Indian Journal of Applied Entomology **33**(1) : 24–28 (2019)

BIO-EFFICACY OF INSECTICIDES AGAINST FRUIT BORER, *HELICOVERPA ARMIGERA* (HUB.) INFESTING TOMATO (*SOLANUM LYCOPERSICUM* L.)

REDDY K.V.N*, A. VYAS, LEKHA AND G. CHHANGANI

Department of Entomology, Rajasthan College of Agriculture (MPUAT) Udaipur
*Corresponding author E-mail: katasaniarjun@gmail.com

ABSTRACT

The present investigation was conducted at the Horticultural farm, Rajasthan College of Agriculture, Udaipur during *Kharif* 2018-19. Among the seven treatments, chlorantraniliprole 18.5 SC (76.23%) was found to be the most effective against fruit borer in terms of per cent population reduction and cost benefit ratio, followed by indoxacarb 14.5 SC (74.47%) and spinosad 45 SC (73.38%). The treatment *Ha*NPV 250 LE (29.34%) proved to be the least effective. Emamectin benzoate 5 SG (72.70%) and Novaluron 10 EC (55.64%) were observed in the middle order of efficacy. All the insecticides significantly increased the yield of marketable fruits over control.

Key words: *Helicoverpa armigera*, tomato, bio-efficacy, newer insecticides

INTRODUCTION

Tomato crop (*Solanum lycopersi*cum L.) has achieved tremendous popularity as one of the foremost remunerative vegetable crops in the world due to its immense commercial and nutritive values and wide range of climatic adaptability. The total production of tomato crop in India during 2017-18 was 19759 thousand metric tonnes covering an estimated area of 789 thousand hectares (Anonymous, 2019). The tomato fruit borer, *H. armigera* (Hubner) is the most destructive pest of tomato in the world. Both the production and productivity is severely affected by this pest. Physiological features like, nocturnal habit, high mobility and fecundity, overlapping generations, ravenous feeding habits, migration, tendency for acquiring resistance against wide range of insecticides, direct attack on fruiting structures and multi-voltine nature, contribute for its severity in different situations. To control the notorious pests, different insecticides have been suggested due to their easy availability and applicability, which have resulted in adverse effects like toxicity to non-target organisms (predators, parasitoids and pollinators), development of insecticide resistance, pest resurgence, toxic residues, environmental pollution and health hazards etc, besides the increased cost of cultivation per unit area. All these factors have led to switching from the use of conventional insecticides alone to more bio-intensive methods of pest management such as the use of biorational insecticides which are selective, less persistent and eco-friendly for management of fruit borer, *H. armigera*. The objective of this work was to test the effectiveness of newer insecticides against tomato fruit borer infestation.

MATERIALS AND METHODS

The present investigation on "Bio-efficacy of insecticides against fruit borer, *Helicoverpa armigera* (Hub.) infesting tomato (*Solanum lycopersicum* L.)" were conducted at Horticultural Farm, Rajasthan College of Agriculture, Udaipur. The experiments were carried out during *Kharif* 2018-19. The experiments were conducted in a randomized block design with 7 treatments and 3 replications. The tomato crop was transplanted on 10th August 2018 in plots of 3.6m x 3.6m. The row to row and plant to plant distance was maintained at 60cm x 45cm. First spray was initiated when the pest population crossed ETL. Second and third sprayings were done at 15 days interval. From each plot five plants were selected randomly and tagged.

The observations were recorded at 3, 7, 10 and 14 days after spraying for mean larval population of *H. armigera*. The population data thus obtained was converted to per cent reduction in population and the efficacy of various treatments was analyzed using analysis of variance.

$$\text{Per cent reduction in population} = 100\left[1 - \frac{T_2 \times C_1}{T_1 \times C_2}\right]$$

Square root transformation was used to analyze the per cent population reduction of *H. armigera*.

The marketable yield of tomatoes after each picking was recorded separately for each treatment. The yields of all pickings were pooled together for each treatment separately and yield per hectare were computed.

Table 1. Details of insecticides tested for their bio-efficacy against tomato fruit borer (*H. armigera*)

Treatments	Dose (a.i./ha)	Quantity (ml or g/ha)	No. of sprays
*Ha*NPV 250 LE	250 LE	250	3
Chlorantraniliprole 18.5 SC	30	163	3
Indoxacarb 14.5 SC	75	518	3
Spinosad 45 SC	50	112	3
Novaluron 10 EC	75	750	3
Emamectin benzoate 5 SG	12	240	3
Control	–	–	–

RESULTS AND DISCUSSION

Bioefficacy of insecticides against fruit borer in terms of per cent population reduction: The cumulative data of first, second and third sprays revealed that chlorantraniliprole 18.5 SC recorded the highest per cent population reduction (76.23%). The next effective treatment was indoxacarb 14.5 SC (74.47%) which was at par with spinosad 45 SC (73.38%) and emamectin benzoate 5 SG (72.70%). The treatments were at par with each other. The treatment novaluron 10 EC (55.64%) was in the middle order of efficacy. The *Ha*NPV 250 LE treatment was least effective (29.34%) in reducing the larval population. Similar results were also obtained by Patil *et al.* (2018) who reported that chlorantraniliprole 18.5 SC (0.49 larvae/ plant) recorded lowest larval population followed by spinosad 45 SC (0.65 larvae/ plant) and indoxacarb 14.5 SC (0.71 larvae/ plant). Emamectin benzoate 5 SG (0.90 larvae/ plant) was in the middle order of efficacy. The highest larval population was found in *Ha*NPV 250 LE (1.25 larvae/ plant). Earlier Singh *et al.* (2017) evaluated nine newer and bio rational insecticides against tomato fruit borer and found that indoxacarb 14.5 SC (63.37%) proved to be the most effective in terms of per cent population reduction. It was followed by Novaluron 10 EC (61.85%) and chlorantraniliprole (56.99%). Abamectin 5 SG (53.66%) and spinosad 45 SC (50.46%) were in the middle order of efficacy. *Ha*NPV 250 LE (44.81%) proved to be the least effective. present findings are in line with those Patel *et al.*, (2016) who evaluated bio-efficacy of different insecticides and results revealed that chlorantraniliprole 35 WG @ 30 g a.i./ ha reduced larval population of *H. armigera* as well as recorded lowest per cent of fruit damage compared to standard checks. Halwai (2013) reported that on the basis of three sprays, overall efficacy of insecticidal treatments against fruit borer, *H. armigera* revealed indoxacarb 14.5 SC (0.005 %) proved as most effective followed by malathion 50 EC (0.05 %) and spinosad 45 SC (0.01 %). The treatments of *Ha*NPV (350 LE/ ha) existed in the middle order of effectiveness.

Marketable yields of tomato: The highest fruit yield (239.78 q/ ha) was obtained from chlorantraniliprole 18.5 SC treated plots. The treatments in the decreasing order of marketable yields are indoxacarb 14.5 SC (238.98 q/ ha), spinosad 45 SC (237.39 q/ ha), emamectin benzoate 5 SG (231.99 q/ ha), novaluron 10 EC (230.29) and *Ha*NPV 250 LE (205.18 q/ ha). Singh *et al.* (2017) reported that highest marketable yield of 265.20 q/ ha was recorded in case of indoxacarb. It was followed by novaluron which yielded 262.85 q/ ha. Minimum fruit yield was recorded from the plots treated with *B. thuringiensis* (206.54 q/ ha) followed by *Ha*NPV (213.24 q/ ha). The yield obtained from chlorantraniliprole, abamectin and spinosad ranged in between 238.55 to 250.71 q/ ha and ranked in middle order.

The biorational treatments were aimed to give better economic returns by increasing the yields and decreasing the fruit damage caused by fruit borer. The data revealed that all treatments were profitable over control. The maximum net profit of Rs 79785 and highest cost benefit ratio of 1:1.285 was obtained from chlorantraniliprole 18.5 SC @ 162 ml/ha. It was followed by indoxacarb 14.5 SC @ 520 g / ha with net profit of Rs 78906 and cost benefit ratio of 1:1.282. Spinosad 45 SC @ 112 ml/ ha recorded net profit of Rs 76285 and cost benefit ratio of 1:1.275. Emamectin benzoate 5 SG @ 240 g/ ha and novaluron 10 EC @ 750 ml / ha recorded net profit and cost benefit ratio of Rs 72885, Rs 64305 and 1:1.265, 1:1.229 respectively. The least net profit and cost benefit ratio was obtained from *Ha*NPV @ 250 LE /ha which recorded Rs 30840 and 1:1.111 respectively.

The present results are in accordance with the results obtained by Patil *et al.* (2018) who revealed that significantly higher (446.52 q/ha) yield obtained when treated with chlorantraniliprole 18.5 SC which remained at par with spinosad 45 SC (439.64 q/ha) and indoxacarb 14.5 SC (436.18 q/ha). The lowest (264.81 q/ha) yield was obtained in untreated control plot. However, rests of treatments emamectin benzoate 5 SG, profenofos 50 EC, *Ha*NPV and *Metarhizium anisopliae* 1.15 WP exhibited 424.41, 350.16, 321.15 and 314.53 q/ha yield of tomato, respectively. The present results are in the line of those by Halwai (2013) who reported that the maximum yield (282.70 q / ha) was obtained in the treatment of indoxacarb followed by malathion (277.30 q /ha) and spinosad (275.14 q/ ha). Arjun (2016) observed that the cost benefit ratio in the decreasing order was chlorantraniliprole (1:8.05), spinosad (1:7.71), emamectin benzoate (1:7.41), indoxacarb

Table 2. Bio efficacy of insecticides against fruit borer larvae in terms of per cent population reduction during *kharif*, 2018

Treatments	PTP/ 10 plants	Per cent population reduction											
		1st spraying				2nd spraying				3rd spraying			
		3rd DAS	7th DAS	10th DAS	14th DAS	3rd DAS	7th DAS	10th DAS	14th DAS	3rd DAS	7th DAS	10th DAS	14th DAS
*Ha*NPV 250 LE	13.67 (3.76)	9.94 (2.98)	37.51 (37.07)	41.95 (44.69)	37.59 (37.21)	10.62 (3.39)	35.19 (33.21)	41.85 (44.51)	32.97 (29.61)	13.75 (5.65)	36.35 (35.14)	41.34 (43.63)	36.32 (35.07)
Chlorantraniliprole 18.5 SC	13.33 (3.72)	58.63 (72.91)	65.41 (82.69)	62.55 (78.76)	58.43 (72.59)	58.90 (73.32)	66.27 (83.80)	60.64 (75.95)	57.04 (70.40)	60.70 (76.05)	67.06 (84.81)	61.97 (77.91)	54.07 (65.57)
Indoxacarb 14.5 SC	15.00 (3.93)	58.08 (72.04)	65.30 (82.54)	61.63 (77.42)	56.89 (70.16)	58.60 (72.85)	63.08 (79.51)	60.24 (75.36)	54.42 (66.15)	59.52 (74.27)	65.61 (82.94)	61.22 (76.82)	52.92 (63.65)
Spinosad 45 SC	13.67 (3.76)	57.88 (71.73)	64.57 (81.56)	60.44 (75.66)	56.72 (69.89)	57.28 (70.77)	62.29 (78.37)	59.47 (74.19)	53.24 (64.19)	58.69 (72.99)	65.33 (82.58)	60.03 (75.05)	52.90 (63.61)
Novaluron 10 EC	14.00 (3.81)	30.07 (25.10)	52.69 (63.25)	59.35 (74.01)	55.18 (67.40)	33.51 (30.48)	49.94 (58.58)	55.05 (67.19)	49.43 (57.69)	33.09 (29.81)	51.95 (62.00)	58.45 (72.62)	50.56 (59.65)
EmamectinBenzoate 5 SG	13.00 (3.67)	56.93 (70.22)	63.66 (80.32)	59.75 (74.63)	55.72 (68.28)	57.28 (70.77)	62.29 (78.37)	59.47 (74.19)	52.54 (63.01)	58.45 (72.63)	65.68 (83.04)	59.21 (73.80)	52.65 (63.19)
Control	13.33 (3.72)	–	–	–	–	–	–	–	–	–	–	–	–
S.Em ±	0.11	2.49	1.89	1.95	1.94	2.85	2.70	2.71	2.62	2.61	2.87	2.74	2.66
C.D at 5%	0.32	7.67	5.83	6.02	5.98	8.78	8.32	8.36	8.07	8.03	8.83	8.43	8.20

Figures in parenthesis of PTP values are (x + 0.5) transformed values; Figures in parenthesis of sprayings are percent retransformed values; PTP- Pretreatment population, DAS – Days after spraying

Table 3. Comparitive economics of insecticides against *H. armigera* on tomato during *Kharif*,2018

Treatments	Average Yield (Kg/plot)	Average Yield (q/ha)	Gross Returns (Rs)	Increased yield over Control (q)	Percent increase in yield	Value of increased yield over Control (Rs)	Management Cost (Rs/ ha)	Net Profit (Rs)	C: B Ratio
*Ha*NPV 250LE	26.59	205.18	307770	24.46	13.53	36690	5850	30840	1:1.111
Chlorantraniliprole 18.5 SC	31.1	239.78	359670	59.06	32.68	88590	8805	79785	1:1.285
Indoxacarb 14.5 SC	30.97	238.98	358470	58.26	32.24	87390	8484	78906	1:1.282
Spinosad 45 SC	30.79	237.39	356085	56.67	31.36	85005	8180	76825	1:1.275
Novaluron 10 EC	29.87	230.29	345435	49.57	27.43	74355	10050	64305	1:1.229
Emamectin benzoate 5 SG	30.09	231.99	347985	51.27	28.37	76905	4020	72885	1:1.265
Control	23.44	180.72	271080	–	–	–	–	–	–

Sale price of tomato = Rs 1500/ 1 quintal, *Ha*NPV = Rs 1450/250 LE, Chlorantraniliprole 18.5 SC = Rs 450/ 30 ml; Indoxacarb 14.5 SC = Rs 450/ 100 ml; Spinosad 45 SC= Rs 1400/ 70ml, Novaluron 10 EC = Rs 380/ 100ml; Emamectinbenzoate 5 SG = Rs 350/ 100g, Labour = 6 @ Rs 250

(1:4.15) and novaluron (1:3.67). The order of increasing per cent fruit damage is chlorantraniliprole 7.52%, spinosad 13.02%, emamectin benzoate 15.57%, novaluron 20.35% and indoxacarb 21.12%.

CONCLUSION

The treatment chlorantraniliprole 18.5 SC was superior among all the insecticidal treatments in terms of per cent population reduction (76.23%), yield (239.78 q/ ha) and cost benefit ratio (1:1.285). The newer group of insecticides should be recommended in case of severe infestation to avoid incurring severe fruit damage and for timely management within short period.

REFERENCES

Anonymus. 2019. Final estimates of area and production of horticulture crops 2017-18. Department of Agriculture, Cooperation and Farmers Welfare.

Arjun, S. 2016. Bionomics and management of *Helicoverpa armigera* (Hubner) on Tomato, *Lycopersicon esculentum* Miller with novel insecticides. M.Sc (Ag.) thesis submitted to Sri Karan Narendra Agriculture University, Jobner.

Halwai, B. 2013. Management of *Helicoverpa armigera* Hubner on Tomato, *Lycopersicon esculentum* Miller with bio-rational insecticides. MSc. Ag. Thesis submitted to SKRNAU, Bikaner.

Patel, R. D., Parmar V. R. and Patel, N. B. 2016. Bio-efficacy of chlorantraniliprole 35 wg against *Helicoverpa armigera* (Hübner) Hardwick in tomato. *Trends In Biosciences*, **9**(15): 793-798,

Patil, P.V., Pawar, S.A., Kadu R.V. and Pawar D.B. 2018. Bio-efficacy of newer insecticides, botanicals and microbial against tomato fruit borer *Helicoverpa armigera* (Hubner) infesting tomato. *Journal of Entomology and Zoology Studies*, **6**(5): 2006-2011.

Singh, N., Dotasara, S.K., Kherwa, B. and Singh, S. 2017. Management of tomato fruit borer by incorporating newer and biorational insecticides. *Journal of Entomology and Zoology Studies*, **5**(2): 1403-1408.

Received: 28.02.2019 Accepted: 25.05.2019