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Bio-efficacy of newer insecticides against pod borer complex and grain yield of pigeonpea crop under field condition

Rakesh Kumar Bhagat, Vikas Singh, Mamta Bhagat and Mukesh Kumar Patel

Abstract
A field experiment was conducted to determine the "Bio-efficacy of newer insecticides against pod borer complex" of Pigeonpea at the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *kharif* of 2020-21. These pod borer complex causing substantial yield loss in Pigeonpea crop hence required intervention to manage them by using suitable pesticides. First application was done at when substantial pest population was observed in experiment field and the second spraying was done at 15 days after first spray. Therefore, bio-efficacy of Bufrofezine 25 SC (1.0 ml /lit.), Diafenthiuron 50 SG (1.0 g /lit.), Dinetofuron 20 SG (0.3 g/lit), Flubendiamide 480 SC (0.3 g/lit), Acetamipride 20 SP (0.3 ml/lit.), Thiamethoxam 25 WG (0.2 g/lit) and Thiaclopride 21.7 SC (0.4 g + jaggry 5 g/lit.) has been tested against Pigeonpea pod borer complex with an untreated control.

Keywords: Bio-efficacy, Pigeonpea. Newer insecticide, *H. armigera, M. vitrata, M. obtusa*

Introduction
Pigeonpea [*Cajanus cajan* (L.) Millsp.] is considered as one of the most important legume crops of India. Pigeonpea belongs to the genus *Cajanus* of the family Fabaceae. It is an important food legume crop of the semi-arid tropical and sub-tropical farming systems under varied agro-ecological environments. India is the largest producer and also the largest consumer of pulses in the world. It accounts for 33 per cent of the world area and 25 per cent share in global production.

India is the world's largest producer of pulses, accounting for 25% of global production. Important pulse crops include chickpea, Pigeonpea, mungbean, urdbean, lentil, and fieldpea (Ali and Gupta, 2012) [1].

Pigeonpea is grown in more than 22 countries around the world, including India, Tanzania, Malawi, Kenya. Myanmar, Nepal, Bangladesh, and the Philippines in South-east Asia. It is widely grown in India, where it plays a major role part in pulse-based farming systems and accounts for the second-largest area of all pulse crops. This crop has recently been introduced in China, where it is planted on hilly slopes to prevent soil erosion (Anonymous 2015) [3].

Pigeonpea was cultivated on 4.78 million ha in India in 2018-19, with a production of around 3.59 million tonnes and a productivity of 791 kg/ha. (Anonymous, 2019) [5], whereas in Chhattisgarh it was cultivated in around 63.25 thousand ha with a production of 25.75 thousand tonnes and a productivity achieved 407 kg/ha (Anonymous 2017-18) [4]. It was cultivated in an area of 0.36 thousand hectares with a total production of 0.11 million tonnes and 306 kg/ha productivity in Raipur district, during 2017.

Pigeonpea being attacked by about 250 insect species belonging to 8 orders and 61 families. Over 30 species of Lepidoptera feed on Pigeonpea pods and seeds worldwide (Shanower *et al*., 1999) [11], but only a handful are commercially significant as pests, including the Tur plume moth, *Exelastis atomosa* (Walsh), Tur pod borer, *Helicoverpa armigera* (Hubner) and Tur Pod fly, *Melanagromyza obtusa* (Mall) collectively known as the "Pod borer complex" (Lal, 1998; Patil *et al*., 1990) [6, 8]. This pod borer complex caused economic damage ranging from 30% to 100% in different locations, requiring us to import pulses from other countries at a huge expense, in addition to direct losses to cultivators in past years.

Various control measure have been used in check the Pigeonpea pests of which spraying of pesticides being the most effective. However the long and indiscriminate use of insecticides has been ecological unsafe which forced to explore host plant resistance and some selective newer insecticides as a best management practice for Pigeonpea insect pests.

The continued use of the same chemical insecticides leads to pesticide resistance and revival. In view of the findings, the present study was designed to obtain data on some approaches for the management of the Pigeonpea pod borer complex using newer insecticides of the market.

Materials and Methods

A field experiment was conducted during the *kharif* 2020-21 at the Research cum Instructional Farm, IGKV, Raipur (C.G.). The quantity of various insecticides were determined for a plot size of 19.20 m^2 and sprayed with the help of hand operated Knapsack sprayer. The spraying of insecticides were applied two times *viz.*, first spray at flower cum pod formation stage followed by second spray at 15 days after first treatments respectively. Before and after spraying of insecticides, sprayer and measuring cylinder was thoroughly washed with clean water.

Observation recorded

Pod damage (%)	Per cent Pods damaged were separated on the basis of shape and size of hole of different pod borer in 100 randomly collected pods from each plot at the time of harvest. **Nature of damage** *Helicoverpa armigera*: Large round and regular holes on the pods. *Maruca vitrata*: Irregular scrapping and holes on the pods. *Melanagromyza obtusa*: Pin head size holes at the peripheral end of the pod.
Yield parameters	Grain yield was recorded on whole plot basis.

$$\text{Pod damage (\%)} = \frac{\text{Number of damage pod}}{\text{Total number of pods (healthy+damage)}} \times 100$$

$$\text{Grain yield (Kg/ha)} = \frac{\text{Weight of grains in Kg /plot}}{\text{Plot area in m}^2} \times 1000$$

Table 1: Treatment details

Tr. No.	Treatments	Dose
T1	Buprofezine 25 SC	1.0 ml/ lit
T2	Diafentiuron 50 WP	1.0 g/ lit
T3	Dinetofuron 20 SG	0.3 g/ lit
T4	Flubendiamide 480 SC	0.3 ml/ lit
T5	Acetamiprid 20 SP	0.2 g/ lit
T6	Thiamethoxam 25 WG	0.4 g/ lit + Jaggery 5g/ lit
T7	Thiacloprid 21.7 SC	0.7 ml/ lit
T8	Untreated Control (Plain Water)	-----

Eight different insecticidal treatments were evaluated including untreated control for the assessment of their comparative performance against pod borers complex of Pigeonpea. The details of tested insecticides which were applied on Pigeonpea are presented in the Table (1). The layout plan and other details of the experiment are presented in field layout.

Result and Discussion

Bio-efficacy of Bufrofezine 25 SC (1.0 ml /lit.), Diafenthiuron 50 SG (1.0 g /lit.), Dinetofuron 20 SG (0.3 g/lit), Flubendiamide 480 SC (0.3 g/lit), Acetamipride 20 SP (0.3 ml/lit.), Thiamethoxam 25 WG (0.2 g/lit) and Thiaclopride 21.7 SC (0.4 g + jaggry 5 g/lit.) has been tested against Pigeonpea pod borer complex with an untreated control.

Bio-efficacy of newer insecticides against tur pod borer (*Helicoverpa armigera*)

The post treatment observation of per cent pod damage by tur pod borer (*H. armigera*) were recorded at the time of harvesting present in (Table 3 & fig 1), which revealed that the significantly lowest per cent pod damage infestation as 3.79% recorded under the treatments of Flubendiamide 480 SC. However, it was statically at par with Dinetofuron 20 SG, Thiamethoxam 25 WG and Diafenthiuron 50 SG. The maximum tur pod borer infestation among treated plot was recorded under the treatment of Bufrofezine 25 SC as 8.00% pod damage, but it was found statically superior over the untreated control as 10.90% pod damage.

The order of bio-efficacy of different treatments against tur pod borer after completion of both sprays was Flubendiamide 480 SC > Dinetofuron 20 SG > Thiamethoxam 25 WG > Diafenthiuron 50 SG > Thiaclopride 21.7 SC > Acetamipride 20 SP > Bufrofezine 25 SC.

In confirmation of the present findings, Patange and Chiranjeevi (2017) [9] also reported that rynaxypyr 18.5 SP @ 30 g a.i./ha was most effective insecticide against Pigeonpea tur pod borer and gave higher grain yield of Pigeonpea crop. Jakhar *et al*. (2017) [5] showed that two sprays of chlorantraniliprole 18.50 SC gave maximum control of tur pod borer (3.33% pod damage) with higher grain yield of 1817 kg per ha, which was at par with Indoxacarb 15.80 EC (3.83% pod damage) with a grain yield of 1758 kg/ha.

Bio-efficacy of newer insecticides against spotted pod borer (*Maruca vitrata*)

The post treatment observation of per cent pod damage by spotted pod borer (*M. Vitrata*) were recorded at the time of harvesting (Table 2 & Fig 1), which revealed that the significantly lowest per cent pod damage infestation as 4.00% recorded under the treatments of Flubendiamide 480 SC. However, it was statically at par with Dinetofuron 20 SG, Thiamethoxam 25 WG and Diafenthiuron 50 SG. The maximum spotted pod borer infestation among treated plot was recorded under the treatment of Bufrofezine 25 SC as 8.59% pod damage, but it was found statically superior over the untreated control as 12.20 pod damage.

The order of bio-efficacy of different treatments against spotted pod borer after completion of both sprays was Flubendiamide 480 SC > Dinetofuron 20 SG > Thiamethoxam 25 WG > Diafenthiuron 50 SG > Thiaclopride 21.7 SC > Acetamipride 20 SP > Bufrofezine 25 SC.

Table 2: Bio-efficacy of newer insecticides against pod borer complex and grain yield of Pigeonpea crop (*Kharif* 2020-21)

S. No.	Treatments	Dose	Pod damaging per centage of different pod borer complex			Grain Yield (kg/ha)
			H. armigera	*M. vitrata*	*M. obtusa*	
1.	Bufrofezine 25 SC	1.0 ml/lit.	8.00 (16.34)	8.59 (16.96)	7.25 (15.59)	1,118.89
2.	Diafenthiuron 50 SG	1.0 g/lit.	6.70 (14.96)	7.09 (15.35)	6.33 (14.33)	12,12.88
3.	Dinetofuron 20 SG	0.3 g/lit.	5.00 (12.70)	4.95 (12.65)	5.67 (13.75)	1,337.62
4.	Flubendiamide 480 SC	0.3 g/lit.	3.79 (10.80)	4.00 (11.86)	3.33 (10.34)	1,384.48
5.	Acetamiprid 20 SP	0.3 ml/lit.	7.67 (16.09)	8.01 (16.89)	7.00 (15.31)	1,173.41
6.	Thiamethoxam 25 WG	0.2 g/lit.	6.58 (14.74)	5.89 (13.91)	6.00 (14.04)	1,246.57
7.	Thiacloprid 21.7 SC	0.4 g + jaggery 5 g/lit.	7.04 (15.28)	7.40 (16.37)	6.45 (14.56)	1,188.36
8.	Untreated control (plain water)	----	10.90 (19.22)	12.20 (22.22)	11.67 (19.95)	616.93
CD at 5 %			4.33	3.89	3.36	41.87
S.E(m)			1.41	1.27	1.14	13.98

Figure in parenthesis () are angular tranformed value

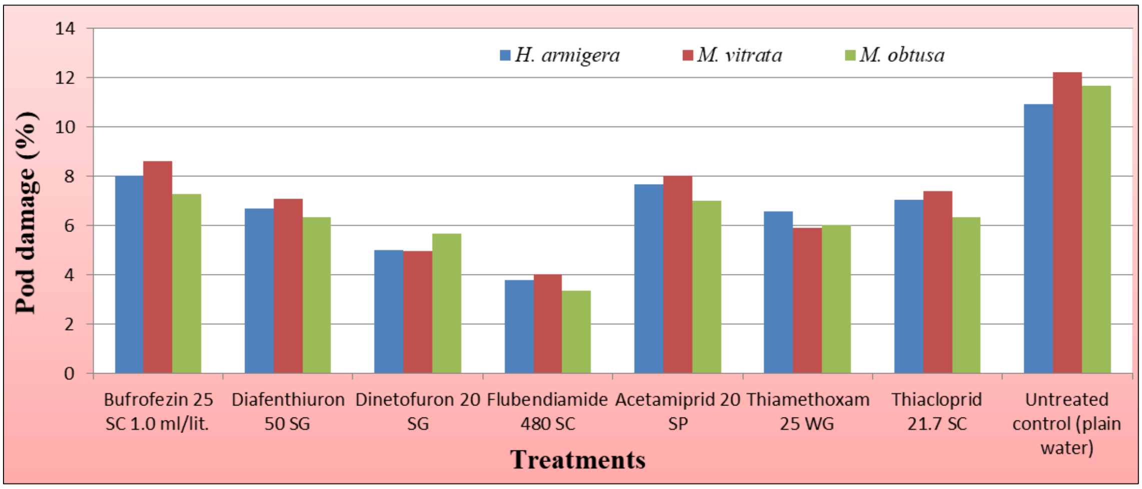

Fig 1: Bio-efficacy of newer insecticides against different pod borer complex of Pigeonpea (*Kharif* 2020-21)

In context of the present findigs, Singh (2012) [13] reported that among the nine newer insecticide molecules evaluated against spotted pod borers of Pigeonpea, indoxacarb treated plots found lowest pod damage (1.30%), which at par with profenophos (1.85% pod damage) emamectin benzoate (2.00% pod damage) and thiodicarb (2.03% pod damage) treated plots. The highest grain yield was recorded with Indoxacarb (2291 kg/ha), while the lowest grain yield was with Flubendiamide (1875 kg/ha). Rani and Eswari (2008) [10] evaluated the bio-efficacy of newer insecticides against *M. vitrata* and reported that the lambda cyhalothrin in combination with the dichlorvos was found most effective and recorded the least pod damage of 4.97 per cent.

Bio-efficacy of newer insecticides against tur pod fly (*Melanagromyza obtusa*)

The post treatment observation of per cent pod damage tur pod fly (*M. obtusa*) were recorded at harvesting present in (Table 2 & Fig 1), which revealed that the significantly lowest per cent pod damage infestation as 3.33% was recorded under the treatments of Flubendiamide 480 SC. However, it was statically at par with Dinetofuron 20 SG, Thiamethoxam 25 WG and Diafenthiuron 50 SG. The maximum tur pod fly infestation among treated plot was recorded under the treatment of Bufrofezine 25 SC as 7.25% pod damage, but it was found statically superior over the untreated control as 11.67% pod damage.

The order of bio-efficacy of different treatments against tur pod fly after completion of both sprays was Flubendiamide 480 SC > Dinetofuron 20 SG > Thiamethoxam 25 WG > Diafenthiuron 50 SG > Thiaclopride 21.7 SC > Acetamipride 20 SP > Bufrofezine 25 SC.

More or less, similar finding were recorded by Mahesh *et al*. (2015) [7] who reported that Deltamethrin 1 EC + Triazophos 35 EC emerged as the most effective treatment against *M. Obtusa* in minimizing the damage to green and dry pods as well as grains. Sreekanth (2014) [14] recorded that the pod damage due to podfly was lowest in spinosad 45% SC (10.2% pod damage) followed by Flubendiamide 480 SC (10.4% pod damage), profenophos 50% EC (10.9% pod damage) and chlorantraniliprole 20% SC (12.5% pod damage) with 76.7, 76.3, 75.1 and 71.5 per cent reduction over control, respectively.

Grain yield of Pigeonpea

Among the all treatment (Table 2) the highest grain yield of Pigeonpea (1384.48 kg/ha) was obtained from the treatment of Flubendiamide 480 SC followed by Dinetofuron 20 SG as 1337.62 kg/ha. Whereas, among the all insecticide treated plots, the lowest grain yield of Pigeonpea was recorded under the treatment of Bufrofezine 25 SC as 1118.89 kg /ha.but it was found statically superior over untreated control as 616.93 kg/ha.

Present findings are in agreement with Srinivasan and Durairaj (2007) [12] who recorded highest grain yield of Pigeonpea in indoxacarb 14.5SC @ 50g a.i./ha (864.0 kg/ha) and spinosad 45SC @ 73g a.i./ha (841.1 kg/ha) as against the minimum yield of 432.7 kg/ha in the untreated control plot. Tamboli and Lolage (2008) also recorded highest grain yield in spinosad 45SC @ 90g a.i./ha (1681 Kg/ha).

Conclusion

Flubendiamide 480 SC was found to be the best treatment against all three pod borer complex *viz*., tur pod borer, spotted pod borer and tur pod fly and also gave the highest grain yield of Pigeonpea.

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