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Evaluation of Sequential Application of Insecticides against Pod Borer of Pigeonpea [*Cajanus cajan* (L.) Millsp.]

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A B S T R A C T

The present study was conducted to evaluate the sequential application of different insecticidal treatments against pod borer [*Helicoverpa armigera* (Hubner)], tur pod fly [*Melanagromyza obtusa* (Malloch)] infesting pigeonpea variety BSMR 736 during *Kharif* 2015-16 and 2017-18. Among all the treatment with application of first spray chlorantraniliprole 18.5 SC @ 0.3 ml /l of water at 50 % flowering stage and second spray of flubendiamide 39.35 SC @ 0.2 ml /l of water at pod development stage provided better control of *Helicoverpa armigera* and *Melanagromyza obtusa* on pigeonpea in terms of lower pod and grain damage and getting higher grain yield. Hence, these two sequential applications of insecticides can be suggested to the farmers for effective management of pod borers on pigeonpea.

Introduction

Pigeonpea [*Cajanus cajan*] is an important pulse crop grown in semi-arid tropics and sub-tropical areas of the world (Van der Maesen, 1991). India accounts for more than 90 per cent of the world's pigeonpea production and area (Mathukia *et al.*, 2016). In India pigeonpea is grown in area of 5.21 million hectares with an annual production of about 4.23 million tonnes and the average productivity is 826 kg/ ha., whereas, in Maharashtra, pigeonpea is cultivated an area of 15.33 lakh hectares with an annual production of 11.70 lakh tonnes and the average productivity is 764 kg/ha (Anonymous, 2017). It is a rich source of protein (21.71%) and supplies a major share of protein requirement of the vegetarian population of the country [Singh *et al.*, 2015]. In spite of all the improvements brought about in the cultivation of pigeonpea crops, the major constraints for low productivity of pigeonpea are inadequate availability of seeds of improved varieties, biotic and abiotic stresses and poor crop management (Ali, 2012). Abiotic and biotic stresses are the most limiting factors in pigeonpea production. Among the biotic pressures, large numbers of insect pests have been identified to infest pigeonpea. The low yields of pigeonpea crop which have remained stagnant for the past 3 to 4 decades are mainly due to insect pest attack and physiological shriveling.

Amongst many insect pests attacking pigeonpea crop as gram pod borer, *Helicoverpa armigera* (Hubner), legume pod borer, *Maruca vitrata* (Geyer) and pod fly, *Melanagromyza obtusa* (Malloch) causes significant reduction in the crop yield of pigeonpea (Sujithra and Chander, 2014). As per a conservative estimate, losses due to these insect pests may vary from 27 per cent to even 100 per cent in pigeonpea (Srilaxmi and Paul, 2010).

Pod borers have been estimated to cause 60 to 90 per cent loss in the grain yield of pigeonpea under favorable conditions and the damage of seeds by pod fl generally ranges between 14.3 to 46.6 per cent (Priyadarshini *et al.*, 2013). *H. armigera* and *M. obtusa* cause adequate economic damage leading to very low yield levels of 500 to 800 kg ha-1 as against the potential yield of 1800 to 2000 kg ha-1 (Durairaj and Shanower, 2003; Lal, 1996).

For management of pod borer complex, agrochemicals are still the first choice of farmers. Insecticides are most commonly recommended, preferred and adopted means, especially for crop with high remunerative prices like pigeonpea. Hence, chemical measures are often termed as necessary evil in present pigeonpea pest management scenario (Wadaskar *et al.,* 2013). Farmers, use chemical pesticides indiscriminately, which leads to increased cost of plant protection resulting in lower profitability.

On these grounds, newer insecticides with novel mode of action are needed to be evaluated to find out an effective and economical insecticide for the management of pigeonpea pod borer complex (Patange and Chiranjeevi, 2017). Keeping these views in mind, present study was conducted to evaluate the efficacy of sequential application of certain insecticides against pod borers and pod bug in pigeonpea ecosystem.

Materials and Methods

Field experiments on pigeonpea (var. BSMR 736) were conducted at Agriculture Research Station, Badnapur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* seasons of 2015-16 and 2017-18. The crop was grown at a spacing of 90 cm X 20 cm with three replications and eight treatments including control in randomized block design. Two applications of respective insecticides, first at 50 % flowering and remaining at pod development stage (21 days after first spray) were made using knapsack sprayer with hollow cone nozzle. The sprays were applied at evening hours to minimize the toxicity for relative pollinators and support their conservation. The pretreatment count was made a day before while, post treatment count were made on three and seven days after each spray, respectively. All the recommended practices were adopted for raising the crop.

The damage caused by the larvae of pod borer (*H. armigera*), identified by the nature of damage caused by them to the pods by way of holes on the pods. The larvae of *H. armigera* cut a bigger and irregular hole on the pods and feed on the developing grains. The observation recorded on the number of *H. armigera* larvae per plant. Five plants were randomly selected from each net plot and three twigs per plant i.e. one each from top, middle and bottom were selected at the time of each observation the total number of *H. armigera* were recorded. The observations on number maggots and pupae of pod fly were recorded from 50 green pods from randomly selected five plants. Sample pods were critically examined for the damage of major insect pests' *viz*. *H. armigera* and *M. obtusa*, as described by Yadav and Dahiya (2004). The total yield per plot including the yield of pods sampled earlier for assessment of pod damage was then computed on kilogram per hectare basis.

Statistical analysis

The data recorded during the course of investigation were subjected to statistical analysis by using analysis of variance (ANOVA) technique for Randomized Block Design to compare means of different treatments as suggested by Panse and Sukhatme (1985).

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads:

Effects of various treatments on population of *H. armigera*

The results revealed that on the basis of pooled data indicated that the populations of *H. armigera* were non-significant at one day before spray and after 3 and 7 days after spray (Table 1), all the insecticides treatments were found significantly superior over control in reducing the larval population of *H. armigera*.

After first application of insecticide treatments, 3 days after spray and 7 days after spray T_3, T_4, T_5 and T_6 were spray of chlorantraniliprole 18.5 SC @ 0.3ml/l was found effective in management of these pests at 50 per cent flowering or pod initiation stage of the crop at 3 DAS (0.36, 0.40, 0.41 and 0.42 larvae/plant) and 7 DAS (0.21, 0.21, 0.21 and 0.21 larvae/plant).

After second application of insecticide treatments, 3 days after spray and 7 days after spray T_6 chlorantraniliprole 18.5 SC @ 0.3ml/l followed by flubendiamide 39.35 SC @ 0.2ml/l were spray at pod development stage of the crop was recorded at 3 DAS (0.31 larvae/plant) and 7 DAS (0.13 larvae/plant) which was at par with treatment T_5, T_4 and T_3 at 3 das (0.45, 0.68 and 0.75 larvae/ plant) and at 7 DAS (0.18, 0.35 and 0.43 larvae/ plant), respectively.

Effect of various treatments on population of *M. obtuse* on green pods

The results revealed that on the basis of pooled data indicated that the populations of pod fly were non-significant at one day before spray and after 3 and 7 days after second spray (Table 1).

All the insecticides treatments were found significantly superior over control in reducing the maggot and pupal population of pod fly in green pods of pigeonpea. There was no population of pod fly at the time of first application (50 per cent flowering) of insecticide treatment.

After second application of insecticide treatments, 3 days after spray and 7 days after spray T_6 Chlorantraniliprole 18.5 SC @ 0.3ml/l followed by flubendiamide 39.35 SC @ 0.2ml/l were spray at pod development stage of the crop was recorded lowest population at 3 DAS (0.22 maggots and pupa/ 50 green pods) and 7 DAS (0.10 maggots and pupa/ 50 green pods) which was at par with treatment T_5, T_4 and T_3 at 3 DAS (0.24, 0.47 and 0.51 maggots and pupa/ 50 green pods) and at 7 DAS (0.12, 0.23 and 0.23 maggots and pupa/ 50 green pods), respectively.

The present findings are confirmed with Patange and Chiranjeevi (2017) also found rynaxypyr 18.5 SP @ 30g a.i./ha as most effective insecticide in minimizing the larval population of gram pod borer, plume moth and pod fly on pigeonpea. Similarly, Maurya *et al.*, (2016) also reported chlorantraniliprole 10 SE @ 60 g a.i./ha to be highly efficacious against *H. armigera* on pigeonpea that resulted in cent per cent reduction of larval population over control

Table.1 Effect of sequential application of insecticides against population of *H. armigera* and *M. obtuse* on pigeonpea

Tr. No.	Treatment details	Dose	No. of *H.armigera* larvae / plant					No. of maggots and pupae of pod fly/ 50 green pods		
			Pooled (2015-17)					Pooled (2015-17)		
			BS	First spray		Second spray		BS	Second spray	
				3 DAS	7 DAS	3 DAS	7 DAS		3 DAS	7 DAS
1.	Acephate 75SP fby Acephate 75 SP	1g/l 1g/l	2.02 (1.59)	1.07 (1.25)	0.77 (1.13)	1.11 (1.27)	0.66 (1.08)	2.07 (1.60)	0.70 (1.10)	0.30 (0.90)
2.	Acetamiprid 20 SP fby Acetamiprid 20 SP	0.2g/l 0.2g/l	1.95 (1.56)	0.98 (1.22)	0.70 (1.10)	1.02 (1.23)	0.60 (1.05)	1.89 (1.54)	0.66 (1.05)	0.29 (0.89)
3.	Chlorantraniliprole 18.5 SC fby Acephate 75 SP	0.3ml/l 1g/l	1.85 (1.53)	0.42 (0.96)	0.21 (0.84)	0.75 (1.12)	0.43 (0.96)	1.93 (1.56)	0.51 (1.00)	0.23 (0.85)
4.	Chlorantraniliprole 18.5 SC fby Acetamiprid 20 SP	0.3g/l 0.2g/l	1.93 (1.55)	0.40 (0.95)	0.21 (0.84)	0.68 (1.09)	0.35 (0.92)	2.07 (1.60)	0.47 (0.98)	0.23 (0.85)
5.	Chlorantraniliprole 18.5 SC fby Indoxacarb 15.8 EC	0.3ml/l 0.7ml/l	1.65 (1.46)	0.36 (0.93)	0.21 (0.84)	0.45 (0.97)	0.18 (0.82)	1.99 (1.58)	0.24 (0.86)	0.12 (0.79)
6.	Chlorantraniliprole 18.5 SC fby Flubendiamide 39.35 SC	0.3ml/l 0.2ml/l	2.00 (1.58)	0.41 (0.95)	0.21 (0.84)	0.31 (0.90)	0.13 (0.79)	1.96 (1.57)	0.22 (0.85)	0.10 (0.77)
7.	Dimethoate 30 EC fby Dimethoate 30 EC	1.3ml/l 1.3ml/l	2.06 (1.60)	1.00 (1.22)	0.88 (1.17)	1.28 (1.34)	0.71 (1.10)	2.00 (1.58)	0.70 (1.10)	0.33 (0.91)
8.	Untreated control (Water spray)	--	2.17 (1.63)	1.98 (1.57)	2.22 (1.65)	3.02 (1.88)	2.98 (1.86)	2.25 (1.66)	1.76 (1.50)	2.15 (1.63)
	SE +(m)		0.07	0.07	0.08	0.08	0.07	0.08	0.07	0.06
	CD at 5%		NS	0.21	0.23	0.22	0.20	NS	0.21	0.18
	CV %		9.80	10.88	12.38	10.53	11.67	9.20	11.52	10.60

Figures of population in parenthesis are $\sqrt{x+0.5}$ transformed value. BS- before spray DAS- days after spray

Table.2 Effects of various treatments on per cent pod and grain damage due to *H. armigera* and *M. obtuse*

Tr. No.	Treatment details	Dose	Per cent pod damage			Per cent grain damage			Grain yield (Kg/ha)
			Pooled(2015-17)			Pooled (2015-17)			
			Pod borer	Pod fly	Total	Pod borer	Pod fly	Total	
1.	Acephate 75SP fby Acephate 75 SP	1g/l 1g/l	9.89 (18.33)	8.83 (17.28)	18.72 (25.63)	6.35 (14.59)	15.40 (23.11)	21.75 (27.80)	1436
2.	Acetamiprid 20 SP fby Acetamiprid 20 SP	0.2g/l 0.2g/l	9.87 (18.31)	9.46 (17.91)	19.32 (26.08)	5.08 (13.02)	14.20 (22.14)	19.28 (26.05)	1513
3.	Chlorantraniliprole 18.5 SC fby Acephate 75 SP	0.3ml/l 1g/l	9.28 (17.73)	9.20 (17.66)	18.47 (25.46)	4.74 (12.57)	11.37 (19.70)	16.10 (23.66)	1812
4.	Chlorantraniliprole 18.5 SC fby Acetamiprid 20 SP	0.3g/l 0.2g/l	7.66 (16.07)	8.78 (17.24)	16.43 (23.91)	3.95 (11.46)	9.92 (18.36)	13.87 (21.86)	1866
5.	Chlorantraniliprole 18.5 SC fby Indoxacarb 15.8 EC	0.3ml/l 0.7ml/l	6.19 (14.41)	5.79 (13.92)	11.98 (20.25)	3.04 (10.04)	7.86 (16.28)	10.89 (19.27)	2052
6.	Chlorantraniliprole 18.5 SC fby Flubendiamide 39.35 SC	0.3ml/l 0.2ml/l	5.61 (13.70)	4.39 (12.10)	10.00 (18.44)	2.67 (9.40)	6.96 (15.29)	9.63 (18.08)	2161
7.	Dimethoate 30 EC fby Dimethoate 30 EC	1.3ml/l 1.3ml/l	11.17 (19.52)	11.34 (19.68)	22.50 (28.32)	7.93 (16.35)	14.82 (22.64)	22.78 (28.51)	1490
8.	Untreated control (Water spray)	--	16.27 (23.79)	14.39 (22.29)	30.65 (33.62)	11.23 (19.58)	21.76 (27.80)	32.93 (35.02)	1171
	SE +(m)		1.36	1.02	1.38	0.91	1.32	1.13	137
	CD at 5%		4.13	3.04	4.16	2.73	4.01	3.43	414
	CV %		13.46	10.17	10.51	11.75	11.15	9.88	14.08

Figures of population in parenthesis are angular transformed value.

Effects of various treatments on per cent pod and grain damage due to *H. armigera* and *M. obtuse*

The results revealed that the pooled data of total pod damage due to pod borer complex in all the insecticides treatments were found significantly superior over control (Table 2). The treatment T_6 chlorantraniliprole 18.5 SC @ 0.3ml/l fby flubendiamide 39.35 SC @ 0.2ml/l was recorded the minimum pod damage (10.00 per cent) was found statistical significant and at par with T_5 chlorantraniliprole 18.5 SC @30 g a.i./ha followed by indoxacarb 15.8 EC @ 73 g a.i./ha (11.98 per cent).

On the basis of pooled data indicated that the total grain damage due to pod borer complex in all the insecticides treatments was found significantly superior over control (Table 2). The treatment T_6 chlorantraniliprole 18.5 SC @ 0.3ml/l followed by flubendiamide 39.35 SC @ 0.2ml/l was recorded the minimum grain damage (9.63 per cent) was found statistical significant and at par with T_5 chlorantraniliprole 18.5 SC @0.3ml/l followed by indoxacarb 15.8 EC @ 0.7ml/l (10.89 per cent), respectively. The present findings are in accordance with findings of Chakravarty and Agnihotri (2016) who reported that among ten different insecticidal treatments tested against pigeonpea pod borer complex (*M. vitrata*, *H. armigera* and *M. obtusa*), alternate spray of rynaxypyr 18.5 SC @ 30g a.i./ha and Spinosad 45 SC @ 56g a.i./ha was found to be most effective with minimum total per cent pod damage of 10.44% and maximum grain yield of 1346.67 kg/ha. However, Sambathkumar *et al.,* (2015) also found chlorantraniliprole 18.5 SC @ 30 g a.i./ha and indoxacarb 15.8 EC @ 75 g a.i/ha highly effective against *M. obtusa* in pigeonpea that resulted in significantly lower per cent pod damage (11.7% and 13.0%, respectively) as compared to 21.7% in untreated control. The present findings are also in close conformity with Patel *et al.,* (2015) who reported that Chlorantraniliprole 18.5% SC @ 30 g a.i./ha registered the lowest pod damage due to pod borer and pod fly and recorded the highest yield of pigeonpea.

Effects of various treatments on grain yield of pigeonpea

The results revealed that on the basis of pooled data indicated that the grain yields in all the insecticides treatments were found significantly superior over control (Table 2).

The treatment T_6 chlorantraniliprole 18.5 SC @ 0.3ml/l fby flubendiamide 39.35 SC @ 0.2ml/l was recorded the maximum grain yield (2161 kg/ha) was found statistical significant and at par with T_5 chlorantraniliprole 18.5 SC @0.3ml/l followed by indoxacarb 15.8 EC @ 0.7ml/l (2052 kg/ha) followed by T_4 chlorantraniliprole 18.5 SC @ 0.3ml/l fby acetamiprid 20 SP@ 0.2g/l (1866 kg/ha) and T_3 chlorantraniliprole18.5 SC @ 0.3ml/l followed by acephate 75 SP @ 1g/l (1812 kg/ha), respectively. The present findings are accordance with of Satpute and Barkhade (2012) also reported rynaxypyr 20 SC @ 40g a.i./ha as the most promising insecticide against pod borer complex of pigeonpea and to give highest yield of 17.52 q/ha. The present findings are also in accordance with the earlier reports of Nishantha (2009) who reported rynaxypyr 20 SC @ 30g a.i./ha as superior molecule in recording lower pod damage and higher grain yield in pigeonpea against pod borer complex. Further strengthens the present findings are Wadaskar *et al.,* (2013) also reported rynaxypyr to be highly efficacious against insect pest complex of pigeonpea was most effective in reducing the pod damage as well as pest population with maximum yield of 16.15 and 17.52 q ha-1respectively.

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