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To study of pest incidence and occurrences of shoot and fruit borer (*Leucinodes orbonalis*) on brinjal during *kharif* season (2019-20)

Sanket Shekhar Mahajan, Anand N Warghat, Anoorag R Tayde, Tushar S Deshmukh and Brajrajsharan Tiwari

Abstract
To study the pest incidence of shoot and fruit borer, *Leucinodes orbonalis*, Guenee on brinjal during *kharif* season of 2019. Studies on the incidence of shoot infestation of *Leucinodes orbonalis* Guenee 2019 *Kharif* season was commenced from 32nd standard week (August first week) on shoot with an average 0.32% infestation. The borer population increased and gradually reached peak level of 34.62% of larval population at 42nd standard week (October third week) and decline in the trend was noticed this may be due to fail in congenial weather parameters. The pest builds up was correlating with max temperature and declined as it falls followed by the incidence of fruit infestation of *Leucinodes orbonalis* Guenee 2019 *Kharif* season commenced from 35th standard week (Last week of August) on shoot with an average 0.83% infestation. The borer population increased and gradually reached peak level of 41.28% of larval population at 46th standard week (second week of November) and decline in the trend was noticed this may be due to fail in congenial weather parameters and it was found that the pest builds up on shoot was negatively correlated with maximum temperature (r = -0.3314) and sun shine hours (r = -0.0905). However, it was positive correlated with relative humidity (r = 0.0963). Where, as per cent fruit infestation had negative correlated with maximum temperature (r = -0.5170) and sun shine hours (r = -0.1279); whereas it had negative correlated with relative humidity (r = -0.0291).

Keywords: Pest, occurrences, seasonal incidences, *kharif*, to study, brinjal, *Leucinodes orbonalis* Guenee, shoot and fruit borer, Prayagraj

1. Introduction
"Brinjal is the king of vegetables". Brinjal occupies an important position among the other regular vegetable crops that are available throughout the year and popular vegetable grown as a poor man's crop in India. Brinjal, *Solanum melongena* L. is one of the major vegetables in India extensively grown under diverse agro-climatic conditions throughout the year. brinjal (*Solanum melongena* L.) is one of the most important solanaceous vegetables in south-east Asian countries including India, Bangladesh, Sri Lanka, China, Japan etc. It is a native of Indo-Burma region, and was known to be grown in India since ancient times. The major brinjal growing states in India are, Andhra Pradesh, Karnataka, West Bengal, Tamil Nadu, Maharashtra, Orissa, Uttar Pradesh, Bihar and Rajasthan. India produces about 13.44 M mt of brinjal from an area of 0.722 M ha with an average productivity of 18.6 mt/ha (Indian Horticulture Database 2013). It is reported to be attacked by about 140 species of insect pests, of which the shoot and fruit borer (*Leucinodes orbonalis* Guen.) is the most important one (Frempong, 1978) [5]. The yield losses caused are as high as 70-92% in India (Rosaiah, 2001) and the pest is reported to cause 3.3-68.9% damage to flowers and 47.6-85.8% damage to fruits in Orissa (Patnaik, 2000). Shoot and fruit borer, *L. orbonalis* (Lepidoptera: Pyralidae) is the key pest throughout Asia (Purohit and Khatri, 1973; Kuppuswamy and Balasubramanian, 1980; Allam *et al*., 1982). The pest has been reported to inflict losses to the tune of 20.7-60.0 per cent in Tamil Nadu (Raja *et al*., 1999), 70 per cent in Andhra Pradesh (Sasikala *et al*., 1999), 80 per cent in Gujarat (Jhala *et al*., 2003) and 41 per cent in Himachal Pradesh (Lal *et al*., 1976). The insecticides have been used extensively for the control of this insect pest. Despite diverse ill effects of the chemicals pesticides, insecticides use still constitutes major control option to tackle this pest (Singh *et al*., 2008)

Table 1: Nutritive value of brinjal fruit per 100gm: The nutritive value varies with varieties. Brinjal has got Ayurveda medicinal value and white brinjal is said to be good for diabetic patients.

Moisture	92.7 gm	Fe^{2+}	0.9 mg
Protein	1.4 gm	Na	3.0 mg
Fat	0.3 gm	K	2.0 mg
Minerals	0.3 gm	Cu	52.0 mg
Fiber	1.3 gm	Cl	0.17 mg
Calories	24	S	44 mg
Ca^{2+}	18 mg	Thiamine	0.04 mg
Mg^{2+}	16 mg	Riboflavin	0.11 mg
Oxalic acid	18 mg	Nicotinic Acid	0.09 mg
P	47 mg	Vitamin E	12.0 mg

Source: Per 100 g edible portion.

Shoot and fruit borer scientific classification, distribution and status, life history and Nature of damage**:**

1.2 Scientific Classification:

Kingdom : Animalia
Phylum : Arthropoda
Class : Insecta
Order : Lepidoptera

The Brinjal fruit and shoot borer (BFSB), *Leucinodes orbonalis* (Lepidoptera: Pyrallidae) is the most obnoxious detrimental and ubiquitous pest one of the most important destructive pests it alone causes damage as high as 85.90% and even up to 100% damage is also recorded in Brinjal and other solanaceous vegetables. *Leucinodes orbonalis* was described and classified by Guenee in 1854. It is an internal borer which damages the tender shoots and fruits.

1.3 Distribution and status

India, Bangladesh, Malaysia, Thailand, Burma, Srilanka, Laos, South Africa, Congo. It is a major and regular pest of brinjal causing damage to even 30 -50% of fruits or more.

1.4 Economic importance: It is one of the most serious pests of Brinjal fruits and plants. Long and narrow are less susceptible to attack 21% of fruits are found damaged by this pest.

1.5 Host range: Brinjal, potato, other wild plants belonging to Solanaceae crops, peas etc.

1.6 Nature of damage: The infestation starts a few weeks after transplanting. The caterpillars bore into the growing shoots, midribs, and petioles of large leaves and feed on internal tissues. As a result of damage, affected shoots wither and dry up and plants exhibit the symptoms of dropping. After fruit formation, larvae make their entry under the calyx, when they are young. The holes are later plugged with excreta leaving no visible sign of infestation. Large circular holes seen on the fruits are the exit holes. Such fruits lose market value and are unfit for human consumption.

1.7 Life History: Egg period: 3-4 days. Eggs are 150-350 creamy-white and lay singly on tender shoots, ventral side of leaves, fruits, and on a flower. Incubation period: 7 days in winter and 3-5 days in summer. The larva is pink coloured with sparsely distributed hairs on warts on the body and brownish head. Larval period 12-15 days in summer and 22 days in winter. A full-grown larva before going for pupation comes out of the fruit by making exit holes. Pupation takes place in the boat-shaped silken cocoon in the fallen leaves or soil. Pupa: 6-8 days in boat-shaped cocoon also in a tough greyish cocoon on the plant itself. Adult: 2-3 days. Medium-sized adults with white wings flashed with triangular brown and red markings on forewing. Total life cycle: 17-50 days.
ETL: 1-5% of fruit damage.

1.8 Importance of Study

The bio-pesticides play an important role in insect pest management by their various inhibitory actions on insect physiology and behaviour. They are the best alternative to chemical insecticides against *Leucinodes orbonalis* on brinjal. They are locally available, relatively cheap, biodegradable, and easy to handle. They are bringing about the balance back to the ecosystem. As the agriculture shift toward organic farming the organic farming, they have much better scope in the management tactics. (Warghat *et al.*, 2019).

1.9 Justification

There is a tremendous misuse of insecticides in an attempt to produce damage free marketable fruits. Insecticides have been reported effective against this pest but it is observed that this pest defies all the chemical control measures. Excessive dependence on huge quantities of insecticides, alone and in combination, to control *L. orbonalis* is causing ecological pollution and pest resistance. It has become necessary to use preparations which are safe, effective and cheap. In order to control these insect pests, in recent years, various types of systemic and contact insecticides either in spray or seed treatment or granular formulation are being applied in vogue. In order to provide safer, eco-friendly and economical management of its major pests. Keeping in view the quantum of pesticides applied in brinjal crop in this region, there for present study was planned to compare conventional and new chemistry insecticides under field conditions. A study entitled, "Study of Pest Incidence and Occurence of Shoot and Fruit Borer (*Leucinodes Orbonalis*) ON Brinjal During *kharif* Season (2019-20)" was taken up which may keep the crop pest suppressed below Economic threshold level (E.T.L). Hence, the present investigation was undertaken to study about the pest biology, life stages and occurrences in given *kharif* seasons to supress the incidences of Shoot and Fruit borer at Central Agriculture Research Farm, SHUATS, Prayagraj.

2. Materials and Methods

The present investigations were carried out with a view to find out the pest incidences and differetnt life stages for the better integrated practices for the suppression of the Shoot and fruit borer (*Leucinodes orbonalis* Guenee.) with some eco-friendly materials like botanicals, microbial, with newer and convectional insecticides and I.P.M. practices. Materials and methods adopted in the present study entitled "Study of Pest Incidence and Occurence of Shoot and Fruit Borer (*Leucinodes orbonalis*) ON Brinjal During *kharif* Season (2019-20)". The details of the material used and the method followed during these studies are described herewith.

2.1 Experimental site

The present investigation was conducted at the Central Research Farm of "Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh" during Kharif season 2019. The research farm is situated on the right side of Prayagraj Rewa road at 20

degrees and 150 North, 600 east longitude city and is about 129.2 cm above sea level. The site selected was uniform, cultivable with typical sandy loam soil having good drainage.

2.2 Materials

For conducting the studies, the brinjal seed (Banaras Purpal), agricultural implements manure and fertilizers, knapsack sprayer, measuring cylinder, buckets, labels, threads, polythene bags, wax, hand lenses, chemicals balance, weighing balance, labours etc. were used. These materials were provided by the department of Agriculture Plant Protection and Entomology, "Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh.

2.3 Method adopted

2.3.1 Cultural operations

2.3.1.1 Preparatory tillage

The plot soil was thoroughly prepared by ploughing followed by two harrowing. The field was cleaned by picking stubbles of previous crop and weeds. Before sowing of seeds on raised beds, one harrowing was done and the experimental plots were laid out as per the statistical design (RBD).

2.3.1.2 Sowing of seeds on raised bed

The seeds of Brinjal 'Banaras purple long' variety were sown on 24.07.2019 to raise the seedling in nursery. Regular watering and weeding were done up to transplanting of seedling to the main field.

2.3.1.3 Transplanting and gap filling

The seedlings were transplanted approximately after 4 weeks, in the main field on 13.08.2019 and two gap filling was done to maintain the plant population, keeping one plant per hill.

2.3.1.4 Application of fertilizers

Application of fertilizers was done at the rate 60: 50: 50 kg N.P.K per hectare. Half dose of Nitrogen and full dose of Phosphorus and Potash were given at the time of transplanting. The remaining dose of nitrogen was applied one month after transplanting. Fertilizers were applied by ring method in the form of single super phosphate, urea and murate of potash.

2.3.1.5 Hoeing and weeding

Timely hoeing and weeding operations were carried out to conserve soil moisture and to remove weeds as and when needed.

2.3.1.6 Protective irrigation

The protective irrigation was given in field experimental plots during dry spell and as it and when essential.

2.3.1.7 Picking

Picking were done plot wise manually.

2.4 Experimental Details

Season : *Kharif*
Crop : Brinjal
Design : Randomized Block Design
Replication : 03.
Plot size : 2m x 1m
Total no. of plots : 27
Total no of plots for objective no. 1 : 24
(Layout no.1) Total length of area : 12.5m.
Total width of area : 5m.
Spacing : 60x45 cm.
Row to row distance : 60 cm.
Plant to plant : 45 cm.
Dose of Fertilizer : 60:50:50, N.P.K. Kg/ha,
FYM : 10 tones/ha.
Variety : Banaras Purple long
Seed rate : 500 g /ha.
Total length of the area : 12 mt.
Total width of the area : 8.8 mt.
Gross cultivated area : 105.6 m^2
Net cultivated area : 63 m^2
Main irrigation channel : 1.0 m.
Sub irrigation channel : 0.5 m.
Width of bund : 0.3 m.

2.5 Meteorological data

The data regarding average minimum and maximum temperature, relative humidity, rainfall, wind speed and sunshine hours during the crop season 2019 were provided by Department of Meteorology of "Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh" that data will be recorded.

Table 2: Dates of spray application.

Sr. No.	Spray application	Date of application
1	First spray	8.10.2019
2	Second spray	24.10.2019

2.6 Methods of recording observations

2.6.1 Efficacy of treatments: The incidence and damage of brinjal shoot and fruit borer were recorded before 1-day spraying and on 3rd day, 7th day and 14th day after insecticidal application. The damage of brinjal shoot and fruit borer were recorded on 5 randomly selected and tagged plants from each plot and then it was converted into per cent of infestation by following formula,

a) On Shoot

Number Basis: The total number of shoots and number of shoots infested of five selected plants from each treatment replication wise were recorded.

$$\% \text{ Shoot infestation} = \frac{\text{No. of shoot infested}}{\text{Total no. of shoot}} \times 100$$

b) On Fruit

Number Basis: at each picking, the total number of fruits and number of fruits infested of five selected plants from each treatment replication wise were recorded.

$$\text{Fruit infestation} = \frac{\text{No. of fruit infested}}{\text{Total no. of fruit}} \times 100$$

(Yadav *et al*. 2015)

2.7 Seasonal incidence

The damage per cent of brinjal shoot and fruit borer observation were recorded at 7 days' interval, from the occurrence or initiation of the pest infestation and were continued up to harvest. The incidence and damage of brinjal shoot and fruit borer were recorded from the six randomly

selected and tagged plants by correlating with weather parameter. Weather data were recorded simultaneously from the Department of Agriculture Meteorology, SHUATS, Prayagraj. Among weather parameters, relative humidity, maximum temperature, minimum temperature, sunshine hour, wind speed and rainfall were considered for correlating with the occurrence and damage of brinjal shoot and fruit borer.

2.8 Study of pest incidence and occurrence of shoot and fruit borer (*leucinodes orbonalis*) on brinjal during *kharif* season (2019-20).

2.8.1 per cent of shoot infestation

Studies on the incidence of shoot and fruit borer population with weather parameters given in table 3 below. Shoot infestation *of Leucinodes orbonalis* Guenee 2019 k*harif* season was commenced from 32rd standard week (August first week) on shoot with an average 0.32% infestation. The borer population increased and gradually reached peak level of 34.62% of larval population at 42nd standard week (October third week). Thereafter, declined trend was observed due to fall of maximum and minimum temperatures as optimum weather condition are decreasing. Therefore, per cent infestation was positively correlated with the maximum and minimum temperature. Hence, decline of temperature leads to the decline of the shoot and fruit borer population.

2.8.2 Per cent of fruit infestation

Studies on the incidence of shoot and fruit borer population with weather parameters given in table 4 below fruit infestation of *Leucinodes orbonalis* Guenee 2019 *kharif* season was commenced from 35th standard week (Last week of August) on shoot with an average 0.83% infestation. The borer population increased and gradually reached peak level of 41.28% of larval population at 46th standard week (second week November) The population increased and gradually reached peak level 41.28% larval population and decline in the trend was noticed this may be due to fail in congenial weather parameters

Table 3 Pest incidence of shoot and fruit borer of brinjal during *Kharif* 2019. (Shoot Infestation of *Leucinodes orbonalis*)

Standard week	% Shoot infestation of *Leucinodes orbonalis*	Temperature ^{0C}		Temperature ^{0}C (mean)	Humidity % (Mean)	Rainfall (mm)	Wind Velocity (Km/hr.)	Sunshine (hr. /day)
		Max.	Min.					
30th	0	34.68	26.57	30.62	76.21	26.77	1.34	5.25
31th	0	34.34	26.37	30.35	71.85	4.28	1.36	4.77
32th	0.32	34.82	37.54	31.18	74.35	6.6	1.35	3.8
33th	1.75	35.08	28.05	31.57	76.57	6.85	1.29	6.05
34th	3.70	33.15	27.08	30.12	77.78	23.97	1.42	2.31
35th	5.89	34.65	27.88	31.27	75	8.74	1.47	5.6
36th	10.74	35.14	28.2	31.67	62.85	3.54	1.54	5.97
37th	14.59	33.6	28.54	31.07	79.35	19.8	1.26	5.85
38th	17.73	33.54	27.34	30.44	78.71	5.9	1.37	3.51
39th	21.98	30.25	26.25	28.25	86	31.74	1.36	2.2
40th	27.89	30.74	22.82	26.78	80.5	17.51	1.26	1.91
41th	30.65	34.44	25.08	29.76	69.85	0.91	1.25	7.74
42th	34.62	32.94	24.71	28.82	75.42	0	1.38	5.34
43th	29.62	32.31	22.51	27.41	76.21	0	1.21	4.3
44th	26.64	33.34	21.6	27.47	74.07	0	1.02	3.1
45th	18.44	32.42	19.88	26.15	74.5	0	1.06	4.8
46th	11.28	31.51	16.02	23.77	74.92	0	1.09	3.7
47th	7.34	30.88	15.4	23.14	76.35	0	0.96	4.6
48th	3.91	30.6	14.87	22.73	77.78	0	1.02	5.6
	R	-0.3314	-0.2004	-0.1634	0.0963	-0.1854	-0.1358	-0.0905
	t=	2.99	0.01	6.80	4.95	0.11	3.41	0.01
Results		S	NS	S	S	NS	S	S

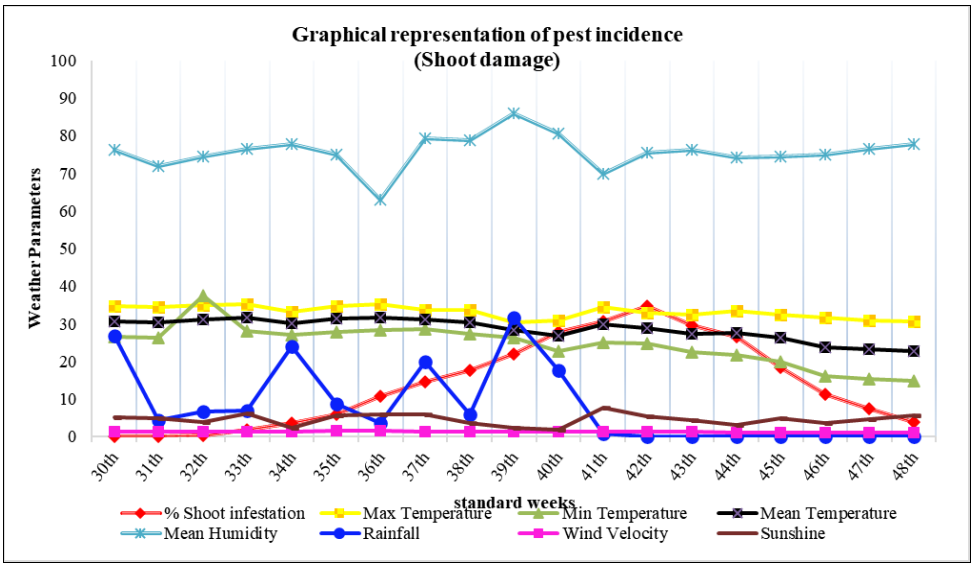

Fig 1: Graphical representation of pest incidence of shoot and fruit borer (On Shoot), *(Leucinodes Orbonalis Guenee)* during *Kharif* 2019.

Table 4: Pest incidence of shoot and fruit borer of brinjal during *Kharif* 2019. (Fruit Infestation of *Leucinodes orbonalis*)

Standard week	% Fruit infestation of *Leucinodes orbonalis*	Temperature ^{0C}		Temperature ^{0}C (mean)	Humidity % (Mean)	Rainfall (mm)	Wind Velocity (Km/hr.)	Sunshine (hr. /day)
		Max.	Min.					
30th	0	34.68	26.57	30.62	76.21	26.77	1.34	5.25
31th	0	34.34	26.37	30.35	71.85	4.28	1.36	4.77
32th	0	34.82	37.54	31.18	74.35	6.6	1.35	3.8
33th	0	35.08	28.05	31.57	76.57	6.85	1.29	6.05
34th	0	33.15	27.08	30.12	77.78	23.97	1.42	2.31
35th	0.83	34.65	27.88	31.27	75	8.74	1.47	5.6
36th	1.8	35.14	28.2	31.67	62.85	3.54	1.54	5.97
37th	2.33	33.6	28.54	31.07	79.35	19.8	1.26	5.85
38th	3.55	33.54	27.34	30.44	78.71	5.9	1.37	3.51
39th	4.87	30.25	26.25	28.25	86	31.74	1.36	2.2
40th	5.78	30.74	22.82	26.78	80.5	17.51	1.26	1.91
41th	7.46	34.44	25.08	29.76	69.85	0.91	1.25	7.74
42th	12.54	32.94	24.71	28.82	75.42	0	1.38	5.34
43th	25.30	32.31	22.51	27.41	76.21	0	1.21	4.3
44th	34.25	33.34	21.6	27.47	74.07	0	1.02	3.1
45th	38.19	32.42	19.88	26.15	74.5	0	1.06	4.8
46th	41.28	31.51	16.02	23.77	74.92	0	1.09	3.7
47th	29.04	30.88	15.4	23.14	76.35	0	0.96	4.6
48th	17.95	30.6	14.87	22.73	77.78	0	1.02	5.6
	R	-0.5170	-0.771	-0.7903	-0.0291	-0.5585	-0.8167	-0.1279
	t=	2.02	0.09	1.62	6.53	0.38	0.02	0.03
Results		S	NS	NS	S	NS	NS	NS

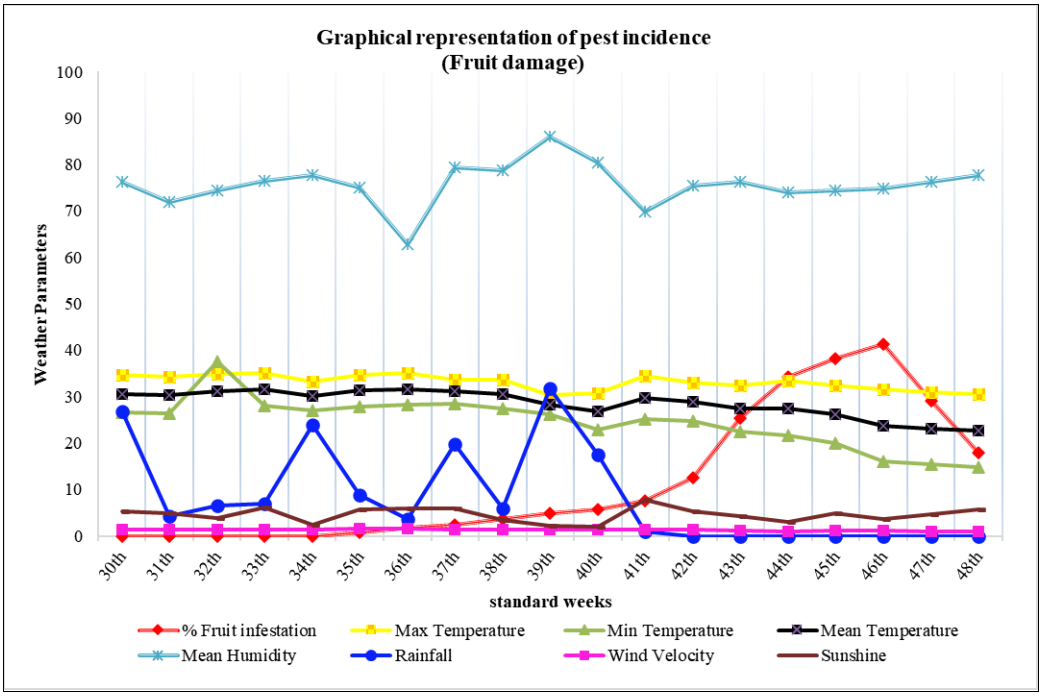

Fig 2: Graphical representation of pest incidence of shoot and fruit borer (On Fruit), (*Leucinodes Orbonalis Guenee*) during *Kharif* 2019.

3. Results and Discussion

To study the pest incidence & occurrences of shoot and fruit borer, *Leucinodes orbonalis*, Guenee on brinjal during *kharif* season of 2019:

Studies on the incidence of shoot infestation *of Leucinodes orbonalis* Guenee 2019 *Kharif* season was commenced from 32nd standard week (August first week) on shoot with an average 0.32% infestation. The borer population increased and gradually reached peak level of 34.62% of larval population at 42nd standard week (October third week) and decline in the trend was noticed this may be due to fail in congenial weather parameters. The pest builds up was correlating with max temperature and declined as it falls. Studies on the incidence of fruit infestation of *Leucinodes orbonalis* Guenee 2019 *Kharif* season commenced from 35th standard week (Last week of August) on shoot with an average 0.83% infestation. The borer population increased and gradually reached peak level of 41.28% of larval population at 46th standard week (second week of November) and decline in the trend was noticed this may be due to fail in congenial weather parameters. Singh *et al*. (2009) reported incidence of fruit borer (*Leucinodes orbonalis*) in terms of shoot infestation was observed during 4th week of August and the incidence had non-significant relationship with temperature, rainfall, and significant relationship with relative humidity. Murthy *et al*., (2001) reported that shoot damage is being started in September month and raised in October and maximum damage is obtained in 2nd to 3rd week of October

and the number of damages is reduced in shoot infestation while fruit setting is occurred. Das *et al*., (2014) [3] According to Das the shoot infestation level are increased in the last weeks of September and in case of fruit there are much amount of infestation are observed in October to November the significant negative association of sunshine and non-significant negative association of maximum temperature. Kaur *et al.,* (2014) [6] Supported the statement of two abiotic factors such as weekly temperature and per cent relative humidity (%RH) were correlated with the population of BSFB on brinjal. The BSFB infestation is likely to be influenced by maximum temperature. The prevalence of low temperatures may be a cause for lengthening the life cycle of this pest, while at elevated temperatures this pest completes the life cycle at a comparatively shorter duration. Shirale *et al*., (2012), Shukla and Khatri (2010) [12] reported adult of shoot and fruit borer increased considerably in the month of October to November and decreased in subsequently weeks of December Maximum shoot, fruit damage was recorded in third weeks of October. Deole (2015) [4] supported that ambient weather revealed a significantly negative relationship with minimum temperature and significantly positive relationship with relative humidity. Mannan *et al.,* (2015) [8] reporting that infestation varied significantly in relation to plant age and season. BSFB infestation is started from the 5th to 6th weeks from transplanting and maximum infestation are observed in last weeks of September to October. Infestation also depends upon the verity and environmental factors. Yadav *et al*., (2015) Supported the study of infestation of BSFB was started from September and highest at 43rd to 44th standard week. The statistically significant values indicated that the occurrence of insect pests' population was due to the prevailing favourable ecological conditions. Kumar, and Singh (2013) [7] supported this Kumar & Singh (2013) [7] observed the role of temperature, rainfall, relative humidity (Morning) in increasing infestation and intensity on shoot and fruits was very conductive but RH (%) (Evening) responded negatively and also reported that raising of vegetative growth also promote the pest infestation on fruiting initial stage continuous decline of infestation and then gradually increases in month October and November.

4. Conclusion

The occurrence of shoot and fruit borer commenced from 32rd standard week (August first week) on shoot with an average 0.32% infestation. The borer population increased and gradually reached peak level of 34.62% of larval population at 42nd standard week (October third week). Thereafter, declined trend was observed due to fall of maximum and minimum temperatures as optimum weather condition are decreasing. Therefore, per cent infestation was positively correlated with the maximum and minimum temperature. Hence, decline of temperature leads to the decline of the shoot and fruit borer population. Per cent infestation on Fruit commenced from 35th standard week (Last week of August) on fruit with an average 0.83% infestation. The borer population increased and gradually reached peak level of 41.28% of larval population at 46th standard week (November second week) and decline in the trend was noticed this may be due to fail in congenial weather parameters.

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