Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

June 2017, Volume 30, Issue 1, Page 19-22

Assessment of Damage and Yield Losses of Tomato Fruit Borer and its Biorational Management

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ARTICLE INFO

Article history:
Received 25 May 2016
Revision Received 5 August 2016
Accepted 19 October 2016

Key words:
Tomato, tomato fruit borer, yield loss, sex pheromone trap, spinosad 45 SC

ABSTRACT

An experiment was conducted to determine the damage and yield losses caused by tomato fruit borer and its biorational management at ICAR Research Complex for NEH Region, Sikkim Centre, Tadong during 2012-13 and 2013-14. The infestation and yield loss of fruit borer was more in tomato cultivated inside polyhouse (20.50-26.26 % and 25.17-28.46 %) than open field condition (14.54-20.76 % and 17.22-20.50 %). Average of 44.25 to 110.25 adults/trap of *Spodoptera litura* were trapped per week through sex pheromone trap. Amongst the biopesticides evaluated, spinosad 45 SC @ 0.4 ml/l was found to be the most effective for controlling fruit borer (75.62 % larval reduction over control after 14 days of second spraying) with less fruit damage (5.46 %) and higher yield (28.42 t/ha).

1. Introduction

Tomato (*Lycopersicon esculentum*) is the world's second important vegetable crop known as protective food because of its special nutritive value and widespread production. In India nearly 7.1 million tonnes of tomato is produced annually, ranking it fifth in the world, from an area of 5.4 lakh ha, placing the country at the second position globally based on its area of production (Arora *et al.,* 2012). Besides various reasons for low productivity, heavy damage is caused by fruit borer that inflicts direct losses in yield of marketable fruits resulting in 22–38% yield loss (Dhandapani *et al.,* 2003). Because of its fleshy nature, tomato fruit is attacked by a number of insect pests and diseases (Pandey *et al.,* 2006) resulting in the consumption of large amounts of pesticides which leave their toxic residues (Kumari *et al.,* 2002). It is a short-duration crop and gives high yield, hence, it is important from the economic viewpoint. Sikkim is gifted with climate suitable for round the year tomato cultivation. It is cultivated both in open fields and inside polyhouses to harvest the crop throughout the year.

The determination of intensity of damage and yield loss caused by fruit borer in tomato along with a suitable organic management strategy is of utmost importance in Sikkim. Any individual biopesticide is unable to control crop pests, when the pest pressure is high or when there is an epidemic in the field, but they can be effective with the integration with other control measures for pest management. Hence, the present investigation was undertaken to determine the intensity of damage, assessment of yield losses caused by tomato fruit borer and develop biorational management strategies.

2. Materials and Methods

2.1 Assessment of damage and yield losses of tomato fruit borer

The tomato crop (variety Romeo) was cultivated in open field and inside polyhouse. The total area of crop field was divided into four equal plots for recording observation. From each plot 10 plants were selected randomly for observation of intensity of damage. During fruit maturing time number of fruit borer damaged fruits were recorded along with total number of fruits per plant at 15 days interval.

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Total of three observations were recorded. In order to determine the yield loss during harvesting period, the total weight of fruits harvested from randomly selected 10 plants/plot were recorded from which the weight of infested and damaged fruits was recorded separately. The same method was followed in case of polyhouse conditions also. Four nos. of sex pheromone traps of *Spodoptera litura* and *Helicoverpa armigera* were installed in tomato field during the fruiting period for management of tomato fruit borer. No. of adults trapped every week were recorded and reinstalled the trap again. The lure of the trap was changed at 25 days interval.

2.2 Evaluation of biopesticides against fruit borer

Six different biopesticides *viz*. *Beauveria bassiana* @ 5g/l, neem oil 0.03 EC @ 3ml/l, neem oil 0.15 EC @ 3ml/l, Spinosad 45 SC @ 0.4 ml/l, nuclear polyhedrosis virus (NPV) @ 1 ml/l and *Bacillus thuringiensis* @ 2 g/l were evaluated against tomato fruit borer by taking Ekalux 25 EC @ 1.5 ml/l as check and one untreated control. The experiment was designed in RBD with 8 treatments and all the treatments were replicated thrice. The population of tomato fruit borer/10 plants and no. of damaged fruit/10 plants were recorded at 7 and 14 days after spraying. Yield data was recorded at harvest separately in each treatment.

3. Results and Discussion

3.1 Assessment of damage and yield losses of tomato fruit borer

In Sikkim, though the infestation of *Spodoptera litura* and *Helicoverpa armigera* are observed but the *S. litura* population is more in comparison to *H. armigera*. Higher infestation of fruit borer was observed in tomato cultivated inside polyhouse (20.50-26.26%) than open field condition (14.54-20.76%) (Table 1). Similarly, the yield loss due to tomato fruit borer was also assessed both in open field and polyhouse cultivated tomato. The yield loss in open field was found to be 17.22 to 20.50% and 19.84 to 27.38% inside polyhouse (Table 2). The higher infestation of tomato fruit borer inside polyhouse might be due to prevalence of conducive climatic conditions. Generally most of the low cost polyhouses are not protected from insects, basically protecting the crop from heavy downpour only. An average of 44.25 to 110.25 adults/trap of *Spodoptera litura* was trapped per week. Only 2-3 adults were trapped in case of *Helicoverpa.* It was observed from the evaluation of sex pheromone traps that this may also be suitable tools for biorational management strategies of *Spodoptera* in Sikkim.

Table 1. Damage of tomato fruit borer in open field and polyhouse

Observations recorded in Open field	No. of fruits observed	No. of infested fruits	% of damaged fruits (mean of 40 data)
First	329	48	14.58
Second	489	85	17.40
Third	473	98	20.76
Observations recorded inside polyhouse			
First	489	100	20.49
Second	676	156	23.04
Third	578	152	26.26

Table 2. Assessment of yield loss due to tomato fruit borer in open field and polyhouse

Observations recorded in Open field	Weight of total fruits in kg	Weight of infested fruits in kg	% of yield loss (mean of 40 data)
First	13.300	2.298	17.22
Second	18.76	3.96	20.50
Observations recorded inside polyhouse			
First	15.85	3.12	19.84
Second	17.28	4.72	27.38

3.2 Evaluation of biopesticides against tomato fruit borer

It was observed from the study that all the treatments significantly reduced the population of tomato fruit borer over control (Table 4). Amongst the treatments, Ekalux 25 EC @ 1.5 ml/l reduced maximum larval population of tomato fruit borer (85.35 per cent) after 14 days of second spray and recorded highest production (30.16 t/ha). Amongst the biopesticides, Spinosad 45 SC @ 0.4 ml/l was found to be the most effective for controlling fruit borer (75.62 % larval reduction over control after 14 days of second spraying) with less fruit damage (5.46 %) and higher yield (28.42 t/ha) and which was statistically at par with Ekalux 25 EC @ 1.5 ml/l. The most effective result of spinosad 45 SC for management of tomato fruit borer is conformity to earlier reports of very good results (100 per cent larval reduction)[3]. Nuclear polyhedrosis virus @ 1 ml/l also showed effective result which was at par with Spinosad 45 EC.

Acknowledgement

The authors thank the Director, ICAR Research Complex for NEH Region, Umiam for extending all kind of support to conduct the experiment.

Table 3. Adults of tomato fruit borer, *S.litura* trapped through sex pheromone trap

Observation periods	May			
	-	**Second week**	**Third week**	**Fourth week**
Adults trapped		92.5	110.25	100.75
	June			
Observation periods	**First week**	**Second week**	**Third week**	**Fourth week**
Adults trapped	60.25	90.50	60.75	52.50
	July			
Observation periods	**First week**	**Second week**	**Third week**	**Fourth week**
Adults trapped	44.25	48.75	80.00	64.25

Table 4. Evaluation of efficacy of different biopesticides against tomato fruit borer

Treatments	Pre-treatment count	No. of larvae/10 plants after first spray		No. of larvae/10 plants after second spray		Larval reduction over control after 14 days of second spray (%)	Fruit damage (%)	Yield (t/ha)
		7 DAT	14 DAT	7 DAT	14 DAT			
Neem oil 0.03 EC @ 3 ml/l	14.33	8.00	11.33	6.66	7.66	43.92	17.62	21.46
Neem oil 0.15 EC 3 ml/l	14.66	8.33	11.00	7.00	8.00	41.43	17.76	21.14
Spinosad 45 SC 0.4 ml/l	13.66	4.66	7.33	2.66	3.33	75.62	5.46	28.42
Nuclear Polyhedrocis virus @ 1 ml/l	14.00	5.33	8.66	4.33	6.33	53.66	6.72	26.84
Bacillus thuringiensis, @ 2 g/l	13.33	5.66	8.00	5.00	7.00	51.24	9.00	23.88
*Beauveriabassiana*7 g/l	14.66	9.00	12.66	7.66	9.33	31.69	20.86	19.34
Ekalux 25 EC @ 1.5 ml/l	14.33	1.66	4.33	1.00	2.00	85.35	3.24	30.16
Control	15.00	13.66	14.33	12.33	13.66	-	24.34	18.86
SEm±	**-**	**1.36**	**1.62**	**1.37**	**1.41**	**-**	**2.05**	**2.08**
LSD (P=0.05)	**-**	**2.91**	**3.46**	**2.93**	**3.01**	**-**	**4.38**	**4.44**

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