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Population Dynamics of Shoot and Fruit Borer, *Leucinodes orbonalis* Guenee infesting Brinjal and its Natural Enemy, *Trathala flavo-orbitalis* in context with Weather Parameters at Bhubaneswar, Odisha

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ABSTRACT: A field experiment was carried out in the research farm of Department of Entomology, OUAT, Bhubaneswar during 2021-22 to study the population fluctuation of shoot and fruit borer of brinjal and its natural enemy *Trathala flavo-orbitalis*. The results revealed that the infestation of shoot and fruit borer recorded two distinct peaks in different growing seasons of study period, 2021-22. During summer 2021,rabi 2021-22 and kharif 2022, the peaks of larval intensity were recorded on 18th (8.73 larvae/Plant/week) and 24th (7.17 larvae/Plant/week) SMW, 12th (5.54 larvae/Plant/week) and 17th (6.86 larvae/Plant/week) SMW and 36th (7.72 larvae/Plant/week) and 42nd (6.48 larvae/Plant/week) SMW respectively. All the temperature factors (maximum, minimum and average) were found to be positively correlated with the population density and infestation of this pest during the three seasons of study period. Morning relative humidity was found to have a negative influence. During summer 2021, wind velocity (Correlation coefficient=0.764) and pan evaporation (r=0.663) showed significant positive correlation with pheromone trap catch. The parasitisation of natural enemy, *T.flavo-orbitalis* had significant positive correlation with all temperature factors during rabi season and non- significant positive correlation during summer and kharif seasons. Also, during summer, morning relative humidity showed significant negative correlation (r=-0.594) with parasitisation whereas afternoon relative humidity had positive significant correlation (r=0.668) during rabi season. Pan evaporation was found to be positively correlated (0.680) during rabi, 2021-22. Among the studied weather parameters, temperature, relative humidity and pan evaporation had maximum contribution towards the population of brinjal shoot and fruit borer.

Keywords: Brinjal Shoot and Fruit borer, Bhubaneswar, Weather parameters, Population dynamics, *Trathala flavo-orbitalis.*

INTRODUCTION

India is the second largest producer of vegetables in the world, but lose of vegetables is about 12% which results in significant reduction in Indian agricultural economy (Manunayaka *et al*., 2020). The major issue of vegetable production are high cost of management for pests and diseases, lower market price, high input price, lack of high yielding variety seedling, lack of proper cold storage structures and loss due to natural calamity (Azad *et al*., 2014). Brinjal (*Solanum melongena*) also called as eggplant belongs to family solanaceae and grown and consumed worldwide in hot and wet climatic situation (Hanson *et al*., 2006). This vegetable is grown throughout the year in India. A group of insect pests attacks this crop, out of which brinjal shoot and fruit borer (*Leucinodes orbonalis*) is the most serious one (Sardana *et al*., 2004). This pest causes considerable damage to brinal crop which limits the profit of the farmers to a great extent. The yield loss may reach up to 85-90 per cent (Mishra, 2008) and may cause 100% damage if no control measures are applied (Rahman, 2007). Due to concealed nature of pest, farmers face much difficulty in controlling this pest.

Meteorological parameters play an important role in the biology of any pest and temperature is the most crucial one which influences the life cycle of the pests including population density. Among the other factors, rainfall, relative humidity, evaporation, and wind speed play a greater role in deciding the population of the pest in particular region. The success of any crop depends on its adaptability to the ambient environment including the soil and escape/tolerate to pests which includes insects, diseases, and weeds (Rao and Bhabani 2010), The best way to avoid pest outbreak is possible only when the congenial weather condition for insect pest infestation is fully known (Dubey and Thorat 1994). The incidences of this insect pest occur either sporadically or in outbreaks every year in the Indian subcontinent (Dhankar, 1988). In view of this as reported by Gangawar and Sacher (1981), the losses caused by brinjal pests vary from season to season depending upon the environmental factors. So early detection of the pest and adoption of deliberate plant protection measures just before its peak activity is highly essential to minimize the loss in marketable fruit yield in brinjal. Use of sex pheromone traps are gaining popularity to monitor the seasonal activity of *L. orbonalis* to schedule the appropriate time of plant protection measures (Tiwari *et al*., 2009). It is a fact that natural enemy has an important role in reducing the pest population in the field. So, the present study was carried out to know the population fluctuation of brinjal shoot and fruit borer and its natural enemy in brinjal ecosystem and the most influential weather factors that insists the pest population.

MATERIAL AND METHODS

The experiment was carried out in the research farm of Dept. of Entomology, OUAT, Bhubaneswar during the period 2021-22 with in a gross plot area of 150 m^2 at a spacing of 75 cm × 60 cm. The brinjal variety Akshita was grown with the recommended agronomic practices. No application measures were taken up except the removal of damaged shoots and fruits at the time of data collection. The environmental factors like maximum temperature, minimum temperature, average temperature relative humidity (morning and afternoon), rainfall, wind velocity and pan evaporation were recorded from the automated weather station, OUAT, Bhubaneswar. For recording the observations, 20 plants were selected randomly. The population fluctuation of *L.orbonalis* was monitored by installing pheromone traps in the plot and the trap catches were recorded daily as number of male moths per trap per day and eventually converted to weekly basis. Weekly larval population of BSFB from all sources viz. shoot, flower and fruit were recorded and expressed as larval intensity. Besides week wise incidence of pest (floral damage, fruit damage both number and weight basis) was recorded from 20 randomly selected plants. The activity of natural enemy (*Trathala flavo-orbitalis*) of BSFB during the entire period of study was observed in the laboratory after dissecting the infested materials. Ten BSFB larvae each from the damaged shoots, floral buds and fruits, collected from the experimental plot were maintained separately to study the extent of parasitisation by *T.flavo-orbitalis*. The population of *T. flavo-orbitalis* was recorded during the entire study period 2021-22. The weather variables were subjected to multiple correlation analysis with the trap catch, larval intensity, floral bud damage, parasitisation and fruit damage (both number and weight basis) to study their relationship whereas, regression analysis was taken up to determine the contribution of each weather parameter on the seasonal activity and damage. In all the cases of analysis, the weather variables prevailed during the previous standard week were correlated and regressed with the population and damage level recorded in the succeeding week.

RESULTS AND DISCUSSION

A. Seasonal fluctuation in abundance and infestation of BSFB

The seasonal activity *of L. orbonalis* in terms of adult moth population trapped in the traps, the corresponding larval population in terms of larval intensity, infestation expressed as floral bud damage and fruit damage in different standard weeks has been studied and presented in Table 1-3. During summer, 2021 (Table 1) the adult male moth of BSFB first appeared during 11th SMW (2nd week of March) and thereafter the pest attained its first larger peak during 17th SMW (4th week of April) with an average of 13.26 male adult catch/trap/week. Then the population catch showed a diminishing trend and it again attained the second small peak during 23rd SMW (1st week of June) with average 10.86 adult/trap/week and thereafter the adult trap catch showed a declining trend with a very low level of population during the final harvesting stage. Samal (2008) also reported that under Bhubaneswar condition, the pheromone trap catches showed two distinct peaks i.e. on 15th SMW (9.5 adults/trap/week) and on 19th SMW (10.7 male adults/trap/week).During rabi, 2021-22 (Table 2), the pest attained its first peak during 11th SMW (2nd week of March) with 9.54 male adult catch/trap/week and the second peak attained during 16th SMW (3rd week of April) with 10.14 male adult catch/trap/week. During kharif 2022 (Table 3) the pest attained its first peak during 35th SMW (last week of August) with 11.65 male adult catch/trap/week and a second smaller peak was attained during 41st SMW (2nd week of October) with 9.24 male adult catch/trap/week. Work of Shah *et al*., (2011) follows in the same line where pheromone trap catch recorded two distinct peaks: the first one being 2nd week of August and the second during 4th week of November. However, the peak larval intensity was recorded one week after the peak adult trap catch. Also, the results of Kharif, 2022 is in proximity with Tiwari *et al*. (2009) who recorded that the population level of adult male moth was highest during 38th SMW and 43rd SMW. The first and second peak of larval intensity was 8.73 and 7.17 during summer, 5.54 and 6.86 during rabi and 7.72 and 6.48 during kharif season. The initial floral buds infestation was observed for the first time during 14th, 4th and 28th SMW in summer, rabi and kharif season respectively. The first peak of floral bud damage was attained during 18th (45.67 %), 12th (34.65 %), 36th (40.66 %) SMW and the second peak during 24th (38.69 %), 17th (39.43%) and 42nd (34.64 %) SMW during the above period. The peak value of fruit infestation (number basis) recorded during 18th and 24th SMW during summer 2021 with 77.48% and 73.52 % infestation and during rabi, 2021-22 the same was observed on 12th and 17th SMW with 62.26 % and 66.42% fruit infestation. During kharif the two peaks were 71.34 % and 67.35% on 36th and 42nd SMW respectively. Yadav *et al*. (2015)

reported that the highest percent fruit infestation of shoot and fruit borer was recorded on 43rd and 44th standard week. The two peaks of parasitisation by *T.flavo-orbitalis* was 24.43 % and 19.97 % during summer,16.98 % and 22.42 % during rabi and 22.60 % and 18.78 % during kharif season. Mourya *et al*. (2023) reported that the whitefly and jassid population in brinjal cultivation showed positively non-significant correlation with the maximum and minimum temperature and non-significant correlation with morning relative humidity, evening relative humidity and rainfall.

B. Correlation of weather parameters with the seasonal incidence and infestation of Brinjal shoot and fruit borer

The data related to the correlation of weather parameters with percent fruit damage by brinjal shoot and fruit borer and its natural enemy was studied during the period 2021-22.The data of summer, 2021 is presented in Table 4 which revealed that the pheromone trap catch had significant positive correlation with average temperature (Correlation coefficient, r= 0.613) and during rabi 2021-22, maximum, minimum and average temperature had significant positive correlation (r=0.865, 0.687, 0.784) where as non-significant positive correlation was found during kharif (r=0.017, 0.342, 0.259).Significant negative correlation was observed with morning relative humidity during summer (r = - 0.681) and non-significant positive correlation was observed during kharif (r = 0.280). Rainfall had non-significant negative correlation with pheromone trap catch. During summer season pan evaporation and wind velocity found to have strong positive correlation (r =0.663, 0.764). As concerned to fruit damage, maximum, minimum and average temperature exerted positive correlation whereas very less impact of relative humidity and rain fall was observed. Pan evaporation and wind velocity were positively correlated with fruit damage. Similarly data in Table 5 indicated that a strong positive relationship has been existed between the temperature variables and parasitisation by *Trathala flavo-orbitalis* during rabi season (0.966,0.874 and 0.941) and non-significant positive correlation was observed during both summer and kharif season. Strong positive correlation was observed between pheromone trap catch and larval intensity (r = 0.844, 0.821, 0.918) and larval intensity and parasitisation (r = 0.876, 0.607, 0.875) during summer, rabi and kharif season respectively. Earlier reports suggest that there is a positive association of pest population with maximum temperature and minimum temperature (Nayak *et al*., 2012; Anwar *et al*., 2017; Mathur *et al*., 2012; Singh *et al*., 2011).

C. Multiple interactions of weather parameters with the seasonal incidence and infestation of BSFB

It is revealed from the Table 6 that during summer 2021, the coefficient of determination (R^2) value for pheromone trap catch was 0.904 which indicates that 90.4% variation in adult trap catch was caused due to abiotic factors .It was also found that among all the weather parameters major contribution was made by pan evaporation (33.58 %) followed by rain fall (17.14 %) and relative humidity (after noon-14.89%).During rabi 2021-22, the coefficient of determination (R^2) was computed 0.912 with the highest contribution was from maximum temperature (48.89%) followed by pan evaporation (10.74%).However, other factors had negligible contribution towards the fluctuation of adult trap catch. In kharif 2022, the R^2 recorded was 0.670 with the highest contribution from average temperature (43.67%) followed by minimum temperature (30.66%) and the third highest contribution was from the maximum temperature (22.37 %). Similarly (Table 7) the larval population of *L. orbonalis* was also significantly influenced by various weather factors and the coefficient of determination (R^2) was found to be 0.801, 0.844 and 0.516 during summer, rabi and kharif season respectively. In respect to relative importance of weather parameters, maximum, minimum and average temperature contributed the most towards the larval intensity. As far as the combined effect of flower bud damage is concerned all the weather parameters governed the flower bud damage to the tune of 95.4 % during rabi season. In all the seasons the temperature had an important contribution. The collective impact of all-weather parameters on fruit damage (weight basis) (Table 8) was estimated to be 45.6%, 95.8% and 61.7% during summer, rabi and kharif season respectively. During kharif season, pan evaporation and relative humidity had significant contribution including average temperature. But during summer and rabi season maximum and minimum temperature had important contribution towards fruit damage. As far as the parasitisation *by T. flavo-orbitalis* is concerned, coefficient of determination (R^2) value was highest i.e. 0.981 during rabi season and maximum temperature exerted maximum influence 62.24 %.During summer season the contribution of maximum and average temperature was found to be 41.29 % and 35.23 % where R^2 recorded 0.689.The findings of the experiment are in line with the findings of Pramanik (2010) who observed that during the year maximum and minimum temperature produced major contribution on fruit damage in brinjal. Maru and Kumar (2018) observed that the contribution of all the weather factors on larval incidence was 70.30% whereas, on fruit damage it was 76.7%.

Table 1: Seasonal incidence of *Leucinodes orbonalis* and the extent of parasitisation by *Trathala flavo-orbitalis* at Bhubaneswar during summer, 2021.

Standard week	Pheromone traps catch (No. /trap/week)	Larval Intensity (Av. No. / plant / week)	Floral bud damage (%)	Fruit damage (%) (number basis)	Fruit damage (%) (weight basis)	Parasitisation (%)
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	4.63	-	-	-	-	-
12	5.23	2.84	-	-	-	-
13	6.46	4.63	-	-	-	-
14	7.18	4.65	15.46	-	-	6.52
15	7.72	4.18	25.96	-	-	8.21
16	11.31	6.12	32.76	56.36	59.35	15.18
17	13.26	7.74	42.13	59.86	62.53	19.97
18	11.58	8.73	45.67	77.48	79.16	24.43
19	11.34	6.32	38.98	64.32	66.26	22.76
20	11.21	6.53	34.83	70.72	73.02	23.25
21	10.63	5.86	32.51	71.54	73.28	18.42
22	10.34	5.04	29.34	71.14	73.54	16.63
23	10.86	6.17	30.23	70.26	71.34	17.21
24	9.25	7.17	38.69	73.52	76.48	19.97
25	8.16	6.14	32.78	66.26	69.26	13.97
26	7.82	5.21	29.85	68.82	71.48	13.42
27	7.24	3.86	28.53	65.94	67.48	10.86
28	6.12	3.62	23.28	54.68	58.86	7.87
29	5.34	3.37	15.58	52.46	55.37	6.74
30	4.12	2.12	10.26	42.03	44.85	3.62

Table 2: Seasonal incidence of *Leucinodes orbonalis* and the extent of parasitisation by *Trathala flavo-orbitalis* at Bhubaneswar during Rabi, 2021-22

Standard week	Pheromone trap catch (No./trap/week)	Larval Intensity (Av. No./plant/week)	Floral bud damage (%)	Fruit damage (%) (number basis)	Fruit damage (%)(weight basis)	Parasitisation (%)
51	-	-	-	-	-	-
52	-	-	-	-	-	-
1	3.14	-	-	-	-	-
2	4.31	3.72	-	-	-	-
3	4.47	3.83	-	-	-	-
4	5.12	3.92	12.25	-	-	1.21
5	5.43	4.32	18.54	-	-	3.48
6	5.85	4.59	18.87	-	-	5.47
7	6.14	4.76	20.34	37.83	41.27	6.87
8	6.28	4.87	25.87	38.84	46.86	10.43
9	7.54	5.13	26.42	43.52	47.21	11.98
10	8.64	5.16	28.54	52.94	56.52	12.53
11	9.54	5.34	30.32	56.85	61.68	14.24
12	7.11	5.54	34.65	62.26	65.38	16.98
13	6.86	5.21	29.52	56.16	59.26	15.62
14	6.56	5.17	25.72	50.74	55.4	13.46
15	7.08	5.32	26.05	55.62	59.28	13.32
16	10.14	5.46	35.86	58.75	63.53	15.72
17	9.96	6.86	39.43	66.42	69.24	22.42
18	8.12	4.86	28.18	56.96	60.59	19.76
19	6.43	4.52	26.87	51.56	53.82	16.21
20	6.24	3.81	19.47	51.43	55.46	15.35

Table 3: Seasonal incidence of *Leucinodes orbonalis* and the extent of parasitisation by *Trathala flavo-orbitalis* at Bhubaneswar during Kharif 2022.

Standard week	Pheromone trap catch (No./trap/week)	Larval Intensity (Av.No./plant/week)	Floral bud damage (%)	Fruit damage (%) (number basis)	Fruit damage (%)(weight basis)	Parasitisation (%)
23	-	-	-	-	-	-
24	-	-	-	-	-	-
25	2.86	-	-	-	-	-
26	5.34	3.26	-	-	-	-
27	5.54	3.48	-	-	-	-
28	6.26	4.52	8.86	-	-	3.42
29	6.86	4.85	13.53	-	-	5.48
30	6.24	4.88	16.87	29.58	33.72	8.64
31	8.86	5.62	22.21	41.52	46.42	12.34
32	7.67	5.84	24.85	44.64	48.82	15.87
33	7.43	6.14	27.63	48.15	53.26	15.48
34	8.86	6.72	36.87	57.72	61.23	17.26
35	11.65	7.63	36.75	65.37	69.82	18.86
36	10.24	7.72	40.66	71.34	74.64	22.60
37	8.23	6.84	33.75	61.68	64.32	17.82
38	8.46	6.45	32.87	60.54	64.86	16.64
39	8.78	6.23	32.58	58.48	63.63	14.53
40	7.15	5.64	31.54	57.63	61.8	14.76
41	9.24	6.09	29.64	61.53	63.47	16.75
42	8.24	6.48	34.64	67.35	69.43	18.78
43	6.87	5.06	25.43	56.48	59.64	13.32
44	5.32	4.24	23.53	47.42	51.42	10.34
45	4.16	3.94	22.06	43.73	45.36	9.29

Table 4: Correlation between various weather parameters with pheromone trap catch of shoot and fruit borer of brinjal (*Leucinodes orbonalis*) during the study period (2021-2022) at Bhubaneswar.

Weather parameters	Correlation coefficient (r)		
	Summer, 2021	Rabi, 2021-22	Kharif, 2022
Max. Temp.	0.352	0.865**	0.017
Min. Temp.	0.424	0.687**	0.342
Av. Temp.	0.613**	0.784**	0.259
Relative humidity (Morning)	-0.681**	-0.044	0.280
Relative humidity (Afternoon)	-0.177	0.436	0.398
Rain Fall	-0.059	-0.026	-0.051
Pan evaporation	0.663**	0.428	-0.328
Wind velocity	0.764**	0.443	-0.130

**significant at 1% level

Table 5: Correlation between various weather parameters with parasitisation by *Trathala flavo-orbitalis* during the study period (2021-2022) at Bhubaneswar

Weather parameters	Correlation coefficient (r)		
	Summer, 2021	Rabi, 2021-22	Kharif, 2022
Max. Temp.	0.150	0.966**	0.278
Min. Temp.	0.208	0.874**	0.204
Av. Temp.	0.232	0.941**	0.297
Relative humidity (Morning)	-0.594**	-0.300	0.043
Relative humidity (Afternoon)	-0.178	0.668**	0.098
Rain Fall	0.045	0.194	-0.247
Pan evaporation	0.442	-0.268	-0.047
Wind velocity	-0.259	0.680**	-0.059

**significant at 1% level

Table 6: Contribution of weather parameters on pheromone trap catch *of Leucinodes orbonalis* during different seasons of study period (2021-22).

Seasons	Coefficients of determination (R^2)	Prediction multiple regression equation	Per cent Contribution *							
			Max. Temp. (ºC) (X_1)	Min. Temp. (ºC).	Avg. Temp. (ºC) (X_3)	RH (%) (Morning) (X_4)	RH (%) (Afternoon) (X_5)	Rain Fall (mm) (X_6)	Wind Velocity (Km/h) (X_7)	Pan Evaporation (mm) (X_8)
Summer, 2021	0.904	$Y=21.896-0.259X_1+1.124X_2-0.760X_3-0.184X_4-0.101X_5+0.042X_6-0.203X_7+1.910X_8$	5.49 (-0.183)	13.81 (0.046)	7.83 (-0.261)	4.11 (-0.137)	14.89 (-0.496)	17.14 (0.571)	3.15 (-0.105)	33.58 (1.119)
Rabi, 2021-22	0.912	$Y=-32.604+0.774X_1-0.310X_2+0.268X_4-0.011X_5-0.005X_6+0.065X_7-1.164X_8$	48.89 (1.825)	22.90 (-0.855)	-	4.71 (0.176)	2.41 (-0.090)	1.26 (-0.047)	9.08 (0.339)	10.74 (-0.401)
Kharif,2022	0.670	$Y=6.565-22.269X_1-22.235X_2+44.638X_3-0.275X_4+0.272X_5-0.010X_6-0.369X_7+0.476X_8$	22.37 (-14.02)	30.66 (-19.21)	43.67 (27.36)	0.54 (-0.339)	1.58 (0.989)	0.35 (-0.222)	0.51 (-0.318)	0.32 (0.199)

Y=Pheromone trap catch

X_1 = Maximum Temperature (ºC), X_2 = Minimum Temperature (ºC), X_3 = Average Temperature (ºC), X_4 = Morning Relative Humidity (%)

X_5 = Afternoon Relative Humidity (%), X_6 = Rain Fall (mm), X_7 = Wind Velocity (Km/h), X_8 = Pan Evaporation (mm)

*Contribution of different weather parameters to pheromone trap catch

(Figures in the parentheses are the standardized partial regression coefficient values, β)

Table 7: Contribution of weather parameters on larval intensity (Average larval population/plant/week) of *Leucinodes orbonalis* during different seasons of study period (2021-22).

Seasons	Coefficients of determination (R^2)	Prediction multiple regression equation	Per cent Contribution *							
			Max. Temp. (ºC) (X_1)	Min. Temp. (ºC). (X_2)	Avg. Temp. (ºC) (X_3)	RH (%) (Morning) (X_4)	RH (%) (Afternoon) (X_5)	Rain Fall (mm) (X_6)	Wind Velocity (Km/h) (X_7)	Pan Evaporation (mm) (X_8)
Summer,2021	0.801	$Y=-5.451+3.572X_1+3.102X_2-6.847X_3+0.073X_4+0.042X_5+0.003X_6-0.138X_7+0.615X_8$	36.71 (4.859)	15.68 (2.075)	33.77 (-4.469)	0.76 (0.101)	2.92 (0.386)	0.56 (0.074)	1.05(-0.139)	8.55 (1.132)
Rabi,2021-22	0.844	$Y=-11.338+0.326X_1-0.142X_2+0.110X_4+0.001X_5-0.007X_6+0.025X_7-0.531X_8$	47.22 (1.817)	23.75 (-0.914)	-	4.29 (0.165)	0.34 (0.013)	4.18 (-0.161)	8.29 (0.319)	11.93 (-0.459)
Kharif,2022	0.516	$Y=7.936-12.410X_1-12.292X_2+24.752X_3-0.158X_4+0.154X_5-0.011X_6+0.104X_7-0.221X_8$	21.18 (-11.52)	31.89 (-17.35)	43.46 (23.65)	0.59 (-0.321)	1.68 (0.917)	0.73 (-0.395)	0.21 (0.117)	0.26 (-0.143)

Y = Larval intensity

X_1 = Maximum Temperature (ºC), X_2 = Minimum Temperature (ºC), X_3 = Average Temperature (ºC), X_4 = Morning Relative Humidity (%)

X_5 = Afternoon Relative Humidity (%), X_6 = Rain Fall (mm), X_7= Wind Velocity (Km/h), X_8= Pan Evaporation (mm)

*Contribution of different weather parameters to larval intensity

(Figures in the parentheses are the standardized partial regression coefficient values, β)

Table 8: Contribution of weather parameters on fruit damage (weight basis) by *Leucinodes orbonalis* during different seasons of study period (2021-22).

Seasons	Coefficients of determination (R^2)	Prediction multiple regression equation	Per cent Contribution *							
			Max.Temp. (ºC) (X_1)	Min. Temp. (ºC). (X_2)	Avg. Temp. (ºC) (X_3)	RH (%) (Morning) (X_4)	RH (%) (Afternoon) (X_5)	Rain Fall (mm) (X_6)	Wind Velocity (Km/h) (X_7)	Pan Evaporation (mm) (X_8)
Summer,2021	0.456	$Y=194.00+73.457X_1+79.508X_2-156.24X_3-0.005X_4-0.617X_5+0.161X_6-0.853X_7+5.090X_8$	38.46 (17.831)	13.54 (6.278)	41.67 (-19.317)	0.001 (-0.001)	1.83 (-0.847)	1.67 (0.773)	0.36 (-0.167)	2.47 (1.145)
Rabi,2021-22	0.958	$Y=-61.650+2.954X_1+0.405X_2+0.195X_4-0.013X_5-0.035X_6-0.055X_7-2.962X_8$	65.75 (0.979)	11.82 (0.176)	-	1.54 (0.023)	0.40 (-0.006)	4.50 (-0.067)	3.63 (-0.054)	12.36 (-0.184)
Kharif,2022	0.617	$Y=158.674-1.195X_1+7.032X_3-3.301X_4+1.063X_5-0.098X_6+3.319X_7-12.546X_8$	3.03 (-0.132)	-	18.84 (0.820)	19.32 (-0.841)	18.36 (0.799)	9.74 (-0.424)	9.63 (0.419)	21.09 (-0.918)

Y=Fruit damage on weight basis (%)

X_1 = Maximum Temperature (ºC), X_2 = Minimum Temperature (ºC), X_3 = Average Temperature (ºC), X_4 = Morning Relative Humidity (%)

X_5 = Afternoon Relative Humidity (%), X_6= Rain Fall (mm), X_7 = Wind Velocity (Km/h), X_8 = Pan Evaporation (mm)

*Contribution of different weather parameters to fruit damage (weight basis)

(Figures in the parentheses are the standardized partial regression coefficient values, β)

CONCLUSIONS

The correlation studies revealed that the damage by *Leucinodes orbonalis* showed positive correlation with maximum temperature, minimum temperature and average temperature while negative correlation with morning relative humidity. The wind velocity and evaporation showed positive association whereas rainfall has non-significant impact on incidence of shoot and fruit borer of brinjal. As concerned to correlation of weather parameters with parasitisation by *Trathala flavo-orbitalis*, all the temperature factors had positive correlation. The coefficient of determination for fruit damage percent (weight basis) was found to be 0.456 to 0.958 which indicates that the climatic factors together were able to explain the impact of 45.60 to 95.80 % in different seasons of study period, 2021-22.

FUTURE SCOPE

The continuous research on seasonal incidence of brinjal shoot and fruit borer is important for the sustainable production of the crop. A better understanding of the life cycle and it's interaction with various weathers parameters are very important for better management of the pest. Also development of valid mathematical model for long range forecasting of *Leucinodes orbonalis* based on pheromone trap catch over years is very much necessary.

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Conflict of Interest. None.

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