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Influence of Weather Factors on Incidence and Infestation of Shoot and Fruit Borer in Brinjal

Shrutilipi Panda [a*], Tushar Ranjan Mohanty [a], Uma Shankar Nayak [b], Bama Shankar Rath [a] and Deepanjali Dugal [a]

[a] Department of Agricultural Meteorology, College of Agriculture, OUAT, Bhubaneswar, Odisha, India.
[b] Regional Research and Technology Transfer Station (RRTTS), Ranital, Bhadrak, Odisha, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To correlate the influence of weather variables on population dynamics, incidence and infestation of Brinjal shoot and fruit Borer (BFSB) in Brinjal.

Place and Duration of Study: The study was carried out at Regional Research and Technology Transfer Station (RRTTS) at Ranital, Bhadrak Odisha and at Instructional Farm at OUAT, Bhubaneswar, Odisha for period of 1 year.

Methodology: The population of Brinjal shoot and fruit Borer were recorded from transplanting to harvest of the crop. Five random plants were selected and tagged for observation recording, except boarder plants. To determine the percentage of affected shoots, brinjal plants showing signs of delicate shoots drooping, withering, and drying were counted. Similarly, the population was correlated with weather conditions and the number of fruits showing signs of bore holes on fruits was tallied to estimate the percent fruit infection.

**Corresponding author: E-mail: panda.shrutee6@gmail.com;*

Results: The investigation indicates that quantitatively establish the relationship of weather parameters as varied with the dates of sowing (23 May,20 November2021, 21 January2022) and Brinjal fruit and shoot borer (BFSB).The studies revealed that the peak population of brinjal shoot and fruit borer was observed during 34th SMW (22-28 August), 5th SMW(30 January- 5 February) and 18th SMW(1-7May) with shoot infestation(38.44%), (11.10%) and (57.99%) respectively. The fruit was infested with a peak of 47.55%, 27.07% and 63.84% on 39th SMW (26 September- 2 October), 9th SMW (27February-5March) and 18th SMW (1-8May) respectively. The BSFB shows positive significant correlation with relative humidity.

Conclusion: The population of BSFB fluctuates with change in temperature, rainfall, and relative humidity. On first sowing date BSFB population has a less population dynamics comparatively to other two sowing dates. So it is concluded for early sowing results in less pest population.

Keywords: BSFB; population dynamics; shoot drooping; relative humidity.

1. INTRODUCTION

Brinjal (*Solanum melongena*) belongs to family solanaceae is native to India and an important vegetable crop grown throughout the world especially in South Asia. The damage caused by insects is the most significant contributing factor for the low yield of brinjal among other variables. It is vulnerable to predation by a variety of insects from nursery till harvest, among them Brinjal fruit and shoot borer causes highest yield loss. The vegetative period of a crop is when the shoot and fruit borer (on shoot) is most common [1]. Infestation levels could reach 66.66 percent on fruits and flowers during the fruiting phase after reaching 78.66 percent on top shoots during the vegetative Phase [2]. The loss resulting from this insect infestation is estimated to be 20.70% on the basis of the weight of the complete fruit and 9.70% exclusively on the basis of the damaged component [3]. Crop losses ranging from 54 to 66 percent were observed from Bangalore [4,5] reported yield losses in several Indian states ranging from 37 to 63 percent. During the vegetative stage of the crop, the larvae bore into the budding tips of young shoots after hatching. Yellowing and wilting of the injured shoot are typical attack symptoms. The larvae favour flower buds and young fruits during the flowering and fruiting stages. By generating a tiny hole all the way around the calyx, it dug into the tender fruits. After completion of the larval stage inside the growing fruits, the mature larvae emerge from the fruit to pupate. The pest-related yield loss ranges from 70 to 92 percent. A proper management strategy for Brinjal Shoot and Fruit Borer should be developed in accordance with modern pest management techniques to ensure food safety, reduce environmental risks, and lessen the severity of damage. Recommended IPM (Integrated Pest Management) practices with installation of pheromone trap @ 50/hectare for mass monitoring and mass trapping [6]. Application of neem oil @ 1500 ppm may be beneficial for the subsiding of infestation by BSFB [7]. Seasonal variations in environmental conditions affect the loss brought on by BSFB as well. Forecasting of pest attacks will be made easier with understanding of the impact of abiotic parameters such temperature, rainfall, and humidity on the population growth of BSFB [8].

2. MATERIALS AND METHODS

2.1 Experimental Details

The hybrid Akshita was shown on three different dates such as (23/05/2021, 20/11/2021, 21/01/2022) and transplanted on 11/06/2021, 17/12/2021 and 3/03/2022 respectively.

2.2 Climate and Weather

Data on weather factors such as weekly temperature (maximum and minimum) in ^{0}c relative humidity (morning and evening) obtained from the Meteorological observatory College of Agriculture Bhubaneswar from 9 May 2021 to 30 May 2022. The weekly means were calculated for standard meteorological week.

2.3 Observation

The BFSB (*Leucinodes orbonalis*) was recorded from transplanting to harvest of the crop. Five random plants were selected and tagged for observation recording, except boarder plants. To determine the percentage of affected shoots, brinjal plants showing signs of delicate shoots drooping, withering, and drying were counted. Similarly, the population related to weather conditions and the number of fruits showing signs of bore holes on fruits was tallied to estimate the percent fruit infection.

Percent shoot infestation = Number of infested shoots / Total number of shoots × 100.

Percent fruit infestation = Number of infested fruits / Total number of fruits×100.

2.4 Statistical Analysis

Correlation-analysis: To understand the relationship between different abiotic factors was correlated with larval intensity, shoot damage, flower bud damage, and fruit damage (both on a number and weight basis). The damage and parasitization recorded in the next week were correlated with the abiotic factors dominant during the preceding standard week in all cases of analysis. Observation on incidence of grubs and adults of pest thus obtained was subjected to statistical analysis to find out the coefficient of correlation with maximum & minimum temperature, relative humidity and rainfall. A simple correlation was worked out between grubs and adults of hadda beetle and abiotic factors using the following formula.

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

r= Simple correlation coefficient
X = Independent variable i.e. abiotic factors. (Maximum & minimum temperature, relative humidity and rainfall)
Y = Dependent variable i.e. Mean number of insect pests
n = number of paired observations

3. RESULTS AND DISCUSSION

3.1 Effect of Date of Sowing on Shoot Infestation (%)

The infestation of BSFB on shoots of brinjal crop was noticed from the 27th SMW and its occurrence ranged from 4.77% to 38.44%. The infestation by BSFB on the shoots increased gradually and reached the peak (38.44%) during 34th SMW (22- 28 August) and declined gradually. The mean atmospheric temperature, mean relative humidity, bright sunshine hour (BSH) and rainfall were 29.5^{0}C, 92%, 6.6 hr/day, 0.0 mm respectively, during the peak period of incidence. The mean temperature, rainfall and BSH showed positive correlation with shoot infestation whereas, relative humidity was found to be negatively correlated. On second sowing date (20/11/2022) infestation of BSFB on shoots of brinjal crop was noticed from the 1st SMW to 10th SMW and its occurrence ranged from 1.24% to 11.10%. The mean atmospheric temperature, mean relative humidity, bright sunshine hour (BSH) and rainfall were 21.45^{0}C, 81.50%,9.0hr/day, 0.0 mm respectively, during the peak period of incidence. The mean temperature and BSH showed positive correlation with shoot infestation. On last sowing date (21/01/2022) the crop exhibited evidence of BSFB infestation on shoots from the 11th SMW to the 21st SMW, with an incidence rate ranging from 11.01 to 57.99%. During the peak period of occurrence, the mean atmospheric temperature, mean RH, rainfall, and BSH were 31.65^{0}C, 84%, 57.4mm, and 5.2 hrs per day respectively. The correlation between the abiotic factors such as temperature (r = 0.84), relative humidity (r = 0.56), rainfall (r = 0.42), and BSH (r = 0.09) with BSFB population was positive.

3.2 Effect of Date of Sowing on Fruit Infestation (%)

Infestation by BSFB on fruits was noticed from 30th SMW to 45th SMW and its occurrence ranged from 4.65%to 47.55 %. At the peak period of incidence the mean atmospheric temperature, rainfall was 29.50^{0}C, 97% and 0.0 mm, respectively. The infestation of fruits by BSFB showed positive correlation with rainfall (r = 0.18), RH (r = 0.28) and BSH (r = 0.19) whereas it was found to be negatively correlated with temperature. On second sowing date (20/11/2021) infestation by BSFB on fruits was noticed from 4th SMW to 10th SMW and its occurrence ranged from 3.67 %to 27.07. At the peak period of incidence, the mean atmospheric temperature, mean relative humidity, rainfall was 26.55^{0}C,81.50% and 0.0 mm, respectively. The infestation of fruits by BSFB showed positive correlation with relative humidity (r = 0.27) and BSH (r= 0.13). The brinjal crop was infested with BSFB from the 11th SMW to 21st SMW, and its occurrence ranged from 21.36 - 63.84%. At the peak prevalence, the mean temperature, mean RH, rainfall, and BSH were each 30.40^{0}C, 84%, 77.8mm, and 5.2 hr/day respectively. Positive correlations were found between the temperature (r = 0.68), relative humidity (r = 0.49), BSH (r = 0.23), and rainfall (r = 0.51).

Table 1. Population Dynamics of BSFB on first sowing date 23 May 2021

Week	Mean Atmospheric Temperature(^{0}C)	Mean Relative Humidity (%)	Total Rainfall (mm)	Bright sunshine hour	Shoot damage (%)	Fruit damage (%)
23	31.90	95	0.0	2.0	0.0	0.0
24	29.40	96	0.0	7.3	0.0	0.0
25	28.25	95	0.0	1.1	0.0	0.0
26	29.95	97	0.0	4.5	0.0	0.0
27	30.25	86	0.8	6.3	6.65	0.0
28	31.25	84	0.0	2.7	10.32	0.0
29	30.85	94	0.0	4.3	18.54	0.0
30	28.40	91	0.0	7.4	14.20	4.65
31	28.5	90	0.0	4.2	21.35	8.25
32	29.75	92	0.0	7.3	28.65	13.33
33	30.50	91	0.0	5.0	33.75	19.85
34	29.50	92	0.0	6.0	38.44	23.45
35	29.50	92	0.0	6.0	38.44	23.45
36	27.75	94	0.0	3.9	30.74	26.67
37	30.80	97	47.6	9.0	22.35	31.75
38	28.95	87	0.0	7.1	25.42	39.08
39	28.85	95	0.0	6.6	20.72	42.65
40	29.20	97	0.0	1.3	17.37	47.55
41	28.50	95	0.0	6.6	12.48	40.25
42	29.60	95	0.0	5.9	14.08	31.38
43	29.50	94	0.0	5.5	11.32	33.54
44	26.35	97	0.0	1.1	7.86	21.37
45	25.10	95	0.0	4.5	6.04	16.28
46	24.20	86	0.0	5.4	4.77	7.84
47	29.60	95	0.0	5.9	14.08	31.38
48	29.50	94	0.0	5.5	11.32	33.54
49	26.35	97	0.0	1.1	7.86	21.37

Table 2. Population Dynamics of BSFB on first sowing date 20 November 2021

Weeks	Mean Atmospheric Temperature(^{0}C)	Mean Relative Humidity (%)	Total Rainfall (mm)	Shoot damage (%)	Bright sunshine hour	Fruitdamage (%)
44	27.35	73.00	0.0	0.0	2.0	0.0
45	26.05	71.00	0.0	0.0	7.3	0.0
46	25.65	84.00	51.7	0.0	1.1	0.0
47	26.95	77.00	30.9	0.0	4.5	0.0
48	23.70	87.50	0.0	0.0	6.3	0.0
49	22.10	88.00	70.8	0.0	2.7	0.0
50	21.50	72.50	1.0	0.0	4.3	0.0
51	17.85	75.50	0.0	0.0	7.4	0.0
52	21.35	86.00	0.8	0.0	4.2	0.0
1	19.60	84.50	0.0	2.23	7.3	0.0
2	21.20	67.00	16.5	4.11	5.0	0.0
3	20.15	60.50	0.0	5.04	6.0	0.0
4	22.20	68.00	12.6	8.19	3.9	3.67
5	21.45	81.50	0.0	11.10	9.0	7.29
6	22.25	80.50	0.0	4.56	7.1	11.85
7	22.10	84.50	1.1	3.53	6.6	16.18
8	25.45	82.50	40.0	2.56	1.3	19.16
9	26.55	81.50	0.0	2.16	6.6	27.07
10	27.65	80.00	0.0	1.24	5.9	17.34

Table 3. Population Dynamics of BSFB on first sowing date 21 January 2022

Weeks	Mean Atmospheric Temperature(^{0}C)	Mean Relative Humidity (%)	Total Rainfall (mm)	Bright sunshine hour(hr)	Shoot damage (%)	Fruit damage (%)
3	20.15	60.50	0.0	6.0	0.0	0.0
4	22.20	68.00	12.6	3.9	0.0	0.0
5	21.45	81.50	0.0	9.0	0.0	0.0
6	22.25	80.50	0.0	7.1	0.0	0.0
7	22.10	84.50	1.1	6.6	0.0	0.0
8	25.45	82.50	40.0	1.3	0.0	0.0
9	26.55	81.50	0.0	6.6	0.0	0.0
10	27.65	80.00	0.0	5.9	0.0	0.0
11	29.30	80.00	0.0	5.5	11.01	0.0
12	29.65	82.00	0.0	1.1	17.37	0.0
13	30.70	85.00	0.0	4.5	24.49	0.0
14	30.05	85.50	0.0	5.4	34.5	21.36
15	31.00	82.00	0.0	6.6	33.67	29.34
16	31.65	86.00	0.0	6.7	43.92	39.49
17	34.10	84.50	0.0	6.8	51.41	47.34
18	31.65	84.00	57.4	5.2	57.99	42.99
19	30.35	89.50	46.7	5.4	53.19	52.60
20	31.70	87.00	0.0	6.6	51.87	62.50
21	30.40	84.00	77.8	6.1	47.67	63.84

Similar observations were also made by Singh et al. (2009) where L. orbonalis infested the crop shoots during the end of August (73.33%), peaking (86.66%) in the third week of September with an intensity of 2.09 per plant. The result of the present study is close to those of the findings of Naresh et al. [9] who observed the peak activity of BSFB during May. On the contrary Atwal and Verma [10], Ahmad [11] reported that temperature range of 25.0^{o}C to 30^{o}C and RH between 70-90 % is most favourable for the development and survival of the pest. It was also in the agreement with the findings of Patel et al. [12] who recorded that infestation by shoot and fruit borer started from last week of February and ended in third week of April with maximum shoot infestation (8.42%) in fourth week of march and the incidence on fruit was noticed at first picking of the crop in the last week of march with a maximum (32.36%) in the first week of June. Similar results were also seen in a study by Mannan et al. [13] where the shoot infestation was only 1.33% in January which then started to increase steadily up to the month of September and fruit infestation was 5.26% in the month of January (minimum),that slightly increased in the month of February and there was a sharp increase in the month of March reaching 31.27% The present investigation was also in accordance with Ara et al. [14] who reported maximum shoot (1.44 per plant) and fruit damage (0.74 per plant) at the 2nd week of March in "Laffa" variety. In "Dohazari" variety maximum shoot damage (1.55 per plant) and fruit damage (0.46 per plant) were recorded at 2nd week of March and 4th week of February, respectively. In variety Uttara, maximum fruit damage (0.24per plant) was recorded in first week of March. The findouts of present experiment is also close to the observations of Singh et al. [15] where the peak infestation occured in the month of June (29.45%) and 4th week of May (25.24%) during the first and second cropping season, respectively.

However, the present investigation was in disagreement with Murthy (2001) who found that the pest was relatively more during the month of September under protected condition. Similar observation was also found by Singh et al. [16] where *L. orbonalis* infested the crop shoot during the end of August (73.33%), peaking(86.66%)in the third week of September with an intensity of 2.09 per plant. Gosh and Senapati [17] also reported that peak infestation of the borer was recorded in mid-June on brinjal. It can be inferred that many of the earlier worker have recorded the incidence of shoot and fruit borer throughout the year in different regions of South East Asia [10,18,1] and the peak population of Brinjal shoot and fruit borer varies with the season. Hence the slight variation in the present investigation might be due to prevailing weather condition and location of the area. The shoot infestation exhibits positive correlation but non-significant with mean atmospheric temperature (r = 0.368). The fruit infestation exhibit positive correlation but non-significant with relative humidity(r = 0.27) on first sowing date. On second sowing date the shoot infestation shows positive correlation with mean atmospheric temperature(r = 0.84), relative humidity (r = 0.56), rainfall(r = 0.42) but with relative humidity and rainfall shows positive significance (0.05%).

4. CONCLUSION

Based on the findings of present study it is concluded that the population of BSFB fluctuates with change in temperature, rainfall and relative humidity. On first sowing date BSFB population has a less population dynamics comparatively to second sowing date. The second sowing date shows tremendous increase of population and the damage percentage increased rapidly.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mall NP, Pandey RS, Singh SV, Singh SK. Seasonal incidence of insect-pests and estimation of the losses caused by shoot and fruit borer on brinjal. Indian Journal of Entomology. 1992;54(3):241-247.
2. Singh SV, Singh KS, Malik YP. Seasonal abundance and economic losses of shoot and fruit borer, *Leucinodes orbonalis* on brinjal. Indian Journal of Entomology. 2000;62(3):247-252.
3. Peswani KM, Lal R. Estimation of loss of brinjal fruits caused by shoot and fruit borer (*Leucinodes orbonalis* Guen.). Indian Journal of Entomology. 1964;26(1):112.
4. Krishnaiah K. Assessment of crop losses due to pests and diseases. In: Govindu HC (ed) University of Agricultural Sciences Technology Series. 1980;33:259- 267.
5. Dhankhar BS. Progress in resistance studies in the eggplant (*Solanum melongena* L.) against shoot and fruit borer

(*Leucinodes orbonalis* Guen.) infestation. Tropical Pest Management. 1988;34(3): 343−354.

6. Kumar NK, Kumari BK, Singh HS, Ranganath HR, Shivakumara B, Kalleshwaraswamy CM. Pheromone trapping protocols for brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae): evaluation of trap design, quantity and dispenser. Journal of Horticultural Sciences. 2006;1(1):39-43.
7. Campos EV, De Oliveira JL, Pascoli M, De Lima R, Fraceto LF. Neem oil and crop protection: from now to the future. Frontiers in plant science. 2016;7:1494.
8. Kaur J, Kang BK, Singh B. Baseline data for insecticide resistance monitoring in Brinjal shoot and fruit borer, *Leucinodes Orbonalis* Guenee. The Bioscan. 2014; 9(4):1395-1398.
9. Naresh JS, Malik VS, Balan JS, Khokhar KS. A new record of Trathala sp., a larval endoparasite attacking brinjal fruit borer, *Leucinodes orbonalis* Guenee. Bulletin of Entomology (New Delhi). 1986; 27(1).
10. Atwal AS, Verma ND. Development of *Leucinodes orbonalis* Guen. (Lepidoptera: Pyraustidae) in relation to different levels of temperature and humidity. Indian Journal of Agricultural Science.1972;42(9): 849-854.
11. Ahmad R. Studies on the pests of brinjal and their control with special reference to fruit borer, *Leucinodes orbonalis* Guenee (Pyralididae: Lepidoptera). Entomologists' Newsletter. 1977;1(4):2-3.
12. Patel LC, Konar AM, Sahoo CS. Biophysical screening of brinjal genotype s against fruit and shoot borer, *Leucinodes orbonalis* (GUEN). The bioscan. 2015;10: 905-909.
13. Mannan MA, Islam KS, Jahan M. Brinjal shoot and fruit borer infestation in relation to plant age and season. Bangladesh Journal of Agricultural Research. 2015; 40(3):399-407.
14. Ara S, Nahar N, Rahman M. Incidence and damage estimation of brinjal shoot and fruit borer in five different brinjal varieties. Progressive Agriculture. 2007; 18(2):75-80.
15. Singh RK, Singh TK, Shah MA. Population incidence of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen (Lepidoptera: Pyralidae) in Manipur. Journal of Experimental Zoology. 2011; 14(1):229-232.
16. Singh RK, Devjani P, Singh TK. Population dynamics of *Leucinodes orbonalis*. Annals of Plant Protection Sciences. 2009;17(2):486-487.
17. Ghosh SK, Senapati SK. Biology and seasonal fluctuation of *Henosepilachna vigintioctopunctata* Fabr. on brinjal under Terai region of West Bengal. Indian Journal of Agricultural Research. 2001; 35(3):149-154.
18. Mehto DN, Singh KM, Singh RN. Dispersion of *Leucinodes orbonalis* Guen. during different seasons. Indian Journal of Entomology. 1980;42:539-540.

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