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Bio-efficacy of some newer insecticides against POD FLY *Melanagromyza obtusa* in pigeonpea under field conditions

Akkabathula Nithish and Navneet Rana

Abstract
The present study was conducted at the Research cum Instructional Farm, IGKV, Raipur, Chhattisgarh during kharif season 2013-2014. The bioefficacy of eight newer insecticidal molecules, acetamiprid 20SP @ 20g a.i/ha, indoxacarb 14.5SC @ 50g a.i/ha, acephate 75SP @ 750g a.i/ha, spinosad 45SC @ 73g a.i/ha, emamectin benzoate 5WSG @ 9.5g a.i/ha, flubendiamide 20WG @ 50g a.i/ha, rynaxipyr 18.5SC @ 30g a.i/ha and thiamethoxam 25WG @ 75g a.i/ha each at two sprays against pod fly *Melanagromyza obtusa* in pigeonpea were evaluated under field conditions including control as check.

Keywords: *Melanagromyza obtusa,* pigeonpea, newer insecticides

Introduction

Our country has the distinction of being the largest producer of legumes with over a dozen of pulse crops, grown on about 25.43 million hectares of land and 18.24 million tonnes of production with the average productivity of 679 kg/ha (Anonymous 2011-12) [4, 5]. Among the important pulses grown in India, pigeonpea belongs to family Leguminosae, is a multipurpose grain legume crop. The green pods of pigeonpea are used as vegetables, grains used as split dal and are rich in protein, averaging a protein digestibility of 70% when cooked (Singh, 1991) [13].
Pigeonpea is cultivated in more than 25 countries of the world. As compared to the other pulses produced in the world, pigeonpea holds the sixth rank in production. It covers 6.5 percent of the world's total pulses area and contributes 5.7 percent to the total pulses production (Rao *et al.*, 2010) [11] and is grown in an area of 4.7 million ha with a production of 3.69 million tonnes in the world with the productivity of 784 kg/ha (FAOSTAT, 2010) [8].
About 90% of the global pigeonpea area falls in India (Anonymous, 2012) [5] growing in 3.86 million hectares with an annual production of 2.65 million tonnes and 741 kg $ha^{-1}$of productivity (FAOSTAT, 2012) [9], which is 4/5th share in the world total pigeonpea produced. In Chhattisgarh, acreage under pigeonpea is 51.9 thousand hectares with a total production and productivity of 31 thousand tonnes and 597 kg/ha, respectively (Anonymous, 2013) [6].
About 250 species of insects belonging to 8 orders and 61 families have been found to attack on pigeonpea, of this only few are economically important as pests (Lal, 1988). Although many insect feeds upon pigeonpea from the seedling stage, most of the economic damage is caused by the pests feeding upon the flowers and pods. Important pest of pigeonpea are pod borers, plume moth, pod fly and pod bug. Amongst these, insect pests associated with fruiting phase of crop are especially, the pod borer complex *viz.*, gram pod borer (*Helicoverpa armigera*), tur plume moth (*Exelastis atomosa*) spotted pod borer (*Maruca vitrata*) and pod fly (*Melanagromyza obtusa*) cause losses in grain yield ranging from 30 to 100 percent (Adgkar *et al.*, 1993) [1].
The pigeon pea pod fly *Melanagromyza obtusa* Malloch (Diptera: Agromyzidae) is a serious pest of pigeonpea reported throughout south and south-east Asia (Shanower *et al*., 1998) [12].
In India it is a serious pest of pigeonpea in Northern Madhya Pradesh, Uttar Pradesh, Bihar, Delhi, Maharashtra, Gujarat, Orissa and Haryana (Ahmad, 1938; Bindra and Jakhmola, 1967) [2, 7].
Females deposit eggs on the pigeonpea green pods and other host plants, and the developing young larva first feeds just under the epidermis of the seed like a leaf miner and damage the seeds. It appears at pod initiation till maturity of crop. The losses inflicted by pod fly are higher on account of concealed damage habit and often remain unnoticed. The damage is evident on account of pin head exit holes on the pods. The affected grains are shriveled, discolored with fungal infection rendering them unsuitable for sowing and consumption (Shanower *et al*., 1998) [12].

Pod yield losses ranging between 5-30% (Talekar, 1990) [16] due to *M. obtusa* was reported during winter and spring from several countries and the main country suffering from its pestilence is India because of its wide spread cultivation (>90% of the world production) (Talekar, 1990; Akhauri *et al.*, 1994 and Shanower *et al*., 1998) [16, 3, 12].

Voluminous work on suppressing the pod fly attack by chemicals has been carried out during last three decades. However, application of insecticides forms first line of defense for management of pigeonpea pod fly as very few natural enemies are effective in pigeonpea ecosystem. The strong inclination towards application of synthetic insecticides for combating pest menace is on account of immediate effect, convenience of application and easy availability of these agrochemicals.

After the introduction of the new molecules, which were tested and found effective against the key polyphagous pests there is every need to study their effect on *Melanagromyza obtusa.* Management of pod fly in pigeonpea relies heavily on insecticides, often to the exclusion of other methods of control. But the studies on the effect of these new molecules on *Melanagromyza obtusa* were inconclusive. Hence, the present study was mainly focused on the effective management strategies of *Melanagromyza obtusa* in pigeonpea at Chhattisgarh, and keeping the above points in view, the present study was formulated.

Materials and Methods

The Present study entitled "bio-efficacy of some newer insecticides against pod fly *Melanagromyza obtusa* in pigeonpea under field conditions" was conducted during July 2013 to February 2014, at the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

A field experiment was laid in randomized block design (RBD) with nine treatments including untreated control, replicated three times for the assessment of their comparative performance against pod fly in pigeonpea. The crop was sown in plot size of 19.6 m^2. In this experiment number of maggots were counted randomly selected five plants from each plot, 24 hours before spraying of insecticides and the post treatment counts were taken after 3, 5, 7, 10 and 15 days of spraying insecticides. The larval populations were subjected to square root transformation ($\sqrt{x+0.5}$). The spraying was done two times (first spray at pod formation stage and second spray at 15 days after first spray).

Table 1: Insecticides tested against *Melanagromyza obtusa* in pigeonpea

Treatments	Insecticides	Trade name	Doses(ai/ha)
T_1	Acetamiprid 20 SP	Pride	20g
T_2	Indoxacarb 14.5 SC	Avanut	50g
T_3	Acephate 75 SP	Lancer	750g
T_4	Spinosad 45 SC	Tracer	73g
T_5	Emamectin benzoate 5 WSG	Safari	9.5g
T_6	Flubendiamide 20 WG	Takumi	50g
T_7	Rynaxipyr 18.5 SC	Coragen	30g
T_8	Thiamethoxam 25 WG	Actara	75g
T_9	Control		-

The percent pod and grain damage were subjected to angular transformation X=$\sqrt{\sin^{-1}}$ P, where X= transformed value and P= Percent data.

Percent pod and grain damage was recorded with the help of following formula

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

$$\text{Grain damage (\%)} = \frac{\text{Number of damaged grains}}{\text{Total number of grains(healthy + damage)}} \times 100$$

Grain yield

To assess the losses caused by pod fly, five random plants from each plot were selected at the time of maturity. There after total number of pods and grains damaged by pod fly were counted separately and the percent losses were counted.

The weight of healthy and damaged grains were recorded from each plot and converted in to kg / ha with the help of following formula

$$\text{Grain yield (kg/ha)} = \frac{\text{weight of grains in Kg/plot}}{\text{plot area in m}^2} \times 10000$$

Results and Discussion

Larval population of *Melanagromyza obtusa* after first spraying

The larval population in the pre treatment observations ranged from 4.86 to 5.10 larvae per plant and was non significant. Looking to the data presented in Table-2, it can be clearly seen that after the third day of first spray all the doses of insecticides showed significant difference over control. Among the treatments, acetamiprid 20SP @ 20g a.i/ha was recorded best effective treatment with the minimum *Melanagromyza obtusa* larval population per plant (0.30) which was at par with thiamethoxam 25WG @ 75g a.i/ha (0.43). It was followed by flubendiamide 20WG @ 50g a.i/ha (0.97), emamectin benzoate 5WSG @ 9.5g a.i/ha (1.33), rynaxipyr 18.5SC @ 30g a.i/ha (1.59), spinosad 45SC @ 73g a.i/ha (1.70) and indoxacarb @ 50g a.i/ha (1.70). The highest larval population was recorded in plots treated with acephate 75SP @ 750g a.i/ha (1.89) which was least effective treatment. The untreated plots significantly differed over rest of treated plots with 4.76 larvae per plant.

After fifth day of first spray, there was significant reduction in larvae over control. The plots treated with acetamiprid 20SP can be adjudged as the best as it recorded least larval population per plant (0.23) which was at par with thiamethoxam 25WG (0.39) while the highest larval population per plant (1.89) was recorded in acephate 75SP.

Observations after seventh day of first spray resulted in significant reduction of larvae over control. The plots treated with acetamiprid 20SP proved to be the best with least larval population per plant (0.23) which was at par with thiamethoxam 25WG (0.47) and flubendiamide 20WG (0.63) whereas the highest larval population per plant (1.73) was recorded in acephate 75SP.

Similarly after tenth day of first spray, all the treatments repeated significant reduction of larvae over control. The plots treated with thiamethoxam 25WG proved to be the best with least larval population per plant (0.37) which was at par with acetamiprid 20SP (0.39) and flubendiamide 20WG (0.63) whereas the highest larval population per plant (1.89) was recorded in acephate 75SP.

Finally after fifteenth day of first spray, acetamiprid 20SP again showed least larval population per plant (0.49) as in the previous observation which was at par with thiamethoxam 25WG (0.60) and flubendiamide 20WG (0.79) whereas the maximum larval population per plant (1.86) was noticed in plots treated with acephate 75SP. Untreated control harboured a population of 4.66 larvae per plant.

Larval population of *Melanagromyza obtusa* after second spraying

In the post treatment observations after third day of second spraying, all the doses of insecticides showed significant difference over control. Among the treatments, acetamiprid 20SP was noticed best effective treatment and recorded minimum larval population per plant (0.33) which was at par with thiamethoxam 25WG (0.63). It was followed by flubendiamide 20WG (0.86), emamectin benzoate 5WSG (1.13), rynaxipyr 18.5SC (1.37), indoxacarb 14.5SC (1.53) and spinosad 45SC (1.67).The highest larval population per plant (1.79) was recorded in plots treated with acephate 75SP. The untreated plot significantly differed over rest of treated plots with 4.60 larvae per plant.

Observations after fifth day of second spray revealed that all the treatments significantly reduced larval population over control. The plots treated with acetamiprid 20SP showed least larval population per plant (0.27) which was at par with thiamethoxam 25WG (0.46) and flubendiamide 20WG (0.59). The highest larval population per plant (1.83) was recorded in acephate 75SP.

After seventh day of second spray, all the treatments showed significant reduction of larvae over control. The plots treated with acetamiprid 20SP proved to be the best with least larval population per plant (0.26) which was at par with thiamethoxam 25WG (0.39) and flubendiamide 20WG (0.56). The highest larval population per plant (1.79) was recorded in acephate 75SP.

After tenth day of second spray, all the treatments showed significant reduction of larvae over control. The plots treated with acetamiprid 20SP once again proved to be the best with least larval population per plant (0.37) which was at par with thiamethoxam 20WG (0.60). The highest larval population per plant (1.90) was recorded in acephate75SP.

Finally after fifteenth day of second spray, acetamiprid 20SP turned out to be the best with minimum larval population per plant (0.47) which was at par with thiamethoxam 25WG (0.73) and flubendiamide 20WG (1.03) while maximum larval population per plant (1.86) was recorded in plots treated with acephate 75SP. Untreated control showed larval population of 4.97 per plant.

Present findings are in agreement with Srujana and Ram keval (2013) who also recorded least pod fly larvae in case of thiamethoxam 25 WG @ 75 g a.i./ha and in acetamiprid 20 SP @ 20 g a.i./ha.

Percent pod damage by *Melanagromyza obtusa*

In case of pod damage by *Melanagromyza obtusa*, all the tested newer insecticides were found significantly superior over untreated control. Among the treatments, the minimum percent pod damage by *M.obtusa* was recorded with acetamiprid 20SP 5.43% (13.47%) which was at par with thiamethoxam 25WG 6.20% (14.40%), flubendiamide 20WG 6.43% (14.68%) and emamectin benzoate 5WSG 6.93% (15.25%). The maximum percent pod damage was recorded in acephate 75SP 6.96% (15.29%) and rynaxipyr 18.5SC 6.96% (15.29%). Percent pod damage by *M.obtusa* recorded in untreated control was 12.00% (20.25%).

Percent grain damage by *Melanagromyza obtusa*

In case of grain damage by *Melanagromyza obtusa*, all the tested newer insecticides were found significantly superior over untreated control. Among the treatments, the minimum percent grain damage by *M. obtusa* was recorded with acetamiprid 20SP 2.83% (9.66%) which was at par with thiamethoxam 25WG 2.90% (9.79%) and flubendiamide 20WG 3.13% (10.18%) whereas maximum percent pod damage of was recorded in acephate 75SP 4.06% (11.61%).Percent pod damage by *M. obtusa* recorded in untreated control was 5.40% (13.42%).

Table 2: Average larval population of *Melanagromyza obtusa* in pre treatment and post treatment observations

No.	Treatments and doses (a.i/ha)	Pre -treatment larval population	Post treatment larval population									
			First spray					Second spray				
			3rd day	5th day	7th day	10th day	15th day	3rd day	5th day	7th day	10th day	15th day
T_1	Acetamiprid 20SP @ 20g ai/ha.	4.56 (2.23)	0.30 (0.89)	0.23 (0.85)	0.23 (0.85)	0.39 (0.94)	0.49 (0.99)	0.33 (0.90)	0.27 (0.87)	0.26 (0.86)	0.37 (0.92)	0.47 (0.98)
T_2	Indoxacarb 14.5 SC @ 50g ai/ha.	4.83 (2.30)	1.70 (1.48)	1.66 (1.44)	1.57 (1.43)	1.70 (1.48)	1.83 (1.52)	1.53 (1.42)	1.46 (1.38)	1.66 (1.46)	1.53 (1.42)	1.83 (1.52)
T_3	Acephate 75SP @ 750g ai/ha.	5.03 (2.41)	1.89 (1.54)	1.83 (1.51)	1.73 (1.46)	1.89 (1.54)	1.86 (1.53)	1.79 (1.51)	1.83 (1.51)	1.79 (1.51)	1.90 (1.55)	2.17 (1.63)
T_4	Spinosad 45SC @73g ai/ha.	4.86 (2.35)	1.70 (1.48)	1.73 (1.49)	1.63 (1.46)	1.73 (1.49)	1.43 (1.38)	1.67 (1.45)	1.60 (1.44)	1.73 (1.49)	1.66 (1.46)	1.97 (1.57)
T_5	Emamectin benzoate 5WSG @ 9.5g ai/ha.	4.93 (2.31)	1.33 (1.34)	1.26 (1.32)	1.33 (1.34)	1.30 (1.33)	1.43 (1.37)	1.13 (1.27)	1.07 (1.25)	1.10 (1.26)	1.13 (1.27)	1.26 (1.32)
T_6	Flubendiamide 20WG @ 50g ai/ha.	5.06 (2.33)	0.97 (1.21)	1.00 (1.22)	0.66 (1.06)	0.63 (1.05)	0.79 (1.13)	0.86 (1.16)	0.59 (1.03)	0.56 (1.03)	0.79 (1.13)	1.03 (1.19)
T_7	Rynaxipyr 18.5SC @ 30g ai/ha.	4.96 (2.33)	1.59 (1.43)	1.46 (1.39)	1.43 (1.39)	1.50 (1.40)	1.56 (1.42)	1.37 (1.36)	1.40 (1.37)	1.50 (1.41)	1.53 (1.41)	1.76 (1.50)
T_8	Thiamethoxam 25WG @ 75gai/ha.	5.10 (2.36)	0.43 (0.96)	0.39 (0.94)	0.47 (0.97)	0.37 (0.93)	0.60 (1.04)	0.63 (1.05)	0.46 (0.97)	0.39 (0.94)	0.60 (1.03)	0.73 (1.11)
T_9	Control	5.03 (2.35)	4.76 (2.29)	4.98 (2.33)	4.33 (2.19)	4.66 (2.27)	4.66 (2.27)	4.60 (2.25)	4.94 (2.32)	5.65 (2.18)	4.96 (2.33)	4.97 (2.33)
SE (m)±		NS	0.06	0.09	0.10	0.06	0.07	0.07	0.10	0.07	0.06	0.09

C.D. (5%)			0.21	0.27	0.29	0.19	0.23	0.23	0.30	0.23	0.20	0.29

Figures in Parentheses are square root transformed values

Table 2: Percent pod and grain damage by *M. obtusa* and grain yield in different treatments.

Treatments	Percent pod damage	Percent grain damage	Grain Yield (Kg/ha)
Acetamiprid 20SP	5.43 (13.47)	3.26 (10.39)	1122.44
Indoxacarb 14.5 SC	7.59 (15.93)	2.90 (9.80)	1207.482
Acephate 75SP	6.96 (15.29)	3.46 (10.71)	1088.43
Spinosad 45SC	7.50 (15.79)	2.83 (9.55)	1360.54
Emamectin benzoate 5WSG	6.93 (15.25)	3.00 (9.55)	1139.45
Flubendiamide 20WG	6.43 (14.68)	4.10 (11.67)	1037.41
Rynaxipyr 18.5SC	6.96 (15.29)	3.73 (11.03)	1071.42
Thiamethoxam 25WG	6.20 (14.40)	3.83 (11.24)	1062.92
Control	12.00 (20.25)	5.40 (13.42)	816.32
SE (m) ±	0.59	0.57	86.90
C.D (5%)	1.78	1.72	260.53

Figures in Parentheses are angular transformed values

Grain yield (Kg/ha)

The highest grain yield 1360.54 Kg /ha was recorded in spinosad 45SC which was at par with indoxacarb 14.5SC (1207.48 kg/ha) emamectin benzoate 5WSG (1139.44 kg/ha) and acetamiprid 20SP (1122.44 kg/ha), while the lowest grain yield of 1037.41 Kg /ha was recorded in flubendiamide 20WG treated plots, and the untreated control resulted least (816.32 kg /ha) grain yield in comparison to newer insecticides treated plots. . Percent pod and grain damage by *Melanagromyza obtusa* and grain yield in different treatments of pigeonpea are given in table No.3

Present findings are in agreement with Srinivasan and Durairaj (2007) [14] as they also recorded highest grain yield 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) [17] who working on newer insecticides in testing the efficacy of newer insecticides also recorded highest grain yield in spinosad 45SC @ 90g a.i./ha (1681 Kg/ha).

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