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Crop phenology based application of insecticides for the management of pod borer of chickpea

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ABSTRACT

Helicoverpa armigera is the major biotic productivity constraint for chickpea. Farmers rarely apply insecticides based on the attainment of economic threshold levels of the pest; translating in higher crop damage and cost of plant protection. Hence, present study was framed to device a farmer friendly, crop phenology based application of newer molecules for the cost effective management of the pod borer. The field experiment was conducted at the Agriculture Research Station, Sakoli during Rabi2016-17, 2017-18 and 2018-19 and Pulses Research Unit, Akola during Rabi2017-18 and 2018-19 to screen of newer insecticides against pod borer of chickpea and to estimate the efficacy and economics of newer insecticides against pod borer of chickpea. The results revealed that, application of Lambda cyhalothrin 5% EC at 50 per cent flowering was followed by chlorantraniliprole 18.5 SC at 15 days after first application and Ethion 50% EC at 50 per cent flowering followed by chlorantraniliprole 18.5 SC at 15 days after first application were found most effective treatments for reduction of gram pod borer population and damage which translating into higher yield and ICBR.

Keywords: *Chickpea, gram pod borer, efficacy, newer insecticides.*

INTRODUCTION

Chickpea (*Cicerarietinum* L.)is an important pulse crop of India, known as king of pulses. It is consumed as vegetables, pulse, flour, a variety of snacks, sweets and other different culinary dishes. Among the pulses crop chickpea is a highly nutritious having best source of proteins (12– 31%), carbohydrates (60–65%), fat (6%) and different kind of vitamins (Saharan and Khetarpaul, 1994; Kumar et al., 2015). The annual losses due to insect pests have been estimated up to 15% in chickpeas (Chandrashekar et al., 2014).India is the major producing country for chickpea, contributing for over 75% of total production in the world. Gram pod borer, *Helicoverp aarmigera* Hubnermenace is the major biotic constraint in the attainment of desired productivity levels in chickpea production. Under favorable climatic conditions, the losses can be very high resulting in economic loss. The economic losses in chickpea are evident from reproductive stage. As farmers rarely employs survey techniques for estimation of economic threshold level the calendar-based application of insecticides will be better alternative to take up plant protection measures. Thus, the application of insecticides at 50 per cent flowering and 15 days after first application will manage the incidence of pod borer of chickpeas. There is the inclination of the farmers for utilization of newer molecules available in the market. Exploring new insecticides with lesser residues and lower environmental threat has become imperative.

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In recent years, newer compounds with novel modes of action are being evolved to check infestation by this insect pest. Thus, there is a need to evaluate the efficacy of newer chemistries on crop phenology- based application for economic production of chickpea. Therefore, the field experiment was conducted for screening of newer insecticides against pod borer of chickpea and to estimate the efficacy and economics of newer insecticides against pod borer of chickpea.

MATERIALS AND METHOD

The field experiment was conducted at Agriculture Research Station, Sakoli during *Rabi* 2016-17, 2017-18, and 2018-19 at Pulses Research Unit, Akola during *Rabi* 2017-18 and 2018-19. Five insecticides viz., Lambda-cyhalothrin 5% EC, Quinalphos 25 EC, Ethion 50 EC, Chlorantraniliprole 18.5 SC and Emamectin benzoate 5 SG were screened against gram pod borer of chickpea. Chickpea variety Jaki 9218 was sown in randomized block design with 7 treatments and 3 replications. A spacing of 30 cm X 10 cm was adopted in a gross plot size 4.2 m X 2.1 m.
Sowing was done by dibbling following similar recommended agronomic practices to all the treatments from sowing to harvesting. The first spray was applied at 50% flowering and second spray 15 days after the first spray. Observations of larval population of *H. armigera* per meter row length were recorded from 3 randomly selected spots from each plot pretreatment and seven and fourteen days after spraying. At the time of crop maturity, observations of pod damage (%) was recorded by collecting pods from 5 plants selected at random, counting healthy and damaged pod separately. Also, observations of yield were recorded after harvesting. Economics of the application of each treatment was workout.

RESULTS AND DISCUSSION

1. Pooled effect of different treatments on the larval population of gram pod borer on chickpea

Pooled assessment of gram pod borer on chickpea concluded from data given in Table -1, all the treatment modules found significantly superior over larval reduction. While most effective treatment module (T1) lambda cyhalothrin fallowed by chlorantriniliprole 18.5 SC recorded 0.53 larvae/mrl with 79.10 per cent larval reduction over control. Which is statistically at par with the treatment modules T3 (Ethion 50% EC followed by chlorantraniliprole 18.5 SC) recorded 0.62 larvae/mrl with a larval reduction of 75.50 per cent and followed by treatment module (T2) quinolphos 25 EC ECfollowed by chlorantraniliprole 18.5 SC recorded 0.62 larvae/mrl with a larval reduction 65.74 per cent. Followed by treatment modules were T4, T6 and T5 recorded 0.89, 0.92, 1.12 larvae/mrl with a larval reduction of 64.76, 63.66, 55.56 per cent, respectively. Whereas untreated control recorded 2.53 larvae/mrl.

2. Effect of different treatments on pod damage by gram pod borer on chickpea

The final assessment of gram pod borer on chickpea in respect of pod damage at harvest concluded from data given in Table -2, reveals that the treatment module T1 was found most effective in a reduction in pod damage with 4.74 per cent damage and statistically at par with treatment module T3 (Ethion 50% EC followed by chlorantraniliprole 18.5 SC) recorded 5.52 per cent. Next treatment followed by T2, T4,T5 and T6 recorded 6.17, 6.92, 7.83 and 7.87 per cent pod damage, respectively. Whereas untreated control recorded a highest (12.64) per cent pod damage.

3. Effect of different treatments on yield of chickpea

The effect of different treatment modules assessed for influence of gram pod borer on yield was given in Table -3 indicating that the higher yield obtained in the treatment module T1 (lambda cyhalothrinfollowed bychlorantriniliprole 18.5 SC) i.e. 21.33 q/ha, which is statistically at par with the treatment module T3 (Ethion 50% EC fb chlorantraniliprole 18.5 SC) obtained 20.83 q/ha and followed by T2 (quinolphos 25 EC fb chlorantraniliprole 18.5 SC) obtained18.85 q/ha yield. Next better treatment module found were T6 and T5 recorded a 18.24 and 17.23 q/ha yield, respectively. Whereas untreated control recorded 14.81 q/ha yield.

4. Net profit and ICBR

The higher monetary return of Rs.25025/-obtained due to the application of Treatment module T1 (Lambda cyhalothrin 5% EC followed by chlorantraniliprole 18.5 SC) with BC ratio of 1:6.80. It was followed by treatment module T3 (Ethion 50% EC followed by chlorantraniliprole 18.5 SC) obtained a net profit of Rs.22375/- with BC ratio 1:5.75. (Table4).

The population of *H. armigera* increased greatly during the reproductive stage and caused substantial damage, therefore at this stage control measures become necessary. In the present study, different insecticides were applied to check the population of *H. armigera* on chickpea. Lambda-cyhalothrin, a synthetic pyrethroids begins working immediately upon contact or ingestion, resulting in fast insect knock-down and kill. Lambda-cyhalothrin kills by acting as a high-power poison to the insect's central nervous system. Once poisoned, the insect's nerve cells become excited, causing paralysis and eventual death.

Ethion is an organophosporus insecticide with quick knock down and long lasting residual activity. Chlorantraniliprole insecticide manages insects at all stages from immature to adult stage thereby, providing excellent and long-lasting crop protection. Exposed insects stop feeding within minutes and extended residual activity protects crops longer than competitive options.

These findings are in a agreement with the findings of Shah et al. (2003) who reported that all the insecticides resulted in significant reduction in the larval population density of gram pod borer, *H. armigera* on chickpea and thereby, increased the biomass and grain yield in comparison with control. However, chlorpyrifos proved to be the best insecticide followed by endosulfan, lambda cyhalothrin and cypermethrin. Hossain *et al.* (2010) who observed that lambda cyhalothrin doubled sprayed with 7 days interval from pod formation stage was the best package in managing pod borer in chickpea considering efficacy and profitability in High Barina Tract of Bangladesh. Similarly, Iqbal et al. (2014) reported that the highest mortality of gram pod borer was recorded in plots treated with Profenofos (85%, 90% & 94%) and Coragen (85%, 90% & 92%) at 3, 5 and 7 days after treatment (DAT), respectively. Suneel Kumar and Sarada (2015) reported that the chlorantraniliprole 20% SC was effective against *H.armigera* in respect of lowest larvae per 10 plants, lower pod damage due to pod borer, higher seed yield and higher cost-benefit ratio. Nenavatiand Kumar(2017) revealed that the number of gram pod borer larvae per meter row length was lowest in plots treated with chlorantraniliprole, which was found to be most superior to the rest of the treatment by recording 91.88 per cent reduction over control respectively. Pod damage due to pod borer was lowest in plots treated with Chlorantraniliprole and Lambda Cyhalothrin. Maximum yield was obtained with Chlorantraniliprole. Jakharet al. (2017) revealed that coragen (chlorantraniliprole) 18.5 SC was best among all the treatments with minimum larval population of H. armigera, minimum pod damage and maximum yield against untreated control. These results are in close proximity with Chaudhari, et al. (2018) who revealed that, application of Emamectin benzoate 5 % SG was found more effective followed by λ-Cyhalothrin 5 % EC and Ethion 50 % EC in terms of higher larval reduction of gram pod borer on chickpea, lower pod damage translating into higher yield. However, highest incremental cost benefit ratio (ICBR) was exhibited in treatment with λ-Cyhalothrin 5 % EC followed by Ethion 50 % EC. Chitralekhaet al. (2018) who reported that after first and second spray minimum mean larval population of H. armigerawas recorded in chlorantraniliprole 18.5 SC. Similarly, per cent larval reduction over control was highest in chlorantraniliprole 18.5 SC. based on the pooled mean of both the years (2015-16 and 2016-17), minimum pod damage and highest yield was recorded in chlorantraniliprole 18.5 SC. Naveen and Mondal (2020) reported that the treatment with chlorantraniliprole 18.5 SC @ 30 g a.i.ha-1was found to be superior than other treatments with 87.12 to 88.14 % reduction of larvae of gram pod borer and increase in yield.

The present findings conclude that the application of Lambda cyhalothrin 5% EC at 50 per cent flowering followed by chlorantraniliprole 18.5 SC at 15 days after first application and Ethion 50% EC at 50 per cent flowering followed by chlorantraniliprole 18.5 SC at 15 days after first application were found most effective treatments for reduction of gram pod borer population and damage which translating into higher yield and ICBR.

Thus, the present findings clearly indicated that the new generation insecticides like chlorantraniliprole 18.5 SC, lambda cyhalothrin 5% EC and Ethion 50% EC were found effective against gram pod borer, .*H armigera*.

Table 1: Cumulative pooled effect of different treatments on larval population of gram pod borer on chickpea.

Tr. No.	Treatment		*H. armigera* larval count/MRL						Per cent reduction over control
	Applications of insecticides		ARS, Sakoli	ARS, Sakoli	PRU Akola	ARS, Sakoli	PRU Akola	Pooled Mean	
	At 50 per cent flowering	15 days after first application	2016-17	2017-18	2017-18	2018-19	2018-19		
T_1	Lambda-cyhalothrin 5% EC (400 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	0.65 (1.07)	0.95 (1.20)	0.00 (0.71)	1.02 (1.23)	0.03 (0.73)	0.53 (1.01)	79.10
T_2	Quinalphos 25 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	1.05 (1.24)	1.30 (1.34)	0.30 (0.90)	1.43 (1.39)	0.25 (0.86)	0.87 (1.17)	65.74
T_3	Ethion 50 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	0.87 (1.17)	1.12 (1.27)	0.00 (0.71)	1.03 (1.24)	0.08 (0.76)	0.62 (1.06)	75.50
T_4	Lambda-cyhalothrin 5% EC (400 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	1.57 (1.44)	1.13 (1.28)	0.08 (0.76)	1.48 (1.41)	0.19 (0.83)	0.89 (1.18)	64.76
T_5	Quinalphos 25 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	1.65 (1.47)	1.62 (1.45)	0.36 (0.93)	1.75 (1.50)	0.25 (0.86)	1.12 (1.27)	55.56
T_6	Ethion 50 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	1.68 (1.48)	1.25 (1.32)	0.08 (0.76)	1.42 (1.38)	0.17 (0.82)	0.92 (1.19)	63.66
T_7	Untreated control	-	3.30 (1.95)	3.00 (1.87)	1.33 (1.35)	3.58 (2.02)	1.44 (1.39)	2.53 (1.74)	-
	f test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
	SE m ±		0.04	0.03	0.04	0.07	0.05	0.02	
	CD at 5%		0.11	0.08	0.13	0.21	0.14	0.05	
	CV %		4.50	3.33	8.55	8.18	8.86	2.22	

S- Significant,
Data subjected to square root transformation for the analysis. {parentheses values = SQRT(n+0.5)}, where n = mean no. of larvae.

Table 2: Effect of different treatments on pod damage by gram pod borer on chickpea.

Tr. No.	Treatment		Per cent gram pod borer damage						Per cent reduction over control
	Applications of insecticides		ARS, Sakol	ARS, Sakol	PRU Akola	ARS, Sakol	PRU Akola	Pooled Mean	
	At 50 per cent flowering	15 days after first application	2016-17	2017-18	2017-18	2018-19	2018-19		
T_1	Lambda-cyhalothrin 5% EC (400 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	3.74 (1.93)	6.56 (2.56)	2.54 (1.59)	8.09 (2.84)	2.80 (1.67)	4.74 (2.18)	62.30
T_2	Quinalphos 25 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	5.82 (2.41)	9.00 (3.00)	4.02 (2.00)	8.19 (2.86)	3.80 (1.95)	6.17 (2.48)	51.06
T_3	Ethion 50 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	4.80 (2.19)	8.05 (2.84)	3.98 (1.99)	7.75 (2.78)	3.03 (1.74)	5.52 (2.35)	56.15
T_4	Lambda-cyhalothrin 5% EC (400 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	6.79 (2.61)	6.70 (2.59)	2.76 (1.66)	14.47 (3.80)	3.87 (1.97)	6.92 (2.63)	45.12
T_5	Quinalphos 25 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	6.49 (2.55)	8.88 (2.98)	4.74 (2.17)	14.64 (3.83)	4.40 (2.10)	7.83 (2.80)	37.89
T_6	Ethion 50 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	6.87 (2.62)	9.91 (3.15)	3.15 (1.77)	14.85 (3.85)	4.57 (2.14)	7.87 (2.81)	37.58
T_7	Untreated control	-	13.12 (3.62)	16.95 (4.12)	6.76 (2.59)	21.28 (4.61)	5.10 (2.26)	12.64 (3.56)	-
	f test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
	SE m ±		0.10	0.29	0.09	0.23	0.07	0.08	
	CD at 5%		0.32	0.89	0.26	0.70	0.20	0.26	
	CV %		7.01	16.72	7.49	11.23	5.73	5.49	

Sig.-Significant
Data subjected to square root transformation for the analysis. {parentheses values = SQRT (n)}, where n = Per cent gram pod borer damage.

Table 3: Effect of different treatments on yield of chickpea.

Tr. No.	Treatment		Yield (q/ha)						Increase in Yield over control (%)
	Applications of incticides		ARS, Sakol	ARS, Sakol	PRU Akola	ARS, Sakol	PRU Akola	Pooled Mean	
	At 50 per cent flowering	15 days after first application	2016-17	2017-18	2017-18	2018-19	2018-19		
T_1	Lambda-cyhalothrin 5% EC (400 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	19.38	19.23	18.66	26.36	23.5	21.33	44.02
T_2	Quinalphos 25 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	17.21	17.30	15.80	24.18	17.9	18.85	27.28
T_3	Ethion 50 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	18.64	20.86	16.23	26.27	19.5	20.83	40.65
T_4	Lambda-cyhalothrin 5% EC (400 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	15.76	18.58	17.44	19.09	13.4	16.44	11.01
T_5	Quinalphos 25 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	15.41	14.29	16.16	20.97	15.9	17.23	16.34
T_6	Ethion 50 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	14.71	16.66	17.20	20.76	15.4	18.24	23.16
T_7	Untreated control	-	12.12	12.72	14.33	16.21	13.6	14.81	-
	f test		**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	
	SE m ±		1.07	1.54	0.70	1.48	0.91	0.43	
	CD at 5%		3.31	4.74	2.16	4.57	2.81	1.32	
	CV %		11.50	15.60	7.32	11.69	9.12	4.18	

Sig.- Significant

Table 4: Effect of different treatments onincremental cost benefit ratio (ICBR).

Tr. No.	Treatment		Total Cost for 2 Spraying	Pooled Yield (q/ha)	Yield increased over control (q/ha)	Value of increased yield (Rs.)	Incremental Benefit (Rs.)	ICBR	Rank
	Applications of insecticides								
	At 50 per cent flowering	15 days after first application							
T_1	Lambda-cyhalothrin 5% EC (400 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	4315	21.33	6.52	29340	25025	6.80	1
T_2	Quinalphos 25 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	4555	18.85	4.04	18180	13625	3.99	4
T_3	Ethion 50 EC (1000 ml/ha)	Chlorantraniliprole 18.5 SC (125 ml/ha)	4715	20.83	6.02	27090	22375	5.75	2
T_4	Lambda-cyhalothrin 5% EC (400 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	3276	16.44	1.63	7335	4059	2.24	6
T_5	Quinalphos 25 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	3516	17.23	2.42	10890	7374	3.10	5
T_6	Ethion 50 EC (1000 ml/ha)	Emamectin benzoate 5 SG (220 g/ha)	3676	18.24	3.43	15435	11759	4.20	3
T_7	Untreated control	-	0	14.81					

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