Biological Forum – An International Journal **15(5): 1439-1442(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Bio-Efficacy and Phytotoxicity of Chlorantraniliprole 18.5% SC against Diamondback Moth (*Plutella xylostella* Linn.) in Cabbage

Suvarna Patil[1]*, R.B. Hirekurubar[2], Raghunatha R[3]., Arunkumar B.[1], Aswathanarayana Reddy [4], Mastiholli A.B.[1], Shantappa T.[1] and Shridhar D.[1]

[1]Regional Horticulture Research and Extension Center, Dharwad (Kumbapur) (Karnataka), India.
[2]Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka), India.
[3] College of Horticulture, Sirsi - 581401, Uttara Kannada (Karnataka), India.
[4]College of Horticulture, NH-75, Tamaka, Kolar (Karnataka), India.

(Corresponding author: Suvarna Patil)*
(Received: 17 March 2023; Revised: 22 April 2023; Accepted: 28 April 2023; Published: 20 May 2023)
(Published by Research Trend)

ABSTRACT: A field experiment was conducted to evaluate the bio-efficacy of new molecule of insecticide chlorantraniliprole 18.5% SC against *Plutella xylostella* L. infesting cabbage at Regional Horticultural Research and Extension Centre, Dharwad, Karnataka during 2019-2020. Treatments included of new molecule of chlorantraniliprole 18.5% SC along with two conventional insecticides. Results revealed that all the insecticidal treatments were significantly superior over untreated control. Among the insecticidal treatments, significantly highest per cent larval reduction of *P. xylostella* over control was recorded in chlorantraniliprole 75 ml/ha (81.91 % with 2.73 larvae/plant), chlorantraniliprole 50 ml/ha (79.99 % with 3.02 larvae/plant) and chlorantraniliprole 25 ml/ha (69.64 % with 4.58 larvae/plant) followed by chlorantraniliprole 18.5% SC (Market standard) 50 ml/ha (77.34 % with 3.42 larvae/plant), Indaxacarb 14.5 % SC 266 ml/ha (71.50 % with 4.30 larvae/plant) and Novaluron 10% EC 750 ml/ha (65.61 % with 5.16 larvae/ plant). The efficacy of insecticides also reflected on marketable yield of cabbage heads. The highest yield of 285.81 q/ha with 51.12 % increase in yield over control was recorded in the treatment of chlorantraniliprole18.5% SC @ 75 ml/ha followed by chlorantraniliprole18.5% SC@ 50 ml /ha with yield of 278.99 q/ha with 47.51% increase in yield over control and Indoxacarb 14.5 % SC 266 ml/ha with yield of 258.46 q/ha with 36.66 % increase in yield over control.

Keywords: Insecticide, cabbage, chlorantraniliprole18.5% SC, Diamondback moth, *Plutella xylostella*.

INTRODUCTION

Cabbage (*Brassica oleracea var. capitata* Linn.) an herbaceous plant of Family Brassicacea, is a widely cultivated vegetable throughout the world as a long standing dietary supplement. It is sturdy, inexpensive, and abundant and its long lasting storage capacity makes it available throughout the year. It is a low calorie vegetable full of vitamins, anthocyanins, sulphur and potassium just to mention a few of the immense nutritional supplements that aid in numerous health benefits such as weight loss, prevention of nerve damage, reduction of blood pressure, detoxification *etc.* which increases its popularity among people all over the world.

In India cabbage is cultivated over 0.399 million ha with annual production of 9059 million tonnes out of which Karnataka contributes to about 233.40 million tonnes from 11.20 thousand ha (Annon., 2019). However, the optimum cabbage production is severely limited due to the attack of insect pests, the most important of which is the diamond back moth (DBM), *Plutella xylostella* (Mahla *et al*., 2005; Kumar *et al*., 2007) whose annual management costs were estimated to be more than US$ 1.0 billion globally (Grzywaez *et al*., 2010). In India, diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield (Ayalew, 2006; Lingappa *et al*., 2006). To manage the diamondback moth (DBM), different insecticides are being used in large quantities by farmers except in a few cases where the crop is grown as per Good Agricultural Practices (GAP) for export purposes. The uses of synthetic insecticides are the main control strategy (Kibata, 1996). Considering the economic importance of the pest, the present study was undertaken to evaluate the bio-efficacy of new green insecticide molecule Chlorantraniliprole 18.5% SC against *Plutella xylostella* L. in cabbage.

MATERIALS AND METHODS

The experiment was carried out at Regional Horticultural Research and Extension Centre, Dharwad during the year 2019-20 in Randomized Completely Block Design (RCBD) with seven treatments *viz.*, T_1-Chlorantraniliprole @ 75 ml/ha, T_2-Chlorantraniliprole @ 50 ml/ha, T_3-Chlorantraniliprole @ 25 ml/ha, T_4-Chlorantraniliprole @ 50 ml/ha (Market standard), T_5-Indoxacarb 14.5 % SC @ 266 ml/ha, T_6-Novaluron

10% EC @ 750 ml/ha and T_7-Untreated check, all of which were replicated thrice in a plot size of 3m × 3m at spacing of 60cm × 45cm. All the recommended agronomic practices were followed to raise the crop under irrigated condition except plant protection measures during the crop growth period.

Insecticides were applied in the form of foliar sprays when the larval population of *P. xylostella* reached an ETL of 2 larvae/plant (Uthamasamy *et al.,* 2011). First spray was applied at 40 days after transplanting and repeated after 15 days of first spray. Insecticidal solutions were diluted in water @ 500 L/ha and applied using knapsack sprayer with hollow cone nozzle.

The larvae were counted on cabbage head and outside the cabbage head. Pre-treatment observation was recorded by counting of diamond black moth larvae from randomly selected 5 tagged plants per plot one day before, and subsequently post treatment observations were recorded on 1, 3, 7 and 14 days after each spray. The larval mortality in each plot was calculated and was subjected to arc sine transformation to normalize the data for statistical analysis. While recording yield data, only marketable heads were taken into account. Yield obtained from net plot was converted into per hectare.

RESULTS AND DISCUSSION

A. Bio-efficacy study

Table 1 depicts bio-effectiveness of different treatment schedules of Chlorantraniliprole 18.5% SC during 2019 – 2020. Before application of treatments Diamondback moth (*Plutella xylostella*) population was ranging from 10.59 to 12.18 larvae/plant and statistically non-significant. However, 14 days after first application, the treatment of Chlorantraniliprole 18.5% SC @ 75 ml/ha recorded minimum DBM population of 4.53 larvae/plant which was significantly at par with Chlorantraniliprole 18.5% SC @ 50 ml/ha (4.86 larvae/plant), Chlorantraniliprole 18.5% SC @ 25 ml/ha (6.97 larvae/plant) and Chlorantraniliprole 18.5% SC (Market standard) @ 50 ml/ha (5.48 larvae/plant). The Indoxacarb 14.5 % SC @ 266 ml/ha (6.57 larvae/plant) and Novaluron 10% EC @ 750 ml/ha (7.96 larvae/plat) and all these treatments were statistically superior over untreated control (15.28 larvae/plant). During 14 days after second application treatment of Chlorantraniliprole 18.5% SC@ 75 ml/ha recorded maximum efficacy among all the treatments with minimum DBM population of 0.00 larvae/plant, which was found significantly at par with Chlorantraniliprole 18.5% SC @ 50 ml/ha (0.07 larvae/plant) and Chlorantraniliprole 18.5% SC (Market stand) @ 50 ml/ha (0.20 larvae/plant). These were followed by market standards Indoxacarb 14.5 % SC @ 266 ml/ha (1.20 larvae/plant), Chlorantraniliprole 18.5% SC @ 25 ml/ha (1.00 larvae/plant) and Novaluron 10% EC @ 750 ml/ha (1.33 larvae/plant) all these treatments were statistically superior over untreated control (17.33 larvae/plant) (Table 1).

All the treatments showed significant reduction in larval population. The overall percentage reduction in larval population after two consecutive rounds of sprays over that of untreated control were 81.91 %, 79.99 %, 69.64 %, 77.34 %, 71.50 % and 65.61 % during 2019-20 respectively for treatments Chlorantraniliprole 18.5% SC@ 75 ml/ha, Chlorantraniliprole 18.5% SC@ 50 ml/ha, Chlorantraniliprole 18.5% SC@ 25 ml/ha, Chlorantraniliprole 18.5% SC@ 50 ml/ha(Market standard), Indoxacarb 14.5 % SC @ 266 ml/ha and Novaluron 10% EC @ 750 ml/ha.

The results are in conformity with that of Dhawan *et al*. (2009) who evaluated chlorantraniliprole @ 30 g a.i./ ha which was the most effective treatment for the control of bollworm complex on cotton. Venkateswarlu *et al*. (2011) also showed that Chlorantraniliprole (18.5% SC @ 10 g a.i./ ha) had highest PROC of diamond back moth, *Plutella xylostella* (83.65% and 82.08%). Nikam *et al*. (2014) also reported effectiveness of spinosad against this pest, who observed the better efficacy of spinosad against DBM. Han *et al.* (2012) reported chlorantraniliprole as the most effective insecticide against *P. xylostella* in radish. Selvaraj and Kennedy (2017) recorded 86.15 and 89.95 per cent reduction in larval population of *P. xylostella* after 1st and 2nd spray, respectively when cauliflower crop was applied with chlorantraniliprole 18.5 SC. Further, effectiveness of chlorantraniliprole was demonstrated in suppressing the larval population of *P. xylostella* in cabbage by several workers (Hiramoto, 2007; Vaseem *et al.,* 2014; Chowdary *et al.,* 2015).

B. Marketable yield of cabbage heads

All the treated plots resulted in higher cabbage yield which ranged between 245.33 to 285.81 q/ha and proved to be significantly superior over the control (189.13 q/ha). The highest yield of 285.81 q/ha was registered chlorantraniliprole @ 75 ml/ha with highest per cent increase (51.12 %) over control This was followed by chlorantraniliprole @ 50 ml/ha (278.99 q/ha with 47.51 % increase over control). Next in the order of effectiveness were chlorantraniliprole @ 50 ml/ha (Market Standard) (271.11 q/ha with 43.34 % increase over control), Indoxacarb 14.5 % SC @ 266 ml/ha (258.46 q/ha with 36.66 % increase over control), chlorantraniliprole @ 25 ml/ha (245.33 q/ha with 29.71 % increase over control) and Novaluron 10 % EC @ 750 ml/ha (243.85 q/ha with 28.93 % increase over control). The lowest yield (189.13 q/ha) was recorded in the untreated plots (Table 3). There was almost 51.12 per cent increase in yield over control. Superiority of chlorantraniliprole revealed in the present investigation is in agreement with several earlier reports. Nikam (2013) recorded highest marketable yield of 230.63 q/ha cabbage heads with chlorantraniliprole 18.5 SC. Sunitha (2014) registered 230.38 q/ha marketable yield in cabbage by chlorantraniliprole 1.67 SC @ 30 g a.i.ha/ha in treated plots. Purushotam *et al.* (2017) recorded 175.30 q/ha yield following the application of chlorantraniliprole 18.5 SC against *P. xylostella* in cabbage. Sudhendu *et al.* (2016) recorded highest yield of 156.80, 164.80 and 177.60 q/ha by the application of chlorantraniliprole 20 SC at different dosages (25, 37.5 and 50 g a.i./ha respectively) in cabbage.

Table 1: Bio-efficacy of Chlorantraniliprole 18.5% SC against Diamondback moth (*Plutella xylostella*) of Cabbage during 2019 – 2020.

Treatments	Formulation dose (g or ml)/ha	DBS	Mean No. of larvae per plant at different days after spray								Pooled mean	% reduction in population over control
			After First Spray				After Second Spray					
			1 DAA	3 DAA	7 DAA	14 DAA	1 DAA	3 DAA	7 DAA	14 DAA		
Chlorantraniliprole 18.5% SC	25	11.24 (3.41)	8.22 (2.95)	6.58 (2.66)	5.13 (2.37)	6.97 (2.73)	4.18 (2.16)	2.71 (1.79)	1.83 (1.52)	1.00 (1.22)	4.58	69.64
Chlorantraniliprole 18.5% SC	50	11.71 (3.49)	6.15 (2.58)	4.92 (2.33)	3.67 (2.04)	4.86 (2.32)	2.92 (1.85)	1.05 (1.24)	0.53 (1.00)	0.07 (0.75)	3.02	79.99
Chlorantraniliprole 18.5% SC	75	10.59 (3.33)	5.73 (2.50)	4.58 (2.25)	3.23 (1.93)	4.53 (2.24)	2.72 (1.79)	0.81 (1.14)	0.20 (0.83)	0.00 (0.71)	2.73	81.91
Chlorantraniliprole 18.5% SC (Market standard)	50	12.18 (3.56)	6.93 (2.73)	5.54 (2.46)	4.10 (2.14)	5.48 (2.44)	3.29 (1.95)	1.23 (1.32)	0.57 (1.03)	0.20 (0.83)	3.42	77.34
Indoxacarb 14.5 % SC	266	11.13 (3.41)	7.47 (2.82)	5.98 (2.54)	5.00 (2.34)	6.57 (2.66)	3.94 (2.11)	2.47 (1.72)	1.73 (1.48)	1.20 (1.26)	4.30	71.50
Novaluron 10% EC	750	11.68 (3.49)	8.81 (3.05)	7.05 (2.75)	6.10 (2.56)	7.96 (2.91)	4.78 (2.3)	3.29 (1.95)	1.97 (1.57)	1.33 (1.35)	5.16	65.61
Untreated control	-	11.21 (3.42)	12.02 (3.54)	12.96 (3.67)	13.50 (3.74)	15.28 (3.97)	15.85 (4.04)	16.25 (4.09)	17.57(4.25)	17.33 (4.22)	15.09	
SEM (±)		NS	0.08	0.09	0.09	0.09	0.09	0.06	0.08	0.11		
CD at 5%			0.23	0.27	0.27	0.27	0.27	0.18	0.26	0.33		

DAS: Days after spray, *Figures in parentheses denote square root transformed values

Table 2: Effect of Chlorantraniliprole 18.5% SC on cabbage yield during 2019 – 2020.

Treatments	Formulation Dose (g/ha)	Cabbage yield (q/ha)	% increase in yield over control
Chlorantraniliprole 18.5% SC	25	245.33	29.71
Chlorantraniliprole 18.5% SC	50	278.99	47.51
Chlorantraniliprole 18.5% SC	75	285.81	51.12
Chlorantraniliprole 18.5% SC (Market standard)	50	271.11	43.34
Indoxacarb 14.5 % SC	266	258.46	36.66
Novaluron 10% EC	750	243.85	28.93
Untreated control	-	189.13	0.00
SEM (±)		**5.21**	
CD (P = 0.05)		**16.06**	

Table 3: Influence of Chlorantraniliprole 18.5% SC on natural enemies of Diamondback moth (*Plutella xylostella*) on cabbage during 2019-20.

Treatments	Formulation Dose (g/ha)	Mean no. of natural enemies / 5 plants					
		Rabi, 2019 – 2020					
		Coccinellids			Spiders		
		Before spray	10 DAS	10 DAS	Before spray	10DAFS	10 DASS
Chlorantraniliprole 18.5% SC	25	2.26 (1.63)	1.99 (1.55)	1.00 (1.17)	1.67 (1.44)	1.33 (1.34)	1.00 (1.22)
Chlorantraniliprole 18.5% SC	50	2.14 (1.62)	1.86 (1.53)	1.30 (1.33)	1.33 (1.34)	1.00 (1.17)	1.00 (1.17)
Chlorantraniliprole 18.5% SC	75	2.08 (1.6)	1.66 (1.47)	1.42 (1.38)	2.00 (1.56)	1.33 (1.29)	0.67 (1.05)
Chlorantraniliprole 18.5% SC (Market stand)	50	2.2 (1.64)	1.66 (1.47)	1.26 (1.32)	2.00 (1.58)	2.00 (1.58)	1.00 (1.22)
Indoxacarb 14.5 % SC	266	2.14 (1.6)	1.73 (1.48)	1.73 (1.49)	1.67 (1.44)	1.33 (1.34)	1.33 (1.34)
Novaluron 10% EC	750	2.28 (1.67)	1.94 (1.56)	1.73 (1.49)	1.33 (1.29)	1.00 (1.17)	1.00 (1.22)
Untreated control	-	2.26 (1.63)	2.15 (1.6)	1.93 (1.54)	1.67 (1.39)	2.00 (1.56)	1.33 (1.34)
SEM (±)	-	0.15	0.13	0.13	0.20	0.20	0.11
CD (P = 0.05)	-	NS	NS	NS	NS	NS	NS

DAS: Days after spray, *Figures in parentheses denote square root transformed values

CONCLUSIONS

It is evident from the present investigation that Chlorantraniliprole 18.5% SC @ 50 ml/ha and 75 ml/ha was found best and effective treatment for management of Diamondback moth in cabbage with higher yield (278.99 q/ha and 285.81 q/ha respectively) and highest per cent reduction in population over control (79.99 and 81.91 respectively). These treatments were found at par with each other and with Chlorantraniliprole 18.5% SC (market sample) @ 50 ml/ha and statistically superior than Indoxacarb 14.5% SC @ 266 ml/ha, Chlorantraniliprole 18.5% SC @ 25 ml/ha and Novaluron 10% EC @ 750 ml/ha. Thus, Chlorantraniliprole 18.5% SC @ 50 ml/ha could be recommended for safe use in cabbage for effective control of Diamondback moth (*Plutella xylostella*) and safer to natural enemies.

Acknowledgement. I thank sponsorer UPL India Ltd. For funding the project "Bioefficacy evaluation of Chlorantraniliprole 18.5% SC on Cabbage.

Conflict of Interest. None.

REFERENCES

Anonymous (2019). Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture, Government of India.

Ayalew, G. (2006). Comparison of yield loss on cabbage from diamondback moth, *Plutella xylostella* L. (Lepidoptera: Plutellidae) using two insecticides. *Crop Protec*., *25*, 915-919.

Chowdary, L. R., Kumar, L. R. and Ghante, V. K. (2015). Rynaxypyr 20 SC (Coragen) green labeled insecticide for the management of head borer (*Hellula undalis* Fab.) in cabbage. *J. Expt. Zoo*., *18*(2), 803-805.

Dhawan, A. K., Singh, R., Singh, K., and Sharma, M. (2009). Efficacy of chlorantraniliprole against bollworm complex on cotton. *J. Insect Sci., (Ludhiana), 22*(3), 248-253.

Grzywaez, B., Bunsong, N., Satthaporn, K., Phithamma, S. and Doungsa, C. (2010). Hymenopterans Parasitoids of Diamondback moth (Lepidoptera: Ypeunomutidae) in Northern Thailand. *Journal of Economic Entomology, 98*(2), 449-456.

Han, W., S. Zhang, F. Shen, M. Liu, C. Ren and X. Gao (2012). Residual toxicity and sublethal effects of chlorantraniliprole on *Plutella xylostella. Pest. Manage. Sci*., *10*, 1002 pp.3282.

Hiramoto, Matthew (2007). Evaluation of chlorantraniliprole, flubendiamide, indoxacarb, metaflumizone and pyridalyl for diamondback moth, *Plutella xylostella*, (Linnaeus) in Hawaii. *Annual meeting*, University of Hawaii, D0167.

Kibata, G. N. (1996). Diamondback moth *Plutella xylostella* L. (Lepidoptera: Yponomeutidae), a problem pest of brassicae crops in Kenya. *Proc. First Biennial Crop Protection Conf*., 27-28 March, Nairobi, Kenya: 1-11.

Kumar, P., Prasad, C. S. and Tiwari, G. N. (2007). Population intensity of insect pests of cabbage in relation to weather parameters. *Annals of Plant Protection Sciences, 15*(1), 245- 246.

Lingappa, S.K., Basavanagoud, K.A., Kulkarni, Roopa, Patil, S. and Kambrekar, D. N. (2006). Threatto Vegetable Production by Diamond back Moth and its Management Strategies disease management of fruits and vegetables Fruit and *Vegetable Diseases, 1*, 357-396

Mahla, R. S., Singh, S. and Chaudhary, P. (2005). Management of diamondback moth, *Plutella xylostella* (L.) larvae by entomopathogenic fungus, *Metarhizium anisopliae. Indian Journal of Entomology, 67*, 342-344.

Nikam, T. A., Chandele, A.G., Gade, R. S. and Gaikwad, S. M. (2014). Efficacy of chemical insecticides against diamond back moth, *Plutella xylostella* L. on cabbage under field condition. *Trends in Biosci*., *7*(12), 1196-1199.

Nikam, T. A. (2013). Bio-efficacy of chemical insecticides against diamondback moth (*P. xylostella*) on cabbage. M. Sc. (Agri) Thesis submitted to MPKV, Rahuri.

Purushotam, Sharma, K.C. Kumawat, S.K. Khinchi, Virendra Kumar and Baddhri, Prasad (2017). Bioefficacy of different insecticides against diamondback moth. *Int. J. Chem. Stu*., *5*(3), 891-893.

Selvaraj, C. and Kennedy, J. S. (2017). Bio-efficacy of some new generation insecticides on *Plutella xylostella* L and toxicity on two natural enemies. *Int. J. Agric. Sci., 9*(3), 3680-3682.

Sunitha, K. (2014). Bio-efficacy and relative toxicity of newer insecticides against diamondback moth (*Plutella xylostella*) on cabbage. M.Sc. (Agri) Thesis submitted to MPKV, Rahuri.

Sudhendu, Sharma, Ravinder, Singh, and C. K. Gill (2016). Efficacy of anthranilic insecticide E2Y45 20 SC (Chlorantraniliprole) against *Plutella xylostella* L. in cabbage, *Brassica oleracea*var. *capitata. J. Appli. Nat. Sci., 8*(3), 1584-1588.

Uthamasamy, S., M. Kannan, K. Senguttuvan and S. A. Jayaprakash (2011). Status, damage potential and management of diamondback moth, *Plutella xylostella* (L.) in Tamil Nadu, India. In: Proceedings of the Sixth International Workshop on Management of the Diamondback Moth and Other Crucifer Insect Pests, 21- 25 March (Eds.: Srinivasan, R., Shelton, A. M., Collins, H. L. (2011). Kasetsart University, Nakhon Pathom, Thailand. AVRDC – The World Vegetable Center, Taiwan, Publication No 11-755, 321 p.

Vaseem, Mohd., Singh, Hem., Kumar, Kaushlendra and Ali, Mohd. (2014). Efficacy of newer insecticides against diamondback moth (*Plutella xylostella* Linn.) on cabbage under poly house condition. *J. Expt. Zool*., *17*(2), 487-489.

Venkateswarlu, V., Sharma, R. K. and Sharma, K. (2011). Evaluation of ecofriendly insecticides against major insect pests of cabbage. *Pesticide Res J*., *23*(2), 172-180.

How to cite this article: Suvarna Patil, R.B. Hirekurubar, Raghunatha R., Arunkumar B., Aswathanarayana Reddy, Mastiholli A.B., Shantappa T. and Shridhar D. (2023). Bio-Efficacy and Phytotoxicity of Chlorantraniliprole 18.5% SC against Diamondback Moth (*Plutella xylostella* Linn.) in Cabbage. *Biological Forum – An International Journal, 15*(5): 1439-1442.