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Bioefficacy of various insecticides against, *Melanagromyza obtusa* (Malloch) on pigeon pea (*Cajanas cajan*) (L) Millsp.

CB Wayal, SA Gaikwad and PJ Warad

Abstract
The field experiment was conducted to assess the bioefficacy of various insecticides against**,** *Melanagromyza obtuse* (Malloch)on pigeon pea (*Cajanas cajan* (L) Millsp.) with eight treatments including an untreated control. In treatments*viz.,* Quinalphos 25 EC, Emamectin benzoate 5 SG, Indoxacarb 14.5 SC, Chlorantraniliprole 18.5 SC, Chlorpyriphos 20 EC, Flubendamide 39.35 SC, Lambda cyhalothrin 5 EC. These treatments replicated thrice in randomized block design. The performance of each insecticide treatment was judged on the basis of larval incidence, pod damage, grain damage and grain yield. Considering the effectiveness of various insecticides in reducing the larval population, the treatment with chlorantraniliprole 18.5 SC was emerged as the most promising treatment for the management of**,** *M. obtusa.* The next promising treatment reducing *M. obtusa*larval population was flubendiamide 39.35 SC which was followed by the treatment with indoxacarb 14.5 SC. The treatment with chlorantrniliprole 18.5 SC was superior in reducing collective pod and grain damage. The maximum grain yield was obtained from the plots treated with chlorantrniliprole 18.5 SC (17.18 q /ha).

Keywords: pigeon pea, *M. obtusa*, pod damage, grain damage, grain yield

Introduction
Pulses constitute an integral part of Indian agriculture because of their vital role in enriching the human diet as well as soil fertility. Being the cheapest source of protein, pulses form an inseparable part of the Indian diet. Besides their higher nutritional value, pulse crops have a unique characteristic of maintaining and restoring soil fertility through biological nitrogen fixation and thus play a vital role in sustainable agriculture (Asthana, 1998) [1]. India ranks first in area with 4.43 Mha and production 4.25 Million Tonnes. The Area under pigeon pea crop in Maharashtra was 1.23 Million ha with annual production of 1.07 Million Tonnes. Although the area under pigeon pea is increasing but yield is not satisfactory. This is due to several limiting factor and one of them is infestation of pests (Anonymous, 2018) [2]. More than 300 insect species belonging to 8 orders and 61 families have been found to infest pigeon pea starting from seedling stage and continues till harvesting and even during the storage condition (Keval *et al*., 2010) [3]. However, about 60% damage is solely caused by the pod borer complex (Wadasker *et al*., 2013) [4] According to Lal *et al*. (1992) [5] pod borers caused 60 to 90 per cent loss in the grain yield under favorable conditions and damage of seed by pod fly ranged from 14.3 to 46.6 per cent. To control these pests, farmers solely rely upon insecticides as the first line of defense to get immediate action. Abuse of insecticides has aggravated the pest problem leading to resurgence, outbreak of secondary pests and development of insecticidal resistance. So that selection of ecofriendly insecticides which is safe to natural enemies and also should not leave toxic residues is essential for pest management programme.

Materials and Methods
The present experiment was conducted during *kharif* season of 2019 at AICRP on pigeon pea, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. In field plots the seed of pigeon pea were sown by following the recommended agronomic practices

Details of experiment
Design: Randomized Block Design
Replications: Three
Treatments: Eight

Variety: ICPL-87
Plot size: 4.50 x 3.60 m2
Spacing: 90x60 cm
Fertilizer dose: 25:50:25, NPK kg / ha.
Method of sowing: Dibbling
Seed rate: 12 kg /ha.
Date of sowing: 23 July 2019

Method of recording observations

The efficacy of insecticides was evaluated by selecting five plants randomly from each treated plot for recording observations on number of *M. obtusa* larvae before each application and at 3, 7 and 14 days after the application of insecticide treatment. Five plants selected earlier randomly from each plot were observed for pod damage at the time of harvesting. Number of damaged pods and healthy pods were counted. The pods were opened and examined for grain damage. From that per cent pod damage and grain damage were calculated by following using formula.

$$\text{i. Per cent pod damage} = \frac{\text{Infected pods}}{\text{Total No. of pods}} \times 100$$

$$\text{ii. Per cent grain damage} = \frac{\text{No of damaged grain}}{\text{Total No. of Grain}} \times 100$$

Statistical analysis

The larval numbers were transformed into √n+0.5 for further statistical analysis. The data on per cent damaged pods and grains were transformed into arcsin values to reduce the variation in different treatments and then subjected to statistical analysis. The significance of treatments was assessed by determining critical difference (CD.) at 5% level of significance.

Results and Discussion

Bioefficacy against *M. obtusa*

After first spray

The effect of various treatments under investigation on the survival maggots of *M. obtusa* is illustrated in Table 1.The average number of *M. obtusa* maggots per 10 pods prior to insecticidal treatments ranged from 2.20 to 3.13 maggots/10 pods and differences among the treatments were non-significant. The data recorded at 3 days after spraying revealed that all the insecticidal treatments were significantly superior over untreated control. The average number of *M. obtusa* mggots/10 pods ranged from 0.40 to 0.87 mggots/10 pods in the insecticidal treatments as against 2.33 mggots/10 pods in untreated control.

The treatment with chlorantraniliprole 18.5% SC was most effective treatment and recorded 0.40 maggots/10 pods and was significantly superior over rest of the treatment except the treatment with flubendiamide 39.35% SC (0.58maggots/10 pods) which is followed by indoxacarb 14.5% SC, quinalphos 25% EC and lambda cyhalothrin 5% EC at par with each other with 0.63, 0.67 and 0.73 maggots/10 pods.

The observations of *M. obtusa* recorded 7 days after spraying showed that the average number of maggots ranged from 0.33 to 0.80 maggots/10 pods in the insecticidal treatments as against 2.47 maggots/plant in untreated control. The treatment with chlorantraniliprole 18.5% SC was significantly superior over all the treatments which recorded 0.33 maggots/10 pods except the treatment flubendiamide 39.35% SC (0.53 maggots/10 pods). Next best treatment were indoxacarb 14.5% SC, quinolphos 25% EC and lambda cyhalothrin 5% EC which is at par with each other with 0.60, 0.63 and 0.67 maggots/10 pods.

The observations of *M. obtusa* recorded at 14 days after spraying showed that the average number of maggots ranged from 0.47 to 1.07 maggots/10 pods in the insecticidal treatments as against 2.63 maggots/10 pods in untreated control. The treatment with chlorantranilipro l 18.5% SC was significantly superior over all the treatments which recorded 0.47 maggots/10 pods except the flubendiamide 39.35% SC (0.60 maggots/10 pods). Next best treatment were indoxacarb 14.5% SC, quinolphos 25% EC and lambda cyhalothrin 5% EC at par with each other with 0.67, 0.80 and 0.87 maggots/10 pods.

After second spray

The effect of various treatments under investigation on the survival maggots of *M. obtusa* is illustrated in Table 1.The data recorded 3 days after spraying revealed that all the insecticidal treatments were significantly superior over untreated control. The average number of *M. obtusa* maggots/10 pods ranged from 0.20 to 0.63 maggots/10 pods in the insecticidal treatments as against 3.27maggots/10 podsin untreated control. The treatment with chlorantraniliprole 18.5% SC was most effective treatment and recorded 0.20 maggots/10 except the treatment with flubendiamide 39.35% SC (0.40mggots /10 pods) which is followed by indoxacarb 14.5% SC, quinolphos 25% EC and lambda cyhalothrin 5% EC at par with each other with 0.47, 0.53 and 0.58 maggots/10 pods.

The observations of *M. obtusa* recorded 7 days after spraying showed that the average number of maggots ranged from 0.13 to 0.60 maggots/10 pods in the insecticidal treatments as against 3.33 maggots/10 pods in untreated control. The treatment with chlorantraniliprole 18.5% SC was significantly superior over all treatments which recorded 0.13 maggots/10 pods except the treatment with flubendiamide 39.35% SC (0.33mggots/10 pods) followed by indoxacarb 14.5% SC, quinolphos 25% EC and lambda cyhalothrin 5% EC which were at par with each other with 0.40, 0.47 and 0.53 maggots/10 pods.

The data recorded 14 days after spraying revealed that all the insecticidal treatments were significantly superior over untreated control. The average number of *M. obtusa* maggots/10 pods ranged from 0.27 to 0.67 maggots/10 pods in the insecticidal treatments as against 3.47 maggots/10 pods in untreated control.

The treatment with chlorantraniliprole 18.5% SC was most effective treatment and recorded 0.27 maggots per plant and was significantly superior over rest of the treatments. In order of effectiveness the next promising treatment were flubendiamide 39.35% SC (0.47mggots/10 pods) which is followed by indoxacarb 14.5% SC, quinolphos 25% EC and emamectin benzoate 5% SG at par with each other with 0.53, 0.60 and 0.63 maggots/10 pods.

Pod damage inflicted by *M. obtusa*

Infestation of pods due to pod fly, *M. obtusa* was presented in (Table 2) revealed that the damage in the untreated plot was to the extent of 9.38 per cent. All the insecticidal treatments recorded significantly lower pod damage which was in the range of 3.05 to 5.63 per cent. Treatment with chlorantraniliprol 18.5% SC recorded minimum pod damage of 3.05 per cent and remain superior over all the treatments. The next promising treatments were flubendiamide 39.35% SC, indoxacarb 14.5% SC, emamectin benzoate 5%, lambda cyhalothrin 5% EC, chlorpyriphos 20% EC and quinolphos 25% EC, which were at par with each other with 3.74, 4.38, 4.72, 4.92, 5.21 and 5.63 per cent pod damage, respectively.

Grain damage influenced by *M. obtusa*

The data on grain damage caused due to pod fly, *M. obtusa* (Table 2) revealed that the damage was 20.22 per cent in untreated plot while the range of damge was 7.83 to 12.29 per cent grain damage in insecticide treated plots. All the insecticidal treatments were significantly superior over untreated control minimizing the grain damage. Among the treatments chlorantraniliprole 18.5% SC recorded lowest graindamage of 7.83 per cent followed by flubendiamide 39.35% SC (9.98%) and indoxacarb 14.5% SC (10.07) which were at par with each other.

Effect of different treatments on grain yield of pigeon pea.

Maximum pigeon pea grain yield of 17.18 q/ha was harvested from the treatment with chlorantraniliprole 18.5 SC and it was significantly superior over rest of the treatment. Next promising treatment were flubendamide 39.35 SC, indoxacarb 14.5 SC and emamectin benzoate 5 SG with 16.19, 15.55 and 14.92 q/ha grain yield respectively. It was followed by the treatment with lambda cyhalothrin 5% EC (14.57 q/ha), chlorpyriphos 20% EC (14.07 q/ha), quinolphos 25% EC (13.45q/ha). Untreated plot registered lowest yield (9.63 q/ha) of pigeonpea. (Table 2.)

Table 1: Bioefficacy of various insecticides against *Melanagromyza obtusa* on pigeonpea

Tr. No.	Treatments	Dose ml or gm/Lit	Number of *Melanagromyza obtusa* maggots/10 pods						
			Precount	After 1st Spray			After 2nd Spray		
				3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Quinalphos 25 EC	2.00 ml	2.67 (1.78)	0.67 (1.08)	0.63 (1.06)	0.80 (1.14)	0.53 (1.01)	0.47 (0.98)	0.60 (1.05)
T_2	Emamectin benzoate 5 SG	0.40 gm	3.07 (1.89)	0.80 (1.14)	0.73 (1.11)	0.93 (1.20)	0.60 (1.05)	0.58 (1.04)	0.63 (1.06)
T_3	Indoxacarb 14.5 SC	0.70 ml	3.13 (1.96)	0.63 (1.06)	0.60 (1.05)	0.67 (1.08)	0.47 (0.98)	0.40 (0.95)	0.53 (1.01)
T_4	Chlorantraniliprole 18.5 SC	0.30 ml	2.63 (1.77)	0.40 (0.95)	0.33 (0.91)	0.47 (0.98)	0.20 (0.83)	0.13 (0.79)	0.27 (0.88)
T_5	Chlorpyriphos 20 EC	2.00 ml	2.93 (1.85)	0.87 (1.17)	0.80 (1.14)	1.07 (1.25)	0.63 (1.06)	0.60 (1.05)	0.67 (1.07)
T_6	Flubendiamide 39.35 SC	0.25 ml	2.87 (1.84)	0.58 (1.04)	0.53 (1.01)	0.60 (1.05)	0.40 (0.95)	0.33 (0.91)	0.47 (0.98)
T_7	Lambda cyhalothrin 5 EC	1.00 ml	2.93 (1.85)	0.73 (1.11)	0.67 (1.08)	0.87 (1.17)	0.58 (1.04)	0.53 (0.01)	0.67 (1.08)
T_8	Untreated control	-	2.20 (1.64)	2.33 (1.68)	2.47 (1.72)	2.63 (1.77)	3.27 (1.94)	3.33 (1.96)	3.47 (1.99)
	S E ±	-	0.07	0.05	0.06	0.07	0.06	0.08	0.06
	C D at 5%	-	N.S.	0.15	0.18	0.21	0.18	0.24	0.17
	C V%	-	13.28	12.14	11.86	13.07	13.07	13.24	11.76

Figures in parentheses are $\sqrt{x+0.5}$ transformed value

Table 2: Effect of insecticidal treatments on pod damage, grain damage and grain yield of pigeon pea.

Tr. No.	Treatment	Dose ml or gm/Lit	*M. obtusa*		
			Percent pod damage	Percent grain damage	Grain yield (q/ha)
T1	Quinalphos 25 EC	2.00 ml	5.63 (13.63)	12.29 (20.51)	13.45
T2	Emamectin benzoate 5 SG	0.40 gm	4.72 (12.45)	10.46 (18.85)	14.92
T3	Indoxacarb 14.5 SC	0.70 ml	4.38 (12.02)	10.07 (18.48)	15.55
T4	Chlorantraniliprole 18. SC	0.30 ml	3.05 (9.92)	7.83 (16.20)	17.18
T5	Chlorpyriphos 20 SC	2.00 ml	5.21 (13.09)	11.37 (19.69)	14.07
T6	Flubendiamide 39.35 SC	0.25 ml	3.74 (11.05)	9.98 (18.40)	16.19
T7	Lambda cyhalothrin 5 EC	1.00 ml	4.92 (12.27)	11.28 (19.60)	14.57
T8	Untreated control	----	9.38 (17.81)	20.22 (26.69)	9.63
S.E. ±			0.92	0.86	0.92
C. D. at 5%			2.78	2.60	2.78
C.V. (%)			12.78	12.82	12.78

Figure in the parenthesis are arcsine transformed value for percentage damage.

On the basis of influence of treatment on yield chlorantraniliprol 18.5% SC is best treatment which is followed by flubendiamide 39.35% SC. During the present investigation chlorantraniliprole 18.5% SC were found most effective with significantly high reduction of pod and grain damage collectively due to *M. obtusa*. The present findings in respect of chlorantraniliprole 18.5% SC are in agreement with those of Dadas *et al.* (2019a) [6]. The performance of spinosad has been well documented by earlier workers like Rani *et al.* (2018) [7] and Patel and Patel (2013) [8]. Similarly, Sreekanth *et al.* (2014) [9] obtained effective control of pod borers through application of chlorantraniliprole 18.5% in pigeon pea. The findings of these workers are confirmative with present findings. The next treatment in order of efficacy against collective pod and grain damage flubendiamide 39.35% SC. This result is in conformity with the findings of Priyadarshini *et.al*. (2017) [10] and Wadaskar *et al.* (2013) [4] proved to be the best treatment in reducing the pod damage. Similarly, Deshmukh *et al.* (2010) [11] determined that flubendiamide 0.007 per cent in pigeonpea was found the most effective in reducing the *M. obtusa* population and pod damage and showed the highest yield of 1850 Kg ha-1 and cost benefit ratio of 1:6.10. Similar with Tohinshi *et al.* (2010) [12]. The next best treatment in order of effectiveness was Indoxacarb 14.5% SE. These results corroborate the findings of Meena *et al*. (2018) [13] which is similar with Patange and Chiranjeevi (2013) [14] and Dinesh *et al*. (2017) [15] who reported that indoxacarb 14.5% SC provided good control against pod borer complex of pigeon pea. The next promising treatment was emamectin benzoate 5% SG effective in reducing larval population and pod and grain damage. These results corroborate the findings of Chandra and Singh (2014) [16] and Sonune and Bhamare (2018) [17]. According Dadas *et al*. (2019) [6], application of chlorantraniliprole 18.5% SC 50% flowering and podding stage of 15 days interval resulted in higher yield of pigeonpea (8.79 qt/ha). Similarly, Sreekanth *et al*. (2014) [9] also observed effective control of pod borer with highest yield of 886.1kg /ha when chlorantraniliprole 18.5% SC 50% was applied thrice, commensing from 50% flowering stage. Also, higher yield of pigeonpea by using chlorantraniliprole 18.5% SC (686.1 kg/ha) was reported by Khorasiya *et al*. (2004) [18].

Conclusion
The treatment with chlorantraniliprole 18.5% SC and flubendiamide 39.35% SC were found to be most effective treatments against plume moth (*M. obtusa*) of pigeon pea and give best control coupled with maximum yield. The next best treatment were indoxacarb 14.5% SE and emamectin benzoate 5% SG.

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