International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 1482-1485

Received: 04-07-2018
Accepted: 08-08-2018

Harshita AP
Department of Entomology, college of Agriculture Jorhat, Assam, India

Saikia DK
Department of Entomology, college of Agriculture Jorhat, Assam, India

Anjumoni Deeve
Department of Entomology, college of Agriculture Jorhat, Assam, India

Bora LC
Department of Plnat Pathology, college of Agriculture Jorhat, Assam, India

Phukan SN
Department of Agricultural Statistics, college of Agriculture Jorhat, Assam, India

Correspondence
Harshita AP
Department of Entomology, college of Agriculture Jorhat, Assam, India

Seasonal incidence of fruit borer, *Helicoverpa armigera* and its eco-friendly management in tomato, *Solanum lycopersicum*

Harshita AP, Saikia DK, Anjumoni Deeve, Bora LC and Phukan SN

Abstract
A field experiment on seasonal incidence of *Helicoverpa armigera* and its management was carried out at the experimental farm, department of horticulture, Assam Agricultural University, Jorhat, during 2015-16 and 2016-17, respectively. The peak infestation of *H. armigera* (6.06 and 6.30 larvae per plant) was recorded during March in 2015-16 and 2016-17, respectively. The first incidence of *H. armigera* during 2015-16 was observed on 12th December'2015 with a mean population of 0.46 larvae per plant and larval population gradually increased till the harvest of the crop. The larvae attained maximum population of 6.06 larvae per plant on 22nd March'2016. During 2016-17, the first incidence of fruit borer was noticed on 17th January'2016 with a mean population of 0.9 larvae per plant and larval population gradually increased till the harvest of the crop. The larvae attained maximum population of 6.3 larvae per plant on 20th March'2017. All the treatments tested against fruit borer gave effective control and increased yield over untreated control. Spinosad @ 0.3 ml per litre was graded as most effective treatment in reducing fruit borer followed by Azadirachtin @ 5 ml per litre.

Keywords: tomato, *Helicoverpa armigera*, seasonal incidence, management

Introduction
Vegetables play an important role in human nutrition. India is the second largest producer of vegetables in the world next to china. As a short duration crop, tomato is known for its out-standing nutritive value and capable of producing high yield per unit area and time, tomato has a great potential in modern agriculture. The total cultivated area and production of tomato in our country have increased gradually over the last few years but the productivity is still very low compared to the average of the world's yield of 26.29 tonnes per hectare. There are several production constrains for poor yield of tomato. The important reason can be contributed to the substantial losses due to heavy infestation of insect pests. Tomato fruit borer *Helicoverpa armigera* has become an important pest in tomato growing areas. At present, farmers are mostly rely on chemical pesticides because of their quick knock down effect to manage this pest. But insecticides are not providing satisfactory control of the target pest due to the outbreak of secondary pests, development of insecticide resistance including resurgence etc. which leads to their misuse of threatening environment safety. The increasing concern for environmental awareness of pesticide hazards has evoked a worldwide interest in the use of pest control agents of bio and plant origin. Hence the present study was under taken to study the seasonal incidence and management of fruit borer effectively using ecofriendly approaches.

Materials and Method
Field experiment was conducted at Assam Agricultural University, Jorhat, Assam during 2015-16 and 2016-17. The experiment was laid out separately in complete randomized block design (RCBD) in three replications with a plot size of 3 m x 3.5 m. to study the seasonal incidence and management studies. Observations on the fruit borer activity were recorded in weekly intervals to study the seasonal incidence during both the year of study. To record the observation five plants per plot were selected. The number of larvae were recorded in the selected plants. The data was statistically analyzed by correlation analysis between weather parameters and fruit borer. To evaluate the ecofriendly management, seven treatments were taken.

Results

The results pertaining to seasonal incidence of fruit borer are presented in the Table 1 and Table 2 during 2015-16 and 2016-17, respectively. During 2015-16, the first incidence of *H. armigera* was observed on 12th December'2015 with a mean population of 0.46 larvae per plant and larval population gradually increased till the harvest of the crop. The larvae attained maximum population of 6.06 larvae per plant on 22nd march'2016 when the maximum temperature, minimum temperature, relative humidity, rainfall and bright sunshine hours were 26.6^{0}C, 16.0^{0}C, 76.5 per cent, 30.6 mm, 28.4, respectively. During this year of study, fruit borer population noticed a non-significant positive correlation with average maximum temperature (r= 0.064), minimum temperature (r= 0.242), total rainfall (r= 0.232). However, average relative humidity (r= -0.494) had significant negative effect on the population build up of the pest. But bright sunshine hours showed a non-significant negative relationship (r=-0.347) with the build up the pest (Table 3). During 2016-17, the first incidence of *H. armigera* was observed on 17th January'2016 with a mean population of 0.9 larvae per plant and larval population gradually increased till the harvest of the crop. The larvae attained maximum population of 6.3 larvae per plant on 20thMarch'2017 when the maximum temperature, minimum temperature, relative humidity, rainfall and bright sunshine hours were26.3^{0}C, 15.2^{0}C, 78 per cent, 26mm, 34.4, respectively. Fruit borer population showed a non-significant positive correlation population of the pest with maximum temperature (r= 0.082), minimum temperature (r= 0.196) and total rainfall (r=0.306). However, average relative humidity (r= -0.557) had a significant negative effect on the population build up of the pest. However, bright sunshine hours (r=-0.329) showed a non-significant negative relationship with the incidence of the pest during second year of the study (Table 3).

The results pertaining to Effectiveness of different treatments on fruit borer are presented in the Table 4, 5 and 6 after first, second and third sprays, respectively. All the treatments were superior than untreated control during first spray. After fifteen days of first spray, Spinosad @ 0.3 per litre could able to reduce the population (3.60 larvae/plant) effectively followed by Azadirachtin 1500 ppm @ 0.5 ml per litre (4.46 larvae/plant) and HaNPV @ 5 ml per litre (4.66 larvae/plant). All the treatments except Spinosad 45 SC and untreated control were on par with each other. During second spray, almost the same trend was continued in reducing the pest population. After fifteen days Spinosad 45SC @ 0.3 ml per litre treated plot noticed least larval population (2.06 larvae/plant). All other treatments were on par with each other except untreated control. After the completion of third spray, Spinosad 45SC @ 0.3 ml per litre (0.93 larvae/plant) was superior over other treatments in reducing the larval population followed by Azadirachtin 1500 ppm @ 5 ml per liter (2.33 larvae/plant) and *Beauveria bassiana* @ 5ml per litre (2.86 larvae/plant).

Table 1: Population build up of fruit borer *Helicoverpa armigera* in relation to meteorological parameters during 2015-16

Dates of observations	Temperature(^{0}c)		Average RH (%)	Rainfall (mm)	BSSH	No. of fruit borer larvae/plant
	Max.	Min.				
29 Oct - 4 Nov	29.5	19.0	83	6.9	37.4	0
5 Nov - 11 Nov	27.1	15.7	79.5	0.0	43.4	0
12 Nov - 18 Nov	27.9	15.4	80.5	3.3	40.8	0
19 Nov - 25 Nov	26.8	13.3	84.5	0.0	45.6	0
26 Nov - 2 Dec	27.0	12.9	81	0.0	55.2	0
3 Dec - 9 Dec	23.7	12.7	87.5	14.1	24.2	0
10 Dec -16 Dec	21.9	13.8	90	21.1	2.7	0.46
17 Dec - 23 Dec	21.9	8.6	81	0.5	40.6	0.66
24 Dec- 31 Dec	23.1	8.2	81.5	0.0	47.1	0.8
1 Jan - 7 Jan	25.3	9.1	81.5	0.0	48.1	1.2
8 Jan - 14 Jan	23.1	9.9	85.5	29.4	22.7	1.73
15 Jan -21 Jan	20.2	10.8	89.5	5.8	12.5	2.46
22 Jan - 28 Jan	21.1	10.2	84	0.0	23.2	2.86
29 Jan - 4 Feb	20.7	10.7	88	0.0	8.3	3.06
5 Feb - 11 Feb	22.8	12.6	83	1.4	11.7	3.26
12Feb - 18 Feb	24.5	13.2	79	0.0	11.2	3.73
19Feb - 25 Feb	26.1	15.9	82.5	5.2	20.6	4.4
26 Feb - 4 Mar	28.3	13.1	74	3.8	49.5	4.73
5 Mar - 11 Mar	25.7	15.9	80	19.5	26.5	5.46
12 Mar - 18 Mar	28.2	16.9	73.5	0.8	26.4	5.93
19 Mar - 25 Mar	26.6	16.0	76.5	30.6	28.4	6.06

Table 2: Population build up of fruit borer Helicoverpa armigera in relation to meteorological parameters during 2016-17

Date of observation	Temperature (^{0}C)		Average RH (%)	Rainfall (mm)	BSSH	No. of fruit borer/plant (larvae)
	Max.	Min.				
5 Nov - 11 Nov	27.9	19.8	88.5	16.5	17.3	0
12Nov - 18 Nov	30.2	18.0	81	0.0	23.4	0
19Nov - 25 Nov	27.5	12.3	80.5	0.0	61.6	0
26 Nov - 2 Dec	27.7	13.8	78.5	0.0	57.4	0
3 Dec - 9 Dec	27.6	11.8	80	0.0	56.3	0
10 Dec -16 Dec	26.5	9.7	79	0.0	61.7	0
17 Dec - 23 Dec	26.0	12.6	80.5	0.0	37.4	0
24 Dec- 31 Dec	25.0	12.6	82.5	43.5	46.3	0
1 Jan - 7 Jan	25.9	10.7	77.5	0.1	57.6	0
8 Jan - 14 Jan	24.0	9.3	79.5	0.0	46.0	0

15 Jan -21 Jan	24.3	8.0	78	0.0	57.0	0.9
22 Jan - 28 Jan	26.8	9.1	73.5	0.0	53.3	2.6
29 Jan - 4 Feb	25.5	11.3	78	2.0	51.1	2.7
5 Feb - 11 Feb	27.4	12.6	74	0.0	30.1	3
12Feb - 18 Feb	27.9	11.0	69	0.0	49.8	3.8
19Feb - 25 Feb	25.6	15.0	81	37.4	31.3	4.2
26 Feb - 4 Mar	25.9	15.0	77	0.0	22.3	4.4
5 Mar - 11 Mar	26.3	14.6	76.5	19.2	35.2	5.4
12 Mar - 18 Mar	26.8	14.3	72	10.6	46.7	5.6
19Mar - 25 Mar	26.3	15.2	78	26	34.4	6.3

Table 3: Correlation coefficient (r) and regression equation of fruit borer *Helicoverpa armigera* with meteorological parameters during 2015-16 and 2016-17

Insect pests and predators	Temperature (^{0}C)		Average Relative humidity (%)	Total rainfall (mm)	BSSH (hr)
	Maximum	Minimum			
Fruit borer per plant (2015-16)	0.064^{NS}	0.242^{NS}	-0.494^{*} Y=46.628-0.463x	0.232^{NS}	-0.347^{NS}
Fruit borer per plant (2016-17)	-0.082^{NS}	0.196^{NS}	0.763^{*} Y=29.67-0.352x	0.015^{NS}	-0.097^{NS}

NS: Non significant,*: Significant at 0.05% level, **: Significant at 0.01% level

Table 4: Efficacy of different treatments on *H. armigera* population after first spray during 2016-17

Treatments	Dose	Pre treatment count	Post treatment count		
			7 DAT	10 DAT	15 DAT
Spinosad 45% SC	0.3 ml/lit	6.0	4.20^{c}	3.53^{c}	3.60^{d}
Azadirachtin 1500 ppm	5 ml/lit	5.86	4.86^{b}	4.46^{b}	4.46^{bc}
Trichogramma pretiosum	1,00,000/ha	5.40	4.80^{b}	4.53^{b}	4.80^{bc}
Beauveria bassiana	5 ml/lit	5.60	4.93^{b}	4.66^{b}	4.73^{bc}
Bacillus thuringiensis var. krustaki	2 ml/lit	5.33	5.06^{b}	5.0^{b}	5.06^{b}
HaNPV 250 LE	5 ml/lit	5.46	4.8^{b}	4.60^{b}	4.66^{b}
Untreated control	-	5.8	6.06^{a}	6.2^{a}	6.33^{a}
S.Ed. (±)		0.27	0.25	0.26	0.23
CD (P=0.05)		NS	0.56	0.58	0.51

DAT: Days after treatment
Data based on mean of 3 replication (5 plants /plot)
NS: Non- significant
Treatment means followed by a common letter do not differ significantly at 5 % of probability by DMRT.

Table 5: Efficacy of different treatments on *H. armigera* population after second spray during 2016-17

Treatments	Dose	Post treatment count		
		7 DAT	10 DAT	15 DAT
Spinosad 45% EC	0.3 ml/lit	2.66^{d}	2.13^{c}	2.06^{c}
Azadirachtin 1500 ppm	5 ml/lit	3.86^{c}	3.60^{b}	3.06^{b}
Trichogramma pretiosum	1,00,000/ha	4.33^{bc}	4.20^{b}	3.93^{b}
Beauveria bassiana	5 ml/lit	4.26^{bc}	3.93^{b}	3.93^{b}
Bacillus thuringiensis var Krustaki	2 ml/lit	4.66^{b}	4.4^{b}	4.0^{b}
HaNPV 250 LE	5 ml/lit	4.46^{b}	4.13^{b}	4.06^{b}
Untreated Control	-	6.46^{a}	6.26^{a}	6.53^{a}
S.Ed. (±)		0.24	0.34	0.33
CD (P=0.05)		0.53	0.75	0.73

DAT: Days after treatment
Data based on mean of 3 replication (5 plants /plot)
NS: Non- significant
Treatment means followed by a common letter do not differ significantly at 5 % of probability by DMRT.

Table 6: Efficacy of different treatments on *H. armigera* population after third spray during 2016-17

Treatments	Dose	Post treatment count		
		7 DAT	10 DAT	15 DAT
Spinosad 45% SC	0.3 ml/lit	1.60^{d}	1.33^{d}	0.93^{d}
Azadirachtin 1500 ppm	5 ml/lit	2.86^{c}	2.60^{c}	2.33^{c}
Trichogramma pretiosum	1,00,000/ha	3.53^{bc}	3.20^{bc}	3.4^{b}
Beauveria bassiana	5 ml/lit	3.26^{bc}	3.26^{bc}	2.86^{c}
Bacillus thuringiensis var krustaki	2 ml/lit	3.73^{b}	3.73^{b}	3.13^{bc}
HaNPV 250 LE	5 ml/lit	3.8^{b}	3.60^{b}	3.06^{bc}
Untreated control	-	6.33^{a}	6.26^{a}	6.33^{a}
S.Ed. (±)		0.33	0.40	0.39
CD (P=0.05)		0.73	0.87	0.86

DAT: Days after treatment
Data based on mean of 3 replication (5 plants /plot)
NS: Non- significant
Treatment means followed by a common letter do not differ significantly at 5 % of probability by DMRT.

Discussion

The first appearance of fruit borer was noticed from the second week of December during 2015-16 but it was appeared lately during 2016-17 from the third week of December. The insect was found to be higher at the fruit maturity stage till the final harvest of the crop. The peak period of activity of fruit borer was noticed during last week of March with a mean of 6.06 larvae per plant during 2015-16 and 6.30 larvae per plant during 2016-17. The present investigation was also observed by Shinde *et al.* (2013) [2] and according to them second peak period of activity of fruit borer was from 13th March to 4th April. However, *H. armigera* remained active from last fortnight of December till the harvest of the crop with a fluctuating population which ranged from 0.46 to 6.06per plant during 2015-16 and from second fort night of January to harvest of tomato, ranging from 0.9 to 6.3 per plant during 2016-17, respectively. This observation was also made by Rishikesh *et al*. (2015) [3] have observed 6.11 larvae per plant during 19th march to 25th March. Reddy *et al*. (2004) [4] from Karnataka revealed that *H. armigera* attained a peak in March-April and they also observed similar trend in larval population at the different localities. Maximum damage due to fruit borer on tomato was recorded during third week of March by Kharpuse (2005) [5] and first week of April by Hath and Das, (2004) [8]. As regards to meteorological parameters, it was observed that maximum temperature (r= 0.064, r= 0.082), minimum temperature (r= 0.242 and r=0.196) and total rainfall (r= 0.232, r= 0.316) had non-significant positive correlation during both the years. However, a significant negative association was exhibited with average relative humidity (r= -0.494, r=-0.557) in both the years. This type of relation was also observed by Rishikesh *et al*. (2015) [3]. Bright sunshine hours (r= -0.347, r= -0.329) had a non-significant negative impact on the larval population during both cropping seasons.

All the treatments were found to be effective in reducing fruit borer population over untreated control. Similar trend with spinosad @ 0.3 ml per treatment (4.2, 3.53 and 3.6 larvae per plant at seven, ten and fifteen days after treatment). The second lowest population was obtained in Azadirachtin @ 5 ml per litre (4.86, 4.46 and 4.46 larvae per plant after seven, ten and fifteen days after treatment) (Table 4). It was observed from the Table 5 of second treatment that the treatment spinosad @ 0.3 ml per litre was still found to be effective giving the lowest population of 2.66, 2.13 and 2.06 larvae per plant after seven, ten and fifteen days, respectively. The Azadirachtin showed the nest best control of fruit borer with 3.86, 3.60 and 3.60 larvae per plant after seven, ten and fifteen days after treatment. After third application, the lowest population of 1.6, 1.33 and 0.93 larvae per plant was recorded in the plot treated with spinosad @ 0.3 ml per litre followed by azadirachtin @ 5 ml per litre with 2.86, 2.6 and 2.33 larvae per plant after seven, ten and fifteen days after treatment, respectively (Table 6). The efficacy of spinosad against fruit borer was also observed by Meena *et al*. (2014) [7] in tomato.

References

1. Annonymous. Indian tomato yet to spread global demand. The Hindu Business Line, Monday, 2010.
2. Shinde YA, Patel BR, Mulekar VG. Seasonal incidence of gram caterpillar, *Helicoverpa armigera* (Hub.) in chickpea. Current Biotica. 2013; (1&2):79-82.
3. Rishikesh M, Rajesh P, Sunil, Satyendra P. Seasonal incidence of insect complex on tomato (*Solanum lycopersicon* L.). Journal of Entomological Research. 2015; 39(4):347-352.
4. Reddy NA, Kumar CTA. A study on correlation between abiotic factors and incidence of tomato fruit borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae). Mysore J Agril. Sci. 2004; 38(3):417-421.
5. Kharpuse YK. Studies on seasonal incidence and role of botanical against major insect pests of tomato (*Lycopersicon esculentum* M.). M.Sc. (Ag.) (Ent.). Thesis submitted to J.N.K.V.V., Jabalpur (M.P.). 2005, 1-53.
6. Kakati M, Saikia DK, Nath RK. Seasonal history and population buildup of tomato fruit borer, *Heliothis armigera* (Hb.) (Lepidoptera: Noctudae). Research on Crop. 2005; 6(2):371-373.
7. Meena LK, Raju SVS. Bioefficacacy of newer insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato, *Lycopersicum esculentum* Mill under field conditions. The bio scan. 2004; 9(1):374-350.
8. Hath TK, Das BR. Incidence of insect pests in late planted tomato under terai agroecology of West Bengal. Environ. Ecol. 2004; 22(1):136-140.