Research Article

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Relative efficacy of cyclaniliprole against *Helicoverpa armigera* and *Spodoptera litura* on chilli (*Capsicum annuum*)

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Abstract

Field experiments were conducted to study the efficacy of insecticide cyclaniliprole 10% DC at 300, 350, 400, and 450 ml ha^{-1}, along with two standard checks: Chlorantraniliprole 18.5% SC at 150 ml ha^{-1} and Abamectin benzoate 5% SG at 200 g ha^{-1}, against lepidopterous insect pests infesting chilli (*Capsicum annuum* L.) crop at Rajasthan College of Agriculture, Udaipur, during *kharif* 2020 and 2021. Chilli variety, Tanaya, was sown in a randomized block design with seven treatments and four replications. The results showed that cyclaniliprole 10% DC was equally effective at 400- and 450-ml ha^{-1} in controlling fruits-borer (*Helicoverpa armigera*) and tobacco caterpillar (*Spodoptera litura*), and was more effective than other standard treatments. The highest mean yield was recorded in treatment of cyclaniliprole 10% DC at 450 ml ha^{-1}, which was 15.05 t ha^{-1} and 15.26 t ha^{-1} during the respective years, compared to the control.

Key words: Borers, Efficacy, Insecticide, Noval, Cyclaniliprole, Aphids, Thrips

Chilli (*Capsicum annuum* L.) vulnerable to many insect pests, *viz.* aphids (*Myzus persicae* Sulzer., *Aphis gossypii* Glover.), thrips (*Scirtothrips dorsalis* Hood.,), yellow mite (*Polyphagotarsonemus latus* Banks), fruits-borer (*Helicoverpa armigera* Hubner) and tobacco caterpillar (*Spodoptera litura* Fabricius) (Swami *et al.,* 2018[a], Swami *et al.,* 2018[b] and Dangi *et al.,* 2024). Among them fruit-borers *H. armigera* and *S. litura* cause both qualitatively and quantitively losses to chilli crop in considerable amount at fruiting stage. At vegetative stage theses caterpillars defoliate the standing crop and after onset of fruiting the larvae makes round holes on fruits by feeding on pericarp resulting in damaged fruits, decreasing yield up to 40 - 50% (Patel *et al.,* 2016 and Selvanarayanan and Narayanasamy, 2006).

Cyclaniliprole is highly effective against numerous insect pests. Once exposed, through contact or ingestion, Cyclaniliprole attaches to insect RyR inducing the uncontrolled release of calcium stores present in muscle cells. Indiscriminate and extensive use of chemical insecticides in past few decades has led to development of resistance and hence the management of *Helicoverpa armigera* has become increasingly difficult due to development of resistance to most commonly used chemical class of insecticides as reported (Armes *et al.* 1996, Kranthi 1997, Ramasubramaniam and Regupathy 2004). Therefore, study was carried out to find out the bio-efficacy of new molecules against lepidopterous insect pests infesting chilli crop.

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MATERIALS AND METHODS

The experiment was conducted RCA, Udaipur, during *kharif* 2020 and 2021. Chilli Tanaya seedlings were transplanted in plot size of 5 m x 5 m at 50 cm x 50 cm spacing in a randomized block design with seven treatments including one untreated control with four replications. Other package and practice were followed as per university recommendation. Noval insecticide, Cyclaniliprole 10% DC was evaluated at different doses, i.e. @ 300 ml ha^{-1}, 350 ml ha^{-1}, 400 ml ha^{-1}, 450 ml ha^{-1}, compared with two standard checks, i.e. chlorantraniliprole 18.5% SC @ 150 ml ha^{-1} and Emamectin benzoate 5% SG @ 200 g ha^{-1} against lepidopterous insect pests infesting chilli crop. Each treatment was applied twice first when the borer population crossed the ETL (Economic Threshold Level) and second was after 16 days of first spray. Periodic observations for number of larvae and damaged fruits were recorded on 10 randomly selected plants per replication per treatment before and after 5 and 10 days after each spray. The per cent fruit damage reduction over the control as well as per cent reduction in larval population over the control was calculated by using Henderson and Tilton (1952) formula.

RESULTS AND DISCUSSION

The Fruit-borer (*Helicoverpa armigera*) mean population was recorded before first spray and 5 and 10 days after each spray during both the years. Before first spray fruit-borer population was uniform in various treatments since the difference in population was not

significant. After spray all the treatments were found significantly effective in controlling fruit-borer population compared to the untreated control. Cyclaniliprole 10% DC @ 450 ml ha^{-1} was more effective at each observation time with low pest population.

Next best treatment in order of effectiveness was cyclaniliprole 10% DC @ 400 ml ha^{-1}, followed by chlorantoniliprole 18.5% SC 150 ml ha^{-1}, emamectin benzoate 5% SG @ 200 ml ha^{-1}, cyclaniliprole 10% DC@ 350 ml ha^{-1} and cyclaniliprole 10% DC @ 300 ml ha^{-1}. The highest fruits borer population was recorded in untreated control. The per cent reduction in fruit-borer population over the control was also calculated (Table-1). The higher population reduction over the control was recorded with cyclaniliprole 10% DC@ 450 ml ha^{-1}, which ranged from 60.03 to 75.06 % and 47.83 to 76.61 % in first and second spray, respectively during *kharif* 2020. While, it was 60.56 to 72.35 % and 60.04 to 73.50 % during first and second spray 5 and 10 days after application, respectively during *kharif* 2021.

The tobacco caterpillar (*Spodoptera litura*) mean population was recorded before first spray and at different time intervals after each spray during first and second seasons. Before first spray, tobacco caterpillar population was uniform in various treatments since difference in population was not significant. After spray all the treatments were found significantly effective in controlling the tobacco caterpillar population compared to the untreated control. Amongst treatments, cyclaniliprole 10% DC @ 450 ml/ha was more effective at each observation time with low pest population (Table 2).

Next treatment in order of effectiveness was cyclaniliprole 10% DC @ 400 ml ha^{-1} followed by chlorantoniliprole 18.5% SC 150 ml ha^{-1}, emamectin benzoate 5% SG @ 200 ml ha^{-1}, cyclaniliprole 10% DC @ 350 ml ha^{-1} and cyclaniliprole 10% DC @ 300 ml ha^{-1}. The highest fruit borer population was recorded in untreated control. The per cent reduction in tobacco caterpillar population over control was also calculated. The higher population reduction over the control was recorded with the treatment of cyclaniliprole 10% DC@ 450 ml ha^{-1}, which ranged from 65.22 to 74.95 % and 58.68 to 74.81 % in first and second spray, respectively during *kharif* 2020. While, it was 65.05 to 74.01 % and 42.92 to 74.34 % in first and second spray, respectively during *kharif* 2021.

Table 1: Evaluation of Cyclaniliprole 10% DC against *H. armigera* on chilli during *kharif* 2020 and 2021

Treatment	Dose (ml/ha)	PTP	I spray (2020)				II spray (2020)				I spray (2021)				II spray (2021)			
			Mean (larvae10 plant^{-1})		Reduction over control (%)		Mean (larvae10 plant^{-1})		Reduction over control (%)		Mean (larvae10 plant^{-1})		Reduction over control (%)		Mean (larvae10 plant^{-1})		Reduction over control (%)	
			5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS
Cyclaniliprole 10% DC	300	5.15 (0.72)*	0.75 (0.28)	0.70 (0.27)	50.01	53.01	0.9 (0.31)	0.87 (0.30)	33.63	38.12	0.97 (0.32)	0.91 (0.31)	50.71	53.52	0.90 (0.31)	0.84 (0.30)	50.03	53.08
Cyclaniliprole 10% DC	350	5.23 (0.73)	0.70 (0.27)	0.65 (0.26)	53.57	56.56	0.84 (0.30)	1.02 (0.33)	38.88	26.35	0.91 (0.31)	0.85 (0.30)	54.22	57.03	0.84 (0.30)	0.78 (0.29)	53.54	56.59
Cyclaniliprole 10% DC	400	5.43 (0.74)	0.625 (0.26)	0.40 (0.21)	58.24	73.29	0.75 (0.28)	0.40 (0.21)	46.42	71.34	0.81 (0.29)	0.58 (0.25)	58.76	70.85	0.75 (0.28)	0.69 (0.27)	58.27	72.18
Cyclaniliprole 10% DC	450	5.28 (0.73)	0.60 (0.25)	0.38 (0.21)	60.03	75.06	0.72 (0.28)	0.32 (0.19)	47.83	76.61	0.78 (0.29)	0.54 (0.24)	60.56	72.35	0.72 (0.28)	0.67 (0.27)	60.04	73.50
Chlorantraniliprole 18.5% SC	150	5.33 (0.73)	0.65 (0.26)	0.43 (0.22)	56.80	71.70	0.78 (0.29)	0.42 (0.22)	44.24	69.95	0.84 (0.30)	0.61 (0.26)	57.39	69.19	0.78 (0.29)	0.72 (0.28)	56.79	72.06
Emamectin benzoate 5% SG	200g	5.25 (0.73)	0.65 (0.26)	0.45 (0.22)	56.68	69.60	0.78 (0.29)	0.42 (0.22)	43.54	69.45	0.84 (0.30)	0.62 (0.26)	57.21	68.60	0.78 (0.29)	0.75 (0.28)	56.69	70.86
Untreated control	-	5.28 (0.73)	1.60 (0.39)	1.50 (0.39)	-	-	1.8 (0.43)	1.62 (0.41)	-	-	1.95 (0.45)	1.95 (0.45)	-	-	1.80 (0.43)	1.80 (0.43)	-	-
S.Em (±)			0.12	0.19	-	-	0.11	0.22	-	-	0.14	0.15	-	-	0.13	0.14	-	-
CD (5%)		NS	0.26	0.41	-	-	0.24	0.46	-	-	0.30	0.32	-	-	0.28	0.30	-	-

*Values in parentheses are square root transformed values PTP- pretreatment count
NS, non-significant, DAS, days after spray

All the treatment were significantly superior to over the control. The maximum reduction in fruit damage was recorded in cyclaniliprole 10% DC @ 450 ml ha^{-1}, followed by chlorantoniliprole 18.5% SC 150 ml ha^{-1}, emamectin benzoate 5% SG @ 200 ml ha^{-1}, Cyclaniliprole 10% DC@ 350 ml ha^{-1} and cyclaniliprole 10% DC@ 300 ml ha^{-1}. All the treatments recorded maximum and significantly yielded in comparison to the control. The mean maximum yield of chilli was recorded in cyclaniliprole 10% DC @ 450 ml ha^{-1} which was 15.05 t ha^{-1} and 15.26 t ha^{-1} during 2020 and 2021 respectively.

The result of effectiveness of different insecticidal treatments against chilli fruit-borer showed that all the treatments were significantly superior over the control in fruit damage. Cyclaniliprole 10% DC @ 450 15.26 ml ha^{-1} was more effective at each observation time with low pest population and fruit damage. The cyclaniliprole 10% DC@ 300 15.26 ml ha^{-1} was least effective treatment as population reduction of fruit borers and mean fruit damage, as against in untreated control.The mean maximum yield of chilli was recorded in the treatment of cyclaniliprole 10% DC @ 450 ml ha^{-1} which was 15.05 t ha^{-1} and 15.26 t ha^{-1} during 2020 and 2021 respectively in comparison to control.

The results are in close agreement with the findings of Parsanna *et al.,* (2020). The present findings are in conformity with those of Parsanna *et al.,* (2020). Tatagar *et al.,* (2009) reported that among various dosages, flubendiamide 20 WG at 60 gm ha^{-1} recorded highest yield of 0.7 t ha^{-1} with lowest mean fruit damage of 3.45 per cent, followed by flubendiamide 20 WG at 40 g a.i. ha^{-1} (0.6 t ha^{-1}). Flubendiamide 480 SC 125 ml ha^{-1} against brinjal shoot and fruit borer during summer and *kharif* season was reported to be most effective by Ameta *et al.,* (2010[b]). Sinha and Nath (2012) and Nayaka *et al.* (2018) evaluated the efficacy of five insecticides, viz. spiromesifen (100 g a.i. ha^{-1}), chlorantraniliprole (20 g a.i. ha^{-1}), novaluron (75 g a.i. ha^{-1}), flubendamide (25 g a.i. ha^{-1}) and carbosulfan EC (250 g a.i. ha^{-1}) against insect pests of brinjal. As far as infestation of *Leucinodes orbonalis* was concerned, damage in various treatments ranged 4.0-14.2% as compared to 23.1% of control on weight basis while it ranged from 3.5-12.2% in treatments on number basis it was 20.6% in untreated check.

CONCLUSION

The efficacy of cyclaniliprole 10% DC showed that test product was equally effective @ 450 and 400

Table 2: Evaluation of Cyclaniliprole 10% DC against *S. litura* on chilli during *kharif* 2020 and 2021

Treatment	Dose (ml/ha)	PTP	I spray (2020) Mean (larvae10 plant^{-1})		I spray (2020) Reduction over control (%)		II spray (2020) Mean (larvae10 plant^{-1})		II spray (2020) Reduction over control (%)		I spray (2021) Mean (larvae10 plant^{-1})		I spray (2021) Reduction over control (%)		II spray (2021) Mean (larvae10 plant^{-1})		II spray (2021) Reduction over control (%)	
			5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS
Cyclaniliprole 10% DC	300	5.40 (0.74)*	0.72 (0.28)	0.70 (0.27)	58.02	61.13	0.95 (0.32)	0.80 (0.29)	32.12	42.99	0.85 (0.30)	0.83 (0.30)	57.81	61.10	1.23 (0.36)	0.99 (0.32)	32.16	44.77
Cyclaniliprole 10% DC	350	5.43 (0.74)	0.70 (0.27)	0.65 (0.26)	59.31	64.16	0.90 (0.31)	0.78 (0.29)	35.94	44.63	0.82 (0.29)	0.77 (0.29)	59.13	64.12	1.17 (0.35)	0.90 (0.31)	36.06	50.82
Cyclaniliprole 10% DC	400	5.30 (0.73)	0.62 (0.26)	0.53 (0.24)	63.57	71.10	0.63 (0.26)	0.40 (0.21)	55.40	71.36	0.75 (0.28)	0.55 (0.24)	63.42	73.91	1.07 (0.33)	0.48 (0.22)	41.01	73.64
Cyclaniliprole 10% DC	450	5.30 (0.73)	0.60 (0.25)	0.45 (0.22)	65.22	74.95	0.58 (0.25)	0.35 (0.20)	58.68	74.81	0.70 (0.27)	0.55 (0.24)	65.05	74.01	1.04 (0.33)	0.48 (0.23)	42.92	74.34
Chlorantraniliprole 18.5% SC	150	5.30 (0.73)	0.65 (0.26)	0.55 (0.24)	61.85	69.84	0.68 (0.27)	0.40 (0.21)	51.90	70.71	0.76 (0.28)	0.57 (0.25)	61.73	72.92	1.10 (0.34)	0.55 (0.24)	39.49	69.73
Emamectin benzoate 5% SG	200g	5.28 (0.73)	0.67 (0.27)	0.58 (0.25)	61.06	68.53	0.73 (0.28)	0.43 (0.22)	49.12	69.69	0.75 (0.29)	0.66 (0.27)	60.84	69.10	1.10 (0.34)	0.50 (0.23)	39.39	72.67
Untreated control	-	5.38 (0.74)	1.72 (0.42)	1.83 (0.43)	-	-	1.40 (0.38)	1.40 (0.38)	-	-	2.03 (0.46)	2.15 (0.47)	-	-	1.82 (0.43)	1.82 (0.43)	-	-
S.Em (±)			0.19	0.14	-	-	0.20	0.17	-	-	0.21	0.16	-	-	0.12	0.24	-	-
CD (5%)		NS	0.40	0.30	-	-	0.42	0.37	-	-								

*Values in parentheses are square root transformed values PTP- pretreatment count

NS, non-significant, DAS, days after spray

ml ha^{-1} to control fruit-borer (*Helicoverpa armigera*) and tobacco caterpillar (*Spodoptera litura*) on chilli crop and better than other standard treatments. Hence, use of cyclaniliprole 10% DC @ 400 ml ha^{-1} can be suggested for the effective control of fruit-borer and tobacco caterpillar insect pests on chilli crop to avoid resistance in fruit borer (*Helicoverpa armigera*) and tobacco caterpillar (*Spodoptera litura*).

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