the grain yield, gross returns and total cost (Table 2).

Results and Discussions

Effect of different insecticides on pod and grain damage due to pigeonpea pod bug, *C. gibbosa*

All the treatments significantly reduced the pod and grain damage by pod bug as compared to damage in untreated control which was pod (10.60%) and grain (4.59%) respectively (Table 1). These findings corroborated with findings reported by (Narasimhamurthy and Ram, 2013) *i.e.* percent pod damage due to pod bug ranged from (8.66%) in Spinosad 45 SC to (15.00%) in NSKE-5%. whereas in control plot the damage was (18.33%) during 2009-2010. Among the treatments, Spinosad 45 SC @ 73 g *a.i.*/ha was found the most effective as it recorded lowest pod (2.72%) and grain (1.17%) damage and the highest grain yield (2943.60 kg/ha) also recorded in this treatment. The second effective treatment against pod bug damage was Rynaxypyr 20 SC @ 40 g *a.i.*/ha as it recorded pod (3.63%) and grain (1.49%) damage and yield recorded was (2734.90 Kg/ha). Similar to present findings Rynaxypyr 20 SC @ 40 g *a.i.*/ha was the effective treatment in reducing damage due to pod bug and obtained higher grain yields reported by (Landge, 2009).

Further Flubendamide 20 WDG @ 50 g *a.i.*/ha, Endosulfan 35 EC @ 700 g *a.i*/ha, Pyridalyl 10 EC @ 100 g *a.i.*/ha and Fenpropathrin 30 EC @ 100 g *a.i*/ha observed promising treatments against pod bug which recorded (4.54%), (5.45%), (6.04%) and (7.27%) pod damage and (1.70%), (2.36%), (2.75%), and (3.33%) grain damage respectively. However Flubendamide 20 WDG @ 50 g *a.i.*/ha and Endosulfan 35 EC @ 700 g *a.i.*/ha were at par with each other in reducing the pod damage. Further non-significant differences were observed between Endosulfan 35 EC @ 700 g *a.i.*/ha and Pyridalyl 10 EC @ 100 g *a.i.*/ha in both pod and grain damage reduction. The respective grain yield in this treatments were (2533.20 kg/ha), (2168.83 kg/ha), (1651.60 kg/ha) and (1370.80 kg/ha) which implies that new insecticide molecules are superior over conventional insecticides. Among conventional insecticides Endosulfan 35 EC and Chlorpyrifos 20 EC whereas in newer molecules Indoxacarb 14.5 SC, Spinosad 45 SC and Pyridalyl 10 EC were effective in reducing the pod borer complex damage with significant increase in grain yield reported similarly by other researchers (Suganthi *et al.,* 2006, Chavan *et al.,* 2009 and Ughade *et al.,* 2009).

Effect of different insecticides on grain yield and incremental cost benefit ratio (ICBR)

The data regarding grain yield of pigeonpea (Table 1 and 2) revealed that all the treatments were statistically significant in increasing grain yield over untreated control. The quantity of grains saved per hectare by applying different insecticides ranged from (446.50 kg/ha) in Fenpropathrin 30 EC @ 100 g *a.i.*/ha to (2019.30 kg/ha) in Spinosad 45 SC @ 73 g *a.i.*/ha. Taking into account the prevailing market price of pigeonpea as Rs. 4200 per quintal in 2009-10, the cost of grain saved ranged from Fenpropathrin 30 EC @ 100 g *a.i.*/ha (Rs.18753.00) to (Rs.84810.60) in Spinosad 45 SC @ 73 g *a.i.*/ha respectively. The net profit ranged from (Rs.16954.20) per ha to (Rs. 77970.36) per ha in Fenpropathrin 30 EC @ 100 g *a.i.*/ha and Spinosad 45 SC @ 73 g *a.i.*/ha respectively. The cost benefit ratio worked out was found ranged from Pyridalyl 10 EC @ 100 g *a.i.*/ha (1:4.10) to (1:25.62) Endosulfan 35 EC @ 700 g *a.i.*/ha respectively. It means that a farmer is likely to get a profit of Rs.25.62 after investing an amount of Rs. 1/- in plant protection measures. But Endosulfan has been banned for production, use and sells work effective from 13/05/2011 all over India (CIB & RC, 2019). So the next promising insecticides as per studies were Spinosad 45 SC and Flubendamide 20 WDG which are at par with each other. The present results are in accordance with the findings of (Sonune and Bhamare, 2018) who also reported that Spinosad 0.0070 per cent and Flubendamide 0.0070 per cent was effective insecticides against pigeonpea pod pest complex *viz.*, pod fly, *M. obtusa* and plume moth, *E. atomosa* management and given pigeonpea grain yield (17.36q/ha) and (17.69q/ha) with ICBR (1:2.8) and (1:2.1) respectively. Further investigations on efficacy of insecticides was reported against pod bug, *C. gibbosa* Spinola in pigeonpea variety GT 101 revealed that Imidacloprid 17.8 SL @ 0.005 per cent proved the most effective and recorded the highest grain yield (1421 kg/ha), per cent increase in yield over control (66.68%) and protection cost benefit ratio (1:11.83) followed by Clothianidin 50 WDG @ 0.025 per cent and Thiamethoxam 25 WG @ 0.008 per cent (Purohit *et al.*, 2017).

Table.1 Efficacy of insecticides against pigeonpea pod sucking bug, *Clavigralla gibbosa* on pigeonpea during *Kharif* 2009-10

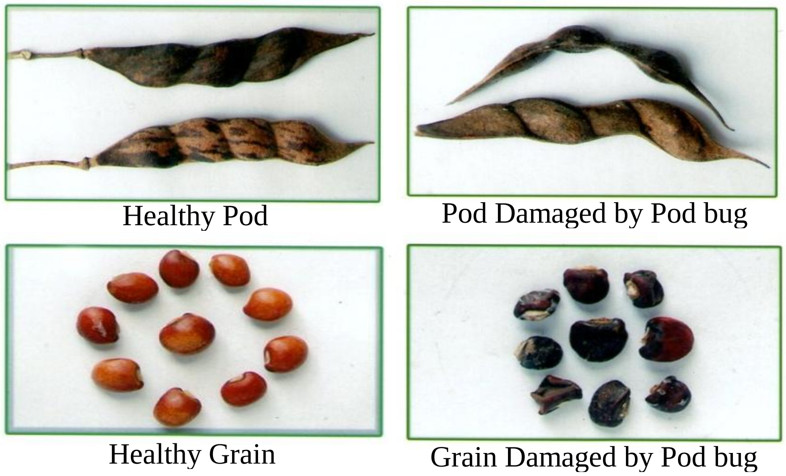
Sr. No.	Treatments	Dose		Per cent damage by - Pod bug		Grain Yield (Kg/ha)
		g *a.i.*/ha	Formulation (ml or g/ha)	Pod	Grain	
1	Endosulfan 35 EC	700	2000	5.45 (13.44)	2.36 (8.72)	2168.83
2	Fenpropathrin 30 EC	100	333	7.27 (15.56)	3.33 (10.47)	1370.80
3	Pyridalyl 10 EC	100	1000	6.04 (14.17)	2.75 (9.46)	1651.60
4	Flubendamide 20 WDG	50	250	4.54 (12.25)	1.70 (7.42)	2533.20
5	Rynaxypyr 20 SC	40	200	3.63 (10.94)	1.49 (6.80)	2734.90
6	Spinosad 45 SC	73	162	2.72 (9.46)	1.17 (6.02)	2943.60
7	Untreated Control	-	-	10.60 (18.93)	4.59 (12.31)	924.30
			Mean	5.75 (13.54)	2.48 (8.74)	2046.75
			SEm±	0.39	0.26	20.62
			CD at 5%	1.21	0.80	63.57

Figures in parentheses ( ) are arcsin transformed values

Table.2 Effect of different insecticides on grain yield and incremental cost benefit ratio (ICBR) of pigeonpea

Treatments	Grain yield (Kg/ha)	Increase in yield over control (Kg/ha)	Avoidable losses %	Dose/ (g or ml/ha)	Cost of Insecticide L^{-1} / Kg^{-1}	Cost of insecticides / ha +Labour[1] Charges Rs 200	Cost of increased yield over control @ Rs.4200 q^{-1}	Net profit (Rs/ha)	Incremental Cost Benefit Ratio	Rank
Endosulfan 35 EC	2168.83	1244.53	26.32	2000	240	2040.00	52270.26	50230.26	1:25.62	1
Fenpropathrin 30 EC	1370.80	446.50	53.43	333	1200	1798.80	18753.00	16954.20	1:10.42	5
Pyridalyl 10 EC	1651.60	727.30	43.89	1000	2280	7440.00	30546.60	23106.60	1:4.10	6
Flubendamide 20WDG	2533.20	1608.90	13.94	250	6600	5550.00	67573.80	62023.80	1:12.17	3
Rynaxypyr 20 SC	2734.90	1810.60	7.08	200	14800	6900.00	76045.20	69145.20	1:11.02	4
Spinosad 45 SC	2943.60	2019.30	-	162	12840	6840.24	84810.60	77970.36	1:12.39	2
Control (Untreated)	924.30	-	-	-	-	-				

Fig.1 Normal and pod sucking bug infested pigeonpea pods and grains



In conclusion, the present study brought out the significant difference among the different recommended insecticides against pigeonpea pod bug. The overall results revealed better response of Spinosad 45 SC @ 73 g *a.i.*/ha, Rynaxypyr 20 SC @ 40 g *a.i.*/ha as well as Flubendamide 20 WDG @ 50 g *a.i.*/ha with minimum pod and grain damage by pod bug which also reflected with higher grain yield and Incremental cost benefit ratio (ICBR). Thus, the results of these studies will be used as a basis for selection of recommended insecticides for successful control of pod sucking bug infesting pigeonpea.

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