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Bio-Efficacy of Chlorefluazuron 5.4% EC Against POD Borer (*Helicoverpa Armigera*) Chickpea

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Abstract: The field efficacy of Chlorfluazuron 5.4 % EC in three doses *i.e.* 1500, 2000 and 2500 ml/ha was evaluated along with Quinalphos 25% EC @ 1000 ml/ha, Lambda-cyhalothrin 5% EC @ 500 ml/ha and Novaluron 10% EC @ 750 ml/ha under field conditions against pod borer (*Helicoverpa armigera*) during Rabi 2018-19 and Rabi 2019-20. During Rabi 2018-19, Minimum larval population of *H. armigera* (0.60 larvae/plant) after 14 days after second spray was found in the higher dose of Chlorfluazuron 5.4 % EC *i.e.* 2500 ml/ha followed by 2000 ml/ha (0.87 larvae/plant). Maximum grain yield (18.25 q/ha) was recorded in the treatment of Chlorfluazuron 5.4 % EC @ 2500 followed by 17.06 q/ha in Chlorfluazuron 5.4 % EC @ 2000 as compared to 12.30 q/ha in control. Same trend was also observed during Rabi 2019-20. On the basis of pod borer population and grain yield data, both doses were statistically at par with each other. Therefore, application of Chlorfluazuron 5.4 % EC @ 2000 was the effective against gram pod borer in chickpea.

Keywords: Chickpea, Chlorfluazuron, Gram pod borer, Bio-efficacy, Grain yield.

Chickpea (*Cicer arietinum* L.) is the most significant pulse crop in the world. India leads the globe in both chickpea production and consumption. In India it is also known as "King of pulses". It contains 21.5 per cent protein, 64.5 per cent carbs, and 4.5 per cent fat which is comparatively deficient in grains and oilseeds. Chickpea is a rich source of nutritional benefits in the diet of Indians. People use its green leaves and pods in their everyday meals as green vegetables and germinated grains for breakfast and other delectable cuisines (Parmar et al., 2015). The major insect-pests *i.e. Helicoverpa armigera*, *Spodoptera litura, Agrotis ipsilon, Plusia orichalchea* and *Bemisia tabaci* attaching during winter and summer seasons on the chickpea crop from seedling to it's maturity and causing severe damage (Yogeeswarudu and Krishna 2014). Out of various insect pests attaching, gram pod borer (*Helicoverpa armigera* Hubner) is a key pest of chickpea during the rabi seasons. It has been shown 32–100 per cent pod damage by and 4.2–77.0 per cent reduce yield (Ujagir and Khare, 1988; Singh et al., 1990). A single gram pod borer larva, has the potential to destroy up to 25–30 chickpea pods throughout its lifetime (Sharma, 1978). Some newer chemical molecules are being introduced in the market having noval mode of approaches, hence it become imperative to test them. Therefore, the present investigation was carried out to evaluate the bio-efficacy of chlorfluazuron 5.4% EC with other insecticide which could be utilized for the effective management of pod borer (*Helicoverpa armigera*) in chickpea crop.

MATERIALS AND METHODS

Field experiments were conducted at experimental site of Agricultural Research Station, Ummedganj, Kota during *rabi* 2018-19 and 2019-

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20 in randomized block design (RBD) having the chickpea variety GNG 469 and replicated three times along with untreated control. The crop was sown in the month of November in plot size of 4.2 x 6.0 m keeping 60 cm row to row and 10 cm plant to plant distance during both the years. Three doses of Chlorfluazuron 5.4 % EC *i. e.* 1500, 2000 and 2500 ml/ha along with Quinalphos 25% EC @ 1000 ml/ha, Lambda-cyhalothrin 5% EC @ 500 ml/ha and Novaluron 10% EC @ 750 ml/ha were evaluated for their efficacy against gram pod borer in chickpea. All the treatments were applied twice in 15 days interval by the spray of insecticides first at 65 days after sowing when population pressure of borer remains maximum at most vulnerable crop stage. Five plants were randomly selected and tagged in each plot and observations on larval population of pod borer per plant was recorded tagged plant at one day before spraying and 3, 7 and 14 days after each spray. Per cent pod damage by pod borer was recorded at 14 days after second spray. Grain yield was recorded from each plot after the harvest of the crop and converted in quintal per hectare before subjecting to the statistical analysis.

RESULTS AND DISCUSSION

Pod borer (*Helicoverpa armigera*) population:

Rabi 2018-19

The data of both the spray on larval population of gram pod borer at one day before spraying and 3, 7 and 14 days after 1stspray presented in table 1 revealed that pod bore population per plant at one day before spraying in different treatments along with control varied from 3.27 to 3.87 and were statistically at pat with each other. All the insecticidal treatments were found statistically superior over control after 3, 7 and 14 days of treatment application. The larval population recorded at 3, 7 and 14 days after first and second spray showed that at 14 days after second spray, lowest population of pod borer (0.60 larvae/ plant) was found in the treatment of Chlorfluazuron 5.4 % EC @ 2500 ml/ha with 85.95 per cent reduction over control followed by 0.87 larvae/plant with 79.63 per cent reduction over control in Chlorfluazuron 5.4 % EC @ 2000 ml/ha as compared to untreated control (4.27 larvae/ plant). Both doses of Chlorfluazuron 5.4 % EC *i.e.* 2000 and 2500 ml/ha were statistically at par. These were followed by Lambda-cyhalothrin 5% EC @ 750 ml/ha, Novaluron 10% EC @ 750 ml/ha, Quinalphos 25% EC @ 1000 ml/ha and Chlorfluazuron 5.4 % EC @ 1500 ml/ha. during both years.

Rabi 2019-20

The data of both the spray on larval population of gram pod borer at one day before spraying and 3, 7 and 14 days after 1stspray presented in table 2 revealed that pod bore population per plant at one day before spraying in different treatments along with control varied from 2.40 to 3.00 and were statistically at pat with each other. All the insecticidal treatments were found statistically superior over control after 3, 7 and 14 days of treatment application. The larval population recorded at 3, 7 and 14 days after first and second spray showed that at 14 days after second spray, lowest population of pod borer (0.53 larvae/ plant) was found in the treatment of Chlorfluazuron 5.4 % EC @ 2500 ml/ha with 89.47 per cent reduction over control followed by 0.73 larvae/plant with 85.53 per cent reduction over control in Chlorfluazuron 5.4 % EC @ 2000 ml/ha as compared to untreated control (5.07 larvae/ plant). Both doses of Chlorfluazuron 5.4 % EC *i.e.* 2000 and 2500 ml/ha were statistically at par. These were followed by Lambda-cyhalothrin 5% EC @ 750 ml/ha, Novaluron 10% EC @ 750 ml/ha, Quinalphos 25% EC @ 1000 ml/ha and Chlorfluazuron 5.4 % EC @ 1500 ml/ha during both years.

Pod damage

Both years data on pod damage by pod borer in chickpea presented in table 3 and 4 showed that at 14 days after 2nd spray, Chlorfluazuron 5.4 % EC @ 2500 ml/ha and 2000 ml/ha were most effective to minimize pod damage with 11.60% and 12.80% pod damage and 67.05% and 63.64% reduction in pod damage over control during Rabi 2018-19 while during Rabi 2019-20, 9.20% and 9.60% pod damage and 68.92% and 67.57% reduction in pod damage, respectively both the

Table 1: Bio-efficacy of Chlorfluazuron 5.4 % EC against pod borer in Chickpea during Rabi 2018-19

Tr. No.	*Treatment details*	*No. of larvae/plant (H.armigera)*												
		First spray							*Second spray*					
		PTP	*3 DAS*	*% ROC*	*7DAS*	*% ROC*	*14 DAS*	*% ROC*	*3 DAS*	*% ROC*	*7DAS*	*% ROC*	*14 DAS*	*% ROC*
T_1	Chlorfluazuron 5.4 % EC @ 1500 ml/ha	3.53 (2.01)	3.07 (1.89)	22.03	2.40 (1.70)	44.62	2.73 (1.80)	48.10	2.60 (1.76)	50.00	2.13 (1.62)	52.94	1.60 (1.44)	62.53
T_2	Chlorfluazuron 5.4 % EC @ 2000 ml/ha	3.87 (2.09)	1.87 (1.54)	52.54	1.47 (1.40)	66.15	1.33 (1.35)	74.68	1.00 (1.22)	80.77	0.87 (1.17)	80.88	0.87 (1.17)	79.63
T_3	Chlorfluazuron 5.4 % EC @ 2500 ml/ha	3.80 (2.07)	1.53 (1.42)	61.02	1.20 (1.30)	72.31	1.40 (1.37)	73.42	1.00 (1.22)	80.77	0.73 (1.11)	83.82	0.60 (1.05)	85.95
T_4	Quinalphos 25% EC @ 1000 ml/ha	3.60 (2.02)	2.67 (1.78)	32.20	2.33 (1.65)	46.15	2.47 (1.72)	53.16	2.13 (1.62)	58.97	1.73 (1.49)	61.76	1.47 (1.40)	65.65
T_5	Lambda-cyhalothrin 5% EC @ 500 ml/ha	3.27 (1.94)	2.27 (1.66)	42.37	1.80 (1.52)	58.46	1.93 (1.56)	63.29	1.53 (1.43)	70.51	1.33 (1.35)	70.59	1.20 (1.30)	71.90
T_6	Novaluron 10% EC @ 750 ml/ha	3.73 (2.06)	2.53 (1.74)	35.59	2.13 (1.62)	50.77	2.27 (1.66)	56.96	1.67 (1.47)	67.95	1.47 (1.40)	67.65	1.33 (1.35)	68.77
T_7	Untreated control	3.40 (1.97)	3.93 (2.10)	-	4.33 (2.19)	-	5.27 (2.40)	-	5.20 (2.39)	-	4.53 (2.24)	-	4.27 (2.18)	-
	S. Em±	0.056	0.06		0.08		0.05		0.04		0.05		0.054	
	CD (P=0.05)	NS	0.17		0.26		0.17		0.12		0.15		0.166	
	CV (%)	4.80	5.66		8.95		5.49		4.30		5.85		6.62	

PTP= Pre Treatment Population, DAS= Days after spray, % ROC= Per cent reduction over control.
Figures in parenthesis are square root (√x+0.5) transformed values.

Table 2: Bio-efficacy of Chlorfluazuron 5.4 % EC against pod borer in Chickpea during Rabi 2019-20

Tr. No.	*Treatment details*	*No. of larvae/plant (H.armigera)*												
		First spray							*Second spray*					
		PTP	*3 DAS*	*% ROC*	*7DAS*	*% ROC*	*14 DAS*	*% ROC*	*3 DAS*	*% ROC*	*7DAS*	*% ROC*	*14 DAS*	*% ROC*
T_1	Chlorfluazuron 5.4 % EC @ 1500 ml/ha	2.40 (1.70)	1.93 (1.56)	35.56	2.00 (1.58)	41.18	2.33 (1.68)	43.55	1.87 (1.54)	59.42	1.60 (1.45)	67.12	1.40 (1.38)	72.37
T_2	Chlorfluazuron 5.4 % EC @ 2000 ml/ha	2.60 (1.76)	1.13 (1.28)	62.22	1.00 (1.22)	70.59	1.33 (1.35)	67.74	0.93 (1.20)	79.71	0.80 (1.13)	83.56	0.73 (1.11)	85.53
T_3	Chlorfluazuron 5.4 % EC @ 2500 ml/ha	2.80 (1.81)	1.00 (1.22)	66.67	0.67 (1.08)	80.39	1.07 (1.25)	74.19	0.60 (1.05)	86.96	0.53 (1.01)	89.04	0.53 (1.02)	89.47
T_4	Quinalphos 25% EC @ 1000 ml/ha	3.00 (1.87)	1.80 (1.52)	40.00	1.73 (1.49)	49.02	2.20 (1.64)	46.77	1.80 (1.52)	60.87	1.53 (1.43)	68.49	1.33 (1.35)	73.68
T_5	Lambda-cyhalothrin 5% EC @ 500 ml/ha	2.40 (1.70)	1.67 (1.46)	44.44	1.40 (1.38)	58.82	1.60 (1.44)	61.29	1.40 (1.38)	69.57	1.20 (1.29)	75.34	1.00 (1.22)	80.26
T_6	Novaluron 10% EC @ 750 ml/ha	2.60 (1.76)	1.80 (1.50)	40.00	1.53 (1.42)	54.90	2.07 (1.60)	50.00	1.53 (1.41)	66.67	1.33 (1.35)	72.60	1.13 (1.28)	77.63
T_7	Untreated control	2.40 (1.70)	3.00 (1.87)	-	3.40 (1.97)	-	4.13 (2.15)	-	4.60 (2.26)	-	4.87 (2.32)	-	5.07 (2.36)	-
	S. Em±	0.09	0.08		0.05		0.05		0.06		0.08		0.057	
	CD (P=0.05)	NS	0.25		0.17		0.16		0.20		0.23		0.175	
	CV (%)	8.83	9.44		6.44		5.64		7.56		9.24		7.08	

PTP= Pre Treatment Population, DAS= Days after spray, % ROC= Per cent reduction over control.
Figures in parenthesis are square root (√x+0.5) transformed values.

Table 3: Bio-efficacy of Chlorfluazuron 5.4 % EC against pod damage in Chickpea and effect on yield during Rabi 2018-19

Tr. No.	*Treatment details*	*Pod damage (%)*	*% ROC*	*Yield (q/ha)*	*Per cent increase in yield over control*
T_1	Chlorfluazuron 5.4 % EC @ 1500 ml/ha	16.60 (24.03)	52.84	15.48	25.85
T_2	Chlorfluazuron 5.4 % EC @ 2000 ml/ha	12.80 (20.96)	63.64	17.06	38.73
T_3	Chlorfluazuron 5.4 % EC @ 2500 ml/ha	11.60 (19.90)	67.05	18.25	48.37
T_4	Quinalphos 25% EC @ 1000 ml/ha	15.80 (23.41)	55.11	15.28	24.23
T_5	Lambda-cyhalothrin 5% EC @ 500 ml/ha	13.80 (21.80)	60.80	16.07	30.65
T_6	Novaluron 10% EC @ 750 ml/ha	14.40 (22.29)	59.09	15.67	27.40
T_7	Untreated control	35.20 (36.39)	-	12.30	-
	S. Em±	0.572		0.529	
	CD (P=0.05)	1.764		1.630	
	CV (%)	4.11		5.83	

Figures in parenthesis are angular transformed values, % ROC= Per cent reduction over control

Table 4: Bio-efficacy of Chlorfluazuron 5.4 % EC against pod damage in Chickpea and effect on yield during Rabi 2019-20

Tr. No.	*Treatment details*	*Pod damage (%)*	*% ROC*	*Yield (q/ha)*	*Per cent increase in yield over control*
T_1	Chlorfluazuron 5.4 % EC @ 1500 ml/ha	14.40 (22.30)	51.35	14.68	32.13
T_2	Chlorfluazuron 5.4 % EC @ 2000 ml/ha	09.60 (18.05)	67.57	16.67	50.05
T_3	Chlorfluazuron 5.4 % EC @ 2500 ml/ha	09.20 (17.64)	68.92	17.33	55.99
T_4	Quinalphos 25% EC @ 1000 ml/ha	13.20 (21.29)	54.41	15.08	35.73
T_5	Lambda-cyhalothrin 5% EC @ 500 ml/ha	11.40 (19.72)	61.49	15.87	42.84
T_6	Novaluron 10% EC @ 750 ml/ha	12.00 (20.25)	59.46	15.48	39.33
T_7	Untreated control	29.60 (32.95)	-	11.11	-
	S. Em±	0.636		0.437	
	CD (P=0.05)	1.960		1.347	
	CV (%)	5.07		4.99	

Figures in parenthesis are angular transformed values, % ROC= Per cent reduction over control

treatments. These were followed by Lambda-cyhalothrin 5% EC @ 750 ml/ha, Novaluron 10% EC @ 750 ml/ha, Quinalphos 25% EC @ 1000 ml/ha and Chlorfluazuron 5.4 % EC @ 1500 ml/ha during both years.

Effect on Chickpea yield

The Chickpea yield data of both *i. e.* seasons Rabi 2018-19 and Rabi 2019-20 presented in Table 3 and 4 revealed that maximum yield was recorded in the treatment of Chlorfluazuron 5.4 % EC @ 2500 ml/ha (18.25 q/ha and 17.33 q/ha, respectively) which was at par with Chlorfluazuron 5.4 % EC @ 2000 ml/ha (17.06 q/ha and 16.67 q/ha, respectively). The next best treatments were Lambda-cyhalothrin 5% EC @ 750 ml/ha, Novaluron 10% EC @ 750 ml/ha, Quinalphos 25% EC @ 1000 ml/ha and Chlorfluazuron 5.4 % EC @ 1500 ml/ha during both years. Among all the treatments lowest yield was recorded in untreated control which provided 12.30 q/ha and 11.11 q/ha during Rabi 2018-19 and Rabi 2019-20, respectively.

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