Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 2889-2896

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 2889-2896**
Journal homepage: http://www.ijcmas.com

Original Research Article

Efficacy of Bio-Pesticides and Novel Insecticides against Tomato Fruit Borer (*H. armigera*)

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A B S T R A C T

All the ten treatments tested against *Helicoverpa armigera* were found significantly superior over untreated based on *H. armigera* population spinosad were found effective. The treatments comprised the T-[1] (spinosad 45 sc), T2- (indoxacarb 14.5 sc), T3-(emamectin benzoate 1.9 EC), T4-(Neem oil), T5- (Bt 5wp), T6-(NPV), T7 - (spinosad45sc + neem oil), T8-(indoxacarb 14.5sc +Bt. 5wp), T9- (emamectin benzoate 1.9 EC + NPV) and (control). Indoxacarb 45sc 0.5ml/liter was the best treatment in the reduction of the larval population followed by spinosad 45sc ml/liter.

Keywords

H. armigera, Tomato, Spinosad and indoxacarb, Biopesticides

Introduction

Tomato (*Solanum lycopersicum*) is one of the most important vegetable crops in the world. Besides other insect pests causing considerable damage, the fruit borer (*Helicoverpa armigera* Hubner) is the serious one that causes considerable losses in quantity as well as the quality of tomato fruits (Reddy and Zehrm, 2004). Early instar larvae feed on flowers, buds, and foliage while matured larval instars bore into fruit resulting in yield reduction (Rath and Nath, 1997).The fourth instar feeds on the developing fruits with the whole body inside the fruit, whereas, only the apical half portion of the 5th instar larvae remains inside the fruit (Kumar, 1996). Considerable economical losses due to *H. armigera* reported to the extent about 50-60% fruits in tomato crop (Singh and Singh, 1977). Through, several chemical insecticides have been reported to be effective against this pest (Bhatt and Patel, 2002). The over-dependence and indiscriminate use of chemical pesticides have resulted in several problems like the development of resistance to pesticides, the outbreak of secondary pest, reduction of biodiversity and natural enemies, residual effects, and health hazards.

However, chemical control of whitefly is quite challenging because it also causes mortality of natural enemies. Further, there are reports of the development of insecticides and biopesticides resistance towards divergent classes of insecticides. The limitations of chemical pesticides are imperative to find out the other alternate and feasible methods, which are non-hazardous to human beings in particular, and the other biotic flora and fauna in general. In this direction, the use of new chemicals, botanicals, or bio-pesticides appears to be a noble approach.

Materials and Methods

The field experiments were conducted at Horticultural Research Centre (HRC) in the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. (U.P.), India. during Rabi-2015-16 and 2016-17 in randomized block design, each replicated thrice. The experiment was conducted in Randomized block Design. All the treatments were randomly distributed among the plots and replicated three times. Observations were recorded on healthy and infected fruits on 10 randomly select plants in each plot. The incidence of insects was recorded one day before spray as pretreatment observations taken on the first observation were recorded before the spray of each plot and 5, 7, 10 days after each spray.

Results and Discussion

Rabi 2015-16

First spray

The efficacy of different treatments against *H. armigera* recorded as the number of larvae per five plants on tomato is presented in Table 1. The results revealed that all the treatments were significantly effective in reducing the infestation of *H. armigera* as compared to control. The initial infestation of *H. armigera* ranged from 0.33 to 1.67 larvae per five plants before the spray and did not differ significantly.

Data recorded on the 3rd day after the first application ranged from 0.00 to 1.00 larvae per five plants among all the treatments. No larval population was recorded in the treatments spinosad, indoxacarb, emamectin benzoate, NPV, and T7 combination. The next effective treatment T5 with 0.33 larvae per five plants and it was followed by T9 combination with 0.67. The highest infestation (1.67 larvae per five plants) was recorded in the control plot.

A similar trend was observed on the 7th day after the first application, i.e. spinosad, indoxacarb, and emamectin benzoate proved to be the best treatment as no larval population was recorded in these treatments. In other treatments larval population ranged from 0.33 to 1.33 larvae per five plants. The maximum infestation was recorded in the control plot with 2.00 larvae per five plants.

Data recorded on the 10th day after the first application, all the treatments were found again effective and significantly superior to control. Spinosad and indoxacarb proved to be the best treatment as no larval population was recorded in these treatments. In other treatments larval population ranged from 0.33 to 1.33 larvae per five plants.

The next effective treatment was emamectin benzoate (0.33 larvae per five plants) and it was followed by T7 combination, T6, and T5 with 0.67, 1.00, 1.00. The maximum larval population (2.33 larvae per five plants) was recorded in the control plot.

Second spray

The data recorded on the 3rd, 7th, 10th day after the second application of treatments are presented in Table 1. One day before treatment, the insect population ranged from 1.33 to 4.00 larvae per five plants and differ significantly.

Data recorded on the 3rd day after the second application, all the treatments were found significantly superior over control. No infestation was recorded in the treatment indoxacarb and found the best treatment. The next effective treatment was spinosad (0.33 larvae per five plants) and it was followed by emamectin benzoate, T7 combination, and T6. The treatment Bt. was found least effective with 3.33 larvae per five plants. The maximum larval population (4.67 larvae per five plants) was recorded in the control plot.

The observation recorded on the 7th day of the second application revealed that indoxacarb again proved most effective as no infestation of insect pests recorded in this treatment. The second most effective treatment was spinosad (0.67 larvae per five plants) followed by emamectin benzoate, T7 combination, and T6 with 1.00, 1.00, 1.33 larvae per five plants. However, the maximum larval population (5.00 larvae per five plants) was recorded in the untreated control.

When the larval population was recorded on the 10th day of the second application, indoxacarb (0.33 larvae per five plants) again proved the most effective treatment. The next effective treatment was spinosad (1.00 larvae per five plants). The treatment Bt. was found least effective with 4.33 larvae per five plants. The order of effectiveness of these treatments was indoxacarb > spinosad > emamectin benzoate > T7 combination > T6 > T4. The maximum infestation of 5.67 larvae per five plants was recorded in the control plot.

Third spray

Similar trends were observed in the reduction of the larval population after the 3rd spray and all the treatments proved better than control. The larval population recorded one day before the 3rd application ranged from 1.00 to 5.33 larvae per five plants (Table 1).

Data recorded on 3rd day after the third application revealed that no larval population was found in the treatment indoxacarb and showed the best treatment. The next effective treatment was spinosad (0.33 larvae per five plants). The treatment Bt. was found least effective with 3.67 larvae per five plants. The maximum larval population (5.00 larvae per five plants) was recorded in the control plot.

When data recorded on the 7th day after the third application, indoxacarb again proved most effective as no larval population was recorded in this treatment. The next effective treatments were spinosad, emamectin benzoate, T7 combination, and T6 with 0.33, 0.67, 1.00, 1.33, and 2.67 larvae per five plants. The maximum insect infestation of 4.67 larvae per five plants was recorded in the control plot.

The data recorded on the 10th day after the third application revealed that indoxacarb maintained its effectiveness and no larval population was recorded in these treatments. The next effective treatments were spinosad (0.33 larvae per five plants) followed by emamectin benzoate and T7 combination with 0.67 and 1.00 larvae per five plants. The treatment Bt.

Was found least effective with 3.33 larvaeper five plants. The maximum larval population (4.00 larvae per five plants) was recorded in the control plot.

Rabi 2016-17

First spray

The efficacy of different treatments against *H. armigera* on tomato during Rabi 2016-17 is presented in Table 2. The results revealed that all the treatments were significantly effective in reducing the infestation of *H. armigera*. Pre-treatment observation recorded one day before spray, the insect infestation ranged from 1.00 to 2.33 larvae per five plants and it was not significant among all the treatments.

Table.1 Efficacy of novel insecticides and bio-pesticides against tomato fruit borer (*H. armigera)* during ***Rabi*** 2015-16

Treatment	No. of larvae per five plants											
	DBS	First spray			DBS	Second spray			DBS	Third spray		
		3DAS	7 DAS	10 DAS		3 DAS	7 DAS	10 DAS		3 DAS	7 DAS	10 DAS
Spinosad 45 SC	0.33 (1.14)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.33 (1.52)	0.33 (1.14)	0.67 (1.28)	1.00 (1.38)	1.67 (1.63)	0.33 (1.14)	0.67 (1.28)	0.33 (1.14)
Indoxacarb 14.5 SC	0.67 (1.28)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.33 (1.52)	0.00 (1.00)	0.00 (1.00)	0.33 (1.14)	1.00 (1.38)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Emamectin Benzoate	0.67 (1.28)	0.00 (1.00)	0.00 (1.00)	0.33 (1.14)	3.33 (2.08)	0.67 (1.28)	1.00 (1.38)	1.33 (1.52)	2.00 (1.71)	0.67 (1.28)	1.00 (1.38)	0.67 (1.28)
Neem Oil	1.67 (1.58)	1.00 (1.38)	1.33 (1.52)	2.00 (1.71)	3.67 (2.16)	2.33 (1.82)	2.67 (1.91)	3.00 (1.99)	3.33 (2.08)	2.67 (1.91)	3.00 (1.99)	2.33 (1.82)
Bt. 5% WP	0.67 (1.28)	0.33 (1.14)	0.33 (1.14)	1.00 (1.38)	2.00 (1.71)	3.33 (2.08)	3.67 (2.16)	4.33 (2.31)	5.00 (2.44)	3.67 (2.16)	4.00 (2.23)	3.00 (1.99)
NPV	0.67 (1.28)	0.00 (1.00)	0.67 (1.28)	1.00 (1.38)	1.67 (1.63)	1.00 (1.38)	1.33 (1.52)	2.00 (1.71)	2.33 (1.82)	1.33 (1.52)	1.67 (1.63)	1.33 (1.52)
Spinosad 45 SC+ Neem	0.33 (1.14)	0.00 (1.00)	0.67 (1.28)	0.67 (1.28)	1.67 (1.63)	0.67 (1.28)	1.00 (1.38)	1.67 (1.63)	2.00 (1.71)	1.00 (1.38)	1.33 (1.52)	1.00 (1.38)
Indoxacarb 14.5 SC+ Bt. WP	1.33 (1.52)	1.00 (1.38)	1.33 (1.52)	1.67 (1.63)	3.67 (2.16)	3.00 (1.99)	3.33 (2.08)	4.00 (2.23)	4.67 (2.36)	3.67 (2.16)	3.67 (2.16)	3.33 (2.08)
Emamectin Benzoate 1.9EC+ NPV	1.67 (1.63)	0.67 (1.28)	1.00 (1.38)	1.33 (1.52)	3.33 (2.08)	2.67 (1.91)	3.00 (1.99)	3.33 (2.08)	3.67 (2.16)	3.33 (2.08)	3.33 (2.08)	2.67 (1.91)
Control	1.00 (1.38)	1.67 (1.63)	2.00 (1.71)	2.33 (1.82)	4.00 (2.23)	4.67 (2.38)	5.00 (2.44)	5.67 (2.57)	5.33	5.00 (2.44)	4.67 (2.37)	4.00 (2.23)
SEm (±)	**0.16**	**0.13**	**0.13**	**0.12**	**0.10**	**0.12**	**0.14**	**0.12**	**0.10**	0.11	**0.10**	**0.10**
CD		**0.38**	**0.39**	**0.35**	**0.29**	**0.36**	**0.41**	**0.36**	**0.31**	0.33	**0.29**	**0.29**

Table.2 Efficacy of novel insecticides and bio-pesticides against tomato fruit borer (*H. armigera)* during ***Rabi*** 2016-17

Treatments	**No. of larvae per five plants**											
	DBS	**First Spray**			**DBS**	**Second Spray**			DBS	**Third Spray**		
		3 DAS	**7 DAS**	**10 DAS**		**3 DAS**	**7 DAS**	**10 DAS**		**3 DAS**	**7 DAS**	**10 DAS**
Spinosad 45 SC	**1.00**	**0.00**	**0.00**	0.33	1.67	**0.00**	0.33	0.67	1.33	**0.00**	0.33	0.33
	(1.38)	(1.00)	(1.00)	(1.14)	(1.63)	(1.00)	(1.14)	(1.28)	(1.52)	(1.00)	(1.14)	(1.14)
Indoxacarb 14.5 SC	**2.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	0.33	**1.00**	**0.00**	**0.00**	**0.00**
	(1.71)	(1.00)	(1.00)	(1.00)	(1.38)	(1.00)	(1.00)	(1.14)	(1.38)	(1.00)	(1.00)	(1.00)
Emamectin Benzoate	1.33	0.33	0.67	1.00	2.00	0.67	1.00	1.33	1.67	0.33	0.67	0.33
	(1.52)	(1.14)	(1.28)	(1.38)	(1.71)	(1.28)	(1.38)	(1.52)	(1.63)	(1.28)	(1.28)	(1.14)
Neem Oil	**1.00**	0.67	**1.00**	1.67	2.33	1.33	1.67	2.00	2.33	**1.00**	**1.00**	0.67
	(1.38)	(1.28)	(1.38)	(1.63)	(1.82)	(1.52)	(1.63)	(1.71)	(1.82)	(1.38)	(1.38)	(1.28)
Bt. 5% WP	**1.00**	1.67	2.00	2.33	4.00	2.33	3.33	3.67	4.67	2.67	2.67	2.00
	(1.38)	(1.63)	(1.71)	(1.82)	(2.23)	(1.82)	(2.08)	(2.16)	(2.36)	(2.16)	(1.91)	(1.71)
NPV	1.00	1.00	1.33	1.67	3.33	1.67	2.33	2.67	3.67	1.67	1.33	1.00
	(1.38)	(1.38)	(1.52)	(1.63)	(2.08)	(1.52)	(1.82)	(1.91)	(2.16)	(2.08)	(1.52)	(1.38)
Spinosad 45 SC+ Neem	1.33	**1.00**	1.33	1.33	2.00	**1.00**	1.33	1.67	2.00	0.67	0.67	0.33
Indoxacarb 14.5 SC+ Bt.	1.67	1.33	2.33	2.67	4.33	2.67	3.00	3.33	4.33	2.33	2.00	2.00
WP	(1.63)	(1.52)	(1.82)	(1.91)	(2.31)	(1.90)	(1.99)	(2.08)	(2.31)	(2.16)	(1.71)	(1.71)
Emamectin Benzoate	2.33	2.00	1.67	2.00	3.00	2.00	2.67	3.00	4.00	2.00	2.33	1.33
NPV	(1.82)	(1.71)	(1.63)	(1.71)	(1.99)	(1.71)	(1.91)	(1.99)	(2.23)	(1.71)	(1.82)	(1.52)
	1.67	2.33	3.00	4.67	5.33	6.00	6.33	6.00	5.67	5.00	3.33	2.67
Control	(1.63)	(1.82)	(1.99)	(2.38)	(2.51)	(2.64)	(2.71)	(2.64)	(2.58)	(2.44)	(2.08)	(1.91)
SEm (±)	**0.17**	**0.14**	**0.12**	0.11	0.11	**0.10**	**0.10**	**0.12**	**0.12**	0.11	**0.10**	**0.14**
CD at 5%	**NS**	**0.41**	**0.36**	**0.34**	**0.33**	**0.31**	**0.29**	**0.35**	**0.37**	**0.33**	**0.30**	**0.42**

The insect infestation was recorded on the 3rd day after the first application, all the treatments were found significantly superior over control. No infestation was recorded in the treatment of indoxacarb and spinosad and found the best treatments. The next effective treatment was emamectin benzoate (0.33 larvae per five plants) and it was followed by neem oil, NPV, and T7 combination. The treatment T9 combination was found least effective with 2.00 larvae per five plants. The maximum larval population (2.33 larvae per five plants) was recorded in the control plot.

Data recorded on the 7th day after the first application ranged from 0.00 to 2.33 larvae per five plants among all the treatments. Indoxacarb and spinosad again proved most effective as no larval populations were recorded in these treatments. The minimum larval population (0.67 larvae per five plants) was recorded in the treatment of emamectin benzoate. It was followed by neem oil, NPV, T7 combination, and T9 combination with 1.00, 1.33, 1.33, and 1.67 larvae per five plants, respectively. The maximum larval population (3.00 larvae per five plants) was recorded in the control plot.

The infestation of *H armigera* recorded on the 10th day after the first application revealed that indoxacarb was again proved the best treatment as no larval population was recorded in this treatment. The next effective treatment was spinosad (0.33 Larvae per five plants). The treatment Bt. was least effective with 2.67 larvae per five plants. The maximum infestation (4.67 larvae per five plants) was recorded in the control plot.

Second spray

Similar trends in the reduction of the larval population were recorded after the second spray and all the treatments proved better than the control. The larval population recorded one day before the second application ranged from 1.00 to 5.33 larvae per five plants (Table 2).

The data recorded on 3rd day after the second application revealed that all the treatments were found significantly superior over control. No infestation was recorded in the treatment of indoxacarb and spinosad and found the best treatments. The next effective treatment was emamectin benzoate with 0.67 larvae per five plants. The maximum larval population (6.00 larvae per five plants) was recorded in the control plot.

When an infestation of *H.armigera* on tomato was recorded on the 7th day after the second application, indoxacarb again proved the most effective treatment as no larval population was recorded. The next effective treatment was spinosad with 0.33 larvae per five plants. In other treatments, the larval population ranged from 1.00 to 3.33 larvae per five plants. The maximum larval population (6.33 larvae per five plants) was recorded in the control plot.

Data recorded on the 10th day after the second application revealed that indoxacarb maintained their effectiveness and significance over control. The least effective treatment was carbosulfan with 3.67 larvae per five plants. The order of effectiveness of these treatments were Indoxacarb > spinosad > emamectin benzoate > T7 combination > neem oil > NPV> T9 combination>T8 combination > Bt. The maximum infestation (6.00 larvae per five plants) was found in the untreated plot.

Third spray

A similar trend in reduction of the larval population was recorded after 3rd spray and all the treatments proved better than the control. The larval population recorded one day before the 3rd application ranged from 1.00 to 5.67 larvae per five plants (Table 2).

Data recorded on 3rd day after application revealed that all the treatments were found significantly superior over control. Indoxacarb and spinosad proved the most effective treatment as no larval population was recorded in these treatments.

The other treatments in order were emamectin benzoate > T7 combination>neem oil > NPV > T9 combination > T8 combination > Bt. The maximum larval population (5.00 larvae per five plants) was recorded in the control plot. When data recorded on the 5th day after application, indoxacarb again proved most effective as no larval population was recorded in this treatment. The next effective treatments were spinosad, emamectin benzoate, T7 combination, neem oil, NPV, T9, T8, and Bt. The maximum insect infestation of 3.33 larvae per five plants was recorded in the control plot.

The data recorded on the 10th day of the third application revealed that indoxacarb again proved most effective as no larval population was recorded in this treatment. The next effective treatments were spinosad, emamectin benzoate. The maximum larval population (2.67 larvae per five plants) was recorded in the control plot. Out of ten insecticides evaluated the efficacy of bio-pesticides and novel insecticides against tomato fruit borer (*H. armigera*). The spinosad and indoxacarb were found most effective biopesticides and novel insecticides for tomato fruit borer (*H. armigera*)and gave percent population.

Acknowledgments

The author expresses gratefulness to the department of Entomology, SVPUAT& T., Meerut for their precious suggestions untiring help, and moral support throughout the research.

References

Ameta, O. P., and Bunker, G. K. 2007. Efficacy of flubendiamide against fruit borer, *Helicoverpa armigera*in tomato with safety to natural enemies. *Indian J. Pl. Prot.* 35(2):235-237.

Barde, S. K. 2006. Studies on seasonal incidence of pest complex of tomato and management of fruit borer *(Helicoverpa armigera* Hubner) by use of biopesticides. M.Sc. (Ag.) Thesis, JNKVV, Jabalpur.

Bharti, Neena., Kumar, Vinay and Singh, U. K. 2009. Efficacy of biopesticides and neem-based insecticides against pod borer, *Helicoverpa armigera* (Hubner) infesting chickpea. *Journal of Applied Biology*. 19(1/2):20-22.

Choudhary, S., Mathur, D. P., Singh, Y. S. 2005. Bioefficacy of D-C Tron plus oil with biopesticides, botanical and chemical insecticide against *Helicoverpa armigera* on tomato. *Indian Journal of Entomology*; 67(2):162-164.

Dhaka, S.S.; Singh, G.; Ali, N.; ArvindYadav and Singh, R. 2010. Field evaluation of Insecticides and Biopesticides against *Helicoverpa armigera* on tomato. *Ann. PI. Protect. Sci.* 18(1): 13-16.

Dodia, D. A., Prajapati, B. G., and Acharya, S. 2009. Efficacy of insecticides against gram pod borer, *Helicoverpa armigera* Hardwick, infesting pigeonpea. *Journal of Food Legumes*. 22(2):144-145.

Ghosal, A. Chatterjee, M. L., and Manna, D. 2012.Studies on some insecticides with a novel mode of action for the management of tomato fruit borer

(*Helicoverpaarmigera* Hub.). *Journal of Crop and Weed*; 8(2):126-129.

Kambrekar, D. N., Somanagouda, G., Basavarajappa, M. P., and Halagalimath, S. P. 2012. Effect of different dosages of emamectinbenzoate 5 SG and indoxacarb14.5 SC on pod borer, *Helicoverpa armigera* infesting chickpea. *Legume Research.* 35(1): 13-17.

Karabhantanal, S. S., and Awaknavar, J. S. 2004. Efficacy of some insecticides against the tomato fruit borer, *Helicoverpa armigera* (Hubner). Pest Management and Economic Zoology; 12(2):131-136.

Murugraj, P., Nachiappan, and Selvanarayanan, V. 2006. Efficacy of emamectin benzoate (Proclaim 5 SG) against tomato fruit borer, *Helicoverpa armigera* (Hubner). *Pestology* 30(2): 11-16.

Ravi, G., Verma, Shashi, and Verma, S. 2008. Evaluation of pesticides against *H. armigera*. *Indian Journal of Entomology*. 59(1):69-77.

Singh, G.; Dhaka, S.S.; Ali, N.; Yadav, A. and Singh, R. 2010. Efficacy of insecticides and bio-pesticides against *Helicoverpa armigera* on *Vignamungo. Annals of Plant ProtectionScience.* 18(1): 225-227.

Singh, S. S.; and Yadav, S. K. 2007. Comparative efficacy of insecticides, biopesticides, and neem formulations against *Helicoverpa armigera* on chickpea. *Annals of Plant Protection Science.* 15(2): 299-302.

Wanjari, R. R., More, G. D., Supare, N. S., Turkar, K. S., and Agarkar, V. K. 1997. Management of *Helicoverpa armigera* (Hub.) on Chickpea with some herbal, chemical, and biopesticides. *J. Soils & Crops*, 8(1): 34-37.