

Research Paper

Bio efficacy of selected insecticides against pod fly, *Melanagromyza obtusa* (Malloch) in pigeonpea

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Received: 10 May 2024

Accepted: 24 June 2024

Handling Editor:

Dr. Sanjay M. Bandi, ICAR-Indian Institute of Pulses Research, Kanpur, India

ABSTRACT

In the present study, efficacy of selected insecticides was evaluated against pod fly, *Melanagromyza obtusa* (Malloch) over three consecutive years in pigeonpea cultivar, Rudreswara (WRG-65). The relative efficacy of nine insecticides was assessed in terms of pod fly population and pod damage. The insecticides were applied twice at 15 days interval, starting from pod formation stage. The results revealed that thiamethoxam 25WG at 0.4g/l + Jaggery @ 5g/l followed by flubendiamide 480 SC @ 0.3ml/l proved significantly superior by reducing pod fly population and pod damage by recording highest grain yield (1582 kg ha⁻¹) and best Cost: Benefit ratio (1:2.39). The potential insecticides observed in this study may be used in rotation with other effective ones in order to avoid development of insecticide resistance in pod fly.

Key words: Bio efficacy, evaluation, insecticides, *Melanagromyza obtusa*, pigeonpea

INTRODUCTION

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important grain legume crop grown in India with an annual production of 3.6 MT in 4.5 m ha and an average productivity of 919 kg ha⁻¹ (AICRP 2022). Over the years, the yield potential of pigeonpea is remained stagnant due to the biotic stress noticed at the reproductive stage of the crop. Among the major pod infesting insects, pod fly, *Melanagromyza obtusa* (Malloch) is the most obnoxious pest of pigeonpea and is an important emerging constraint for attaining the potential yield of the crop under subsistence farming conditions, irrespective of agro ecological zones.

Pod fly is the important pest of pigeonpea especially in medium and long duration cultivars and also very severe on second flush of the crop when the first flush is dropped due to untimely rains at flowering stage of the crop. It infests the crop at pod development stage resulting in significant losses. Female flies lay eggs in immature/developing pods, and the emerged maggots feed on developing seeds by making tunnel. Maggots consume its starchy portion and embryo, damaged embryo fail to germinate and grains become shriveled and striped. They excrete a trail of excreta on which saprophytic fungus develops and makes the seed inedible. The

infested immature pods do not show any external evidence of damage until the fully grown larvae make exit hole in the pod walls, it make complicity of management (Sharma *et al.* 2010). Hence, pest management is an important aspect of pigeonpea production. A yield loss of 10 to 80% was recorded due to pod fly in pigeonpea irrespective of climatic conditions (Kumar and Nath 2003, Subharani and Singh 2009). During the pest surveys it was observed that damage due to *M. obtusa* was recorded from 10 to 40% in different districts of Telangana. Hence, in the present investigation aimed to evaluate the bio efficacy of different insecticides for the sustainable management of the pigeon pea pod fly.

MATERIALS AND METHODS

The experiment on evaluation of insecticides against pod fly in pigeonpea was conducted at Regional Agriculture Research Station, PJTSAU, Warangal (India) for three consecutive *Kharif* seasons (2018 - 2021). The experiment was laid out in randomized complete block design (RBD) using medium duration pigeonpea variety, WRG 65. The trial consisted insecticides *viz.*, buprofezin 25 SC @ 1.0ml/l, diafenthiuron 50 WP @ 1.0 g/l, dinotefuron 20 SG @ 0.3 g/l, flubendiamide 480 SC @ 0.3 ml/l, lufenuron 5.4 EC @ 1.0 ml/l, thiamethoxam 25 WG @

0.4g/l, thiamethoxam 25 WG + jaggery @ 0.4g+5g/l, acetamiprid 20 SP @ 0.2g/l, thiacloprid 21.7 SC at 0.7ml/l and untreated control. Treatments were replicated thrice with each plot consisted of 30 m² (6 rows of 5m bed length, each at 120 × 20 cm spacing). The crop was raised with standard agronomical management practices and not following any crop protection strategies. Totally, two sprays were applied at 15 days interval commenced from pod formation stage.

Pre treatment counts of maggots were recorded from 100 randomly selected pods per replication by destructive sampling method discarding the border effect on one day before 2nd spray. Subsequently post treatment observations of per cent pod and locule damage were recorded at the time of harvest by taking 100 pods per replication from randomly selected plants from each treatment at harvest. The pin hole on pod exhibited the damage caused by *M. obtusa*. Further, grain yield and the economics of the treatment was also worked out based on grain yield and cost of protection. All the pods from each treatment were then threshed and grain yield per plot was recorded and computed for per hectare basis. The data obtained was subjected to ANNOVA using SPSS package.

RESULTS AND DISCUSSION

Efficacy of various insecticides against pod fly, Melanagromyza obtusa

The mean maggot population of *Melanagromyza obtusa* during 2019-20 in different insecticidal treated plots before (precount) second spray ranged from 35.67 to 62 per 100 pods. Post treatment results, 10 days after two sprays of insecticides showed thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l as most effective treatment with 67% control of maggot population followed by flubendiamide 480 SC @ 0.3ml/l with 64% control. However, during 2020-21, flubendiamide 480 SC @ 0.3ml/l recorded as most effective treatment with 63% control of maggot population followed by thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l with 61% control. During 2021-22, thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l recorded as most effective treatment with 69% control of maggot population followed by flubendiamide 480 SC at 0.3ml/l with 65% control.

The cumulative mean maggot population of *Melanagromyza obtusa* in different insecticidal treated plots before (precount) second spray ranged from 42 to 88.33 from *Kharif*, 2019 to 2021. Post

treatment results after two sprays of insecticides showed significant differences in mean maggot population among various treatments after ten days of spraying. The cumulative data of efficacy of insecticides against *Melanagromyza obtusa* revealed that significant minimum number of *Melanagromyza obtusa* maggot counts and high percent reduction (72.04%) over control was recorded in thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l treated plot after two sprays followed by flubendiamide 480 SC at 0.3ml/l (63.37%) and thiacloprid 21.7 SC at 0.7 ml/l (56.91%) (Table 1).

Effect of various treatments on pod damage

The mean percent pod damage by pod fly, *Melanagromyza obtusa* during 2019-20 in different insecticides treated plots showed that least percent pod damage was recorded in flubendiamide 480 SC @ 0.3ml/l treated plot (6.2%) followed by thiamethoxam 25WG @ 0.4g/l + Jaggery @ 5g/l (6.3%) and dinotefuron 20 SG @ 0.3 g/l (6.3%). However during 2020-21 and 2021-22, least percent pod damage was recorded in thiamethoxam 25WG @ 0.4g/l + Jaggery @ 5g/l treated plot (6.48% and 4.42%) followed by flubendiamide 480 SC @ 0.3ml/l (7.76% and 5.03%) (Table 02).

The cumulative percent pod damage due to pod fly, in different treatments is presented in Table 2. The results with respect to mean cumulative percent pod damage by pod fly in different insecticidal treatment revealed that all the treatments significantly reduced the pod damage by pod fly compared to control *i.e.* 15.47%. The data revealed that the cumulative mean percent pod damage due to pod fly in different treatments ranged from 5.73% to 15.47%. Among all the treatments, thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l treated plot recorded significantly least percent pod damage of 5.73% followed by flubendiamide 480 SC @ 0.3ml/l (6.33%) and thiacloprid 21.7 SC @ 0.7 ml/l (6.86%).

Effect of various treatments on locule damage

The mean percent locule damage by pod fly, *Melanagromyza obtusa* during 2019-20 in different insecticides treated plots showed that least percent locule damage was recorded in flubendiamide 480SC @ 0.3ml/l (3.2%) treated plot followed by thiacloprid 21.7 SC @ 0.7 ml/l (3.8%) and thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l (4.0%). However during 2020-21 and 2021-22, least percent locule damage was recorded in thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l (3.09% and 3.4%) treated plot

followed by flubendiamide 480 SC @ 0.3ml/l (3.88% and 5.03%) (Table 02).

The cumulative percent locule damage due to pod fly, in different treatments is presented in Table 2. The results with respect to mean cumulative percent locule damage by pod fly in different insecticidal treatment revealed that all the treatments significantly reduced the locule damage by pod fly compared to control *i.e.*, 10.58%. The data revealed that the cumulative mean percent locule damage due to pod fly in different treatments ranged from 3.5% to 10.58%. Among all the treatments, thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l treated plot recorded significantly least percent pod damage of 3.5% followed by flubendiamide 480 SC @ 0.3ml/l (4.04%) and thiacloprid 21.7 SP @ 0.7 ml/l (4.1%).

Effect of various treatments on seed yield and economics

Effectiveness of different insecticide molecules to minimize the pod fly infestation reflected by grain yields. The results with respect to cumulative grain yield in different treated plots revealed that, all the treatments registered significantly higher grain yield as compared to the control. The mean grain yield per hectare in all insecticidal treatments ranged from 1264 kg to 1582 kg ha⁻¹ as compared to 1201 kg ha⁻¹ in untreated control, thereby proving that all the chemical treatments were superior over untreated control. Significantly the highest grain yield, 1582 kg ha⁻¹ was recorded in thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l with 31.68% increase in grain yield over untreated control followed by flubendiamide 480 SC @ 0.3ml/l (25.35% increase) and thiacloprid 21.7 SP @ 0.7 ml/l treated plots (22.48% increase) (Table 2).

The comparative economics of insecticidal treatments evaluated against pod fly over a period of three years revealed that the cost benefit ratio (BC) ranged from 1:58 to 1:2.39. The best cost benefit ratio of 1:2.39 recorded in thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l treated plot followed by thiamethoxam 25WG @ 0.4g/l (1:2.15) and thiacloprid 21.7 SP @ 0.7 ml/l (1:2.13) which are at par with each other. Further, with respect to net returns over control of different treatments ranged from Rs. 66, 892 to Rs. 46,084/- per hectare. The highest net returns of Rs. 66,892 ha⁻¹ were recorded in thiamethoxam 25WG @ 0.4g/l + Jaggery @ 5g/l treated plot followed by Rs. 60,088 ha⁻¹ in thiacloprid 21.7 SC @ 0.7 ml/l and Rs. 59,232 ha⁻¹

in thiamethoxam 25WG @ 0.4g/l treated plots, respectively.

The cumulative efficacy of insecticides against pod fly in pigeonpea for three years revealed that thiamethoxam 25WG @ 0.4g/l + jaggery at 5g/l is most effective against *Melanagromyza obtusa* with more grain yield and also registering highest B:C ratio. The results are supported by the findings of Nithesh and Rana (2019) who reported that the minimum per cent pod damage of 13.47% and grain damage of 9.66% by *M. obtusa* by using acetamiprid 20 SP. This was at par with thiamethoxam 25 WG (14.40% pod damage and 9.79% grain damage), and flubendiamide 20WG (14.68% pod damage and 10.18% grain damage). Similarly, Kumar *et al.* (2016) reported lowest pod damage of 4.33 per cent with the use of methomyl 40 SP @ 0.6 g/l treated plots followed by thiamethoxam 25 WG @ 0.25g/l and dinotefuran 20 SG at 0.20 g. These reports are statistically at par with each other and lowest seed damage of 2.22 per cent was recorded in thiamethoxam 25 WG at 0.25 g/l treated plot.

The results obtained in the present study are also closely related with the findings of Srujana and Keval (2014) who studied the efficacy of insecticides against pod fly. The results showed that the per cent pod damage and grain damage by pod fly was minimum in thiamethoxam 25 WG @ 75 g a.i./ha treated plot followed by fipronil 25 EC @ 8 g a.i./ha. Similar studies were also conducted by Vikram *et al.* (2015) who revealed that the per cent pod damage by pod fly, *M. obtusa* was minimum (21.33%) in plots treated with imidacloprid 17.8 SL at 20 g ai. ha followed by thiamethoxam 25 WG at 75 g ai / ha (22.67%) as compared to control plot (36.00%). The per cent grain damage was minimum (8.77%) with imidachloprid 17.8 SL followed by fipronil 05 SC at 40 g ai /ha (9.42%) as compared to control plot damage (13.33). Patel *et al.* (2014) reported that lowest pod damage (5.11%) and grain damage (3.27%) due to pod fly at harvest in plots treated with thiamethoxam 25 WG 0.01% as compared to other insecticides *viz.*, thiodicarb 75 WP 0.075%, deltamethrin 36 EC 0.045%, acephate 75 SP 0.075%, imidacloprid 70 WG 0.014% and dimethoate 30 EC 0.03%. Srikanth *et al.* (2020) concluded that insecticides like thiacloprid 21.7 SC at 0.7 ml/l, followed by diafenthiuron 50 WP @ at 1.5 g/l, flubendiamide 480 SC @ 0.2 ml/l and dimethoate 30 EC @ 2.0 ml/l were very effective against pod fly with more grain yield and high incremental cost benefit ratio (ICBR).

Table 1. Cumulative data of pod fly population from 2019-22

Insecticides	Dosage	Precount before second spraying (per 100 pods)				10 days after 2 nd spray (per 100 pods)				Per cent reduction over control
		2019	2020	2021	Mean	2019	2020	2021	Mean	
Buprofezin 25 SC	1ml/l	46.33	76.33	52.67	58.44	21.00	38.33	29.40	29.58	43.61
Diafenthiuron 50 WP	1g/l	47.55	58.33	55.33	53.74	28.30	39.67	25.27	31.08	40.74
Dinotofuron 20 SG	0.3 g/l	42.67	60.67	50.0	51.11	20.70	33.33	22.93	25.65	51.09
Flubendiamide 480 SC	0.3 ml/l	35.67	71.33	53.33	53.44	12.70	26.33	18.60	19.21	63.37
Lufenuron 5.4 EC	1 ml/l	56.33	68.67	61.67	62.22	26.00	38.67	26.20	30.29	42.25
Thiamethoxam 25 WG	0.4 g/l	41.33	73.67	66.0	60.33	26.00	31.00	22.93	26.64	49.20
Thiamethoxam 25 WG+Jaggery	0.4 g/l+ 5 g/l	37.67	53.67	34.67	42.00	12.60	20.67	10.73	17.00	72.04
Acetamiprid 20 SP	0.2 g/l	54.0	81.67	67.0	67.56	32.30	40.00	37.33	36.54	30.33
Thiacloprid 21.7 SC	0.7 ml/l	42.22	56.33	48.67	49.07	22.00	25.00	20.80	22.60	56.91
Untreated control	-	62	111.67	91.33	88.33	48.00	62.67	46.67	52.45	
SEm±		3.6	3.01	3.6	3.58	3.6	2.51	2.42	2.57	-
CD (p=0.05)		NS	9.0	9.1	10.7	10.9	7.51	6.5	4.7	-
CV (%)		12.9	7.31	10.8	11.5	12.1	11.82	10.6	14.23	-

Table 2. Economics of some selected insecticides against podfly in pigeonpea over three years (2019-22)

Insecticides	Dosage	Per cent pod damage (%)				Per cent locule damage (%)				Yield kg/ha				% yield Increase over control	B:C Ratio
		2019	2020	2021	Mean	2019	2020	2021	Mean	2019	2020	2021	Mean		
Buprofezin 25 SC	1ml/l	8.2	8.83	10.11	9.05	6.1	4.84	7.11	6.017	1232	1626	1083	1314	9.37	1:1.91
Diafenthiuron 50 WP	1g/l	8.03	11.01	11.8	10.28	6.4	6.16	8.8	7.120	1319	1554	1101	1325	10.29	1:1.58
Dinotofuron 20 SG	0.3 g/l	6.3	8.09	9.12	7.84	4.5	5.99	6.12	5.537	1302	1667	1288	1419	18.15	1:2.07
Flubendiamide 480 SC	0.3 ml/l	6.2	7.76	5.03	6.33	3.2	3.88	5.03	4.037	1267	1728	1521	1505	25.35	1:1.75
Lufenuron 5.4 EC	1 ml/l	8.7	9.26	10.37	9.44	6.2	5.45	8.37	6.673	1219	1610	1332	1387	15.48	1:1.79
Thiamethoxam 25WG	0.4 g/l)	7.2	7.83	8.46	7.83	5.4	6	8.46	6.620	1284	1701	1357	1447	20.50	1:2.15
Thiamethoxam 25 WG+Jaggery	0.4 g/l+ 5 g/l	6.3	6.48	4.42	5.73	4	3.09	3.4	3.497	1284	1803	1658	1582	31.68	1:2.39
Acetamiprid 20 SP	0.2 g/l	9.1	9.41	10.28	9.60	5.5	6.03	8.28	6.603	1154	1547	1091	1264	5.23	1:1.88
Thiacloprid 21.7 SC	0.7 ml/l	7.2	7.03	6.34	6.86	3.8	3.15	5.34	4.097	1298	1767	1348	1471	22.48	1:2.13
Untreated control	-	13.4	16.79	15.47	15.22	10.1	11.16	10.47	10.577	1056	1501	1047	1201	-	1:1.77
SEm±	-	0.9	0.6	0.7	0.62	0.44	0.38	0.48	0.45	46.2	32.16	57.2	54.14	-	-
CD (p=0.05)	-	1.52	1.9	2.1	1.86	1.31	1.24	1.42	1.35	142	136.4	162	162.11	-	-
CV (%)	-	9.6	10.4	13.6	12.2	8.9	6.8	10.5	12.9	12.6	10.28	11.7	6.7	-	-

Thiamethoxam 25WG @ 0.4g/l + jaggery at 5g/l showed superiority in respect of reduction of maggot count, pod/locule damage and grain yield may be due to the mixing of pesticide with a jaggery

as food bait attractive to pod fly. Jaggery used as food bait to attract the pod fly and thiamethoxam is a broad-spectrum, systemic insecticide, which means it is absorbed quickly by plants and transported to

all of its parts, where it acts to deter pod fly feeding. Pod fly absorbed it and the compound gets in the way of information transfer between nerve cells by interfering with nicotinic acetylcholine receptors in the central nervous system, and eventually paralyzes pod fly maggot and controlled it effectively. Further, Sharma *et al.* (2010) reported that the Neo-nicotinoid insecticide such as imidacloprid and thimethoxam has been recommended for the management of pod fly.

The present study brought out the significant difference among insecticides applied against pod fly, *Melanagromyza obtusa* control. The overall results revealed thiamethoxam 25WG @ 0.4g/l + jaggery @ 5g/l recorded least maggot population, lowest pod and locule damage which reflected in grain yield and ICBR ratio. Hence, the potent chemical observed in the study may be used as alternate to the other effective ones in order to avoid development of insecticide resistance in pod fly of pigeonpea.

ACKNOWLEDGMENTS

The authors are grateful to Honorable Vice chancellor and Director of Research, Professor Jayashankar Telangana State Agricultural University, Hyderabad for providing funding, necessary facilities and moral support for conducting this experiment.

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