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Influence of weather parameters on incidence of major pests of brinjal

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Abstract
A study was conducted on influence of weather parameters on seasonal incidence of major insect pests of brinjal at research farm of Department of Agricultural Entomology, VNMKV, Parbhani during 2018-19. The activity of insect pests was observed throughout the crop growth period. The infestation of *Leucinodes orbonalis* on developing shoots of brinjal was observed from 32th to 45th SMWs and the peak shoot infestation was 17.9 per cent during 42nd SMW. However, the maximum damage (40.6 per cent) to brinjal fruits due to *L. orbonalis* was noticed during 42nd SMW. The study indicated that evapotranspiration and bright sunshine hours had positive correlation with population of aphids. However, weather parameters *viz.*, maximum temperature, evapotranspiration and bright sunshine hours were influenced significantly positive on the incidence of jassids, whiteflies, mites as well as shoot and fruit borer.

Keywords: seasonal incidence, standard meteorological week (smw), weather parameters, evapotranspiration, bright sunshine hours, brinjal

Introduction

Brinjal (*Solanum melongena* L.) also called eggplant is a species of nightshade grown for its edible fruit. Eggplant is a common in North America, Australia and New Zealand; in British English, it is aubergine, in South Asia and South Africa, brinjal. The Eggplant is a delicate tropical perennial often cultivated as a tender or half-hardy annual in temperate climate. The plant has spiny stem, white to purple flower and fruit is widely used for cooking. As a member of genus *Solanum*, it is related to tomato and potato.

India is the second largest producer of vegetables in world after China. Majority of Indians are vegetarian, with a per capita consumption of 135 g per day as against the recommended 300 g per day (Dhandapani, 2003) [6]. Among the vegetables, brinjal is an important solanaceous vegetable in India. Brinjal is known as poor man's vegetable because of it's low cost production, easy to prepare culture and availability throughout year.

In India, brinjal was cultivated on an area of 736 thousand ha with an annual production of 12826 thousand million tonnes during 2017-2018. The total area under brinjal cultivation was 30 thousand ha with an annual production of 690 thousand million tonnes and productivity of 23 tonnes fruits ha^{-1}in Maharashtra during 2017-2018. West Bengal is a leading state in brinjal production. The major brinjal producing states are West Bengal, Orissa, Bihar, Karnataka, Andhra Pradesh, Maharashtra, Karnataka and Uttar Pradesh (Anon., 2018) [1].

There are also several constraints in brinjal production which are responsible for reduction in yield. Insect pest is one of the most important factor among them. This economically important commercial crop is infested by more than 142 species of insects, 4 species of mites and 3 species of nematode from planting to harvest (Sohi, 1966) [40]. Among the various insect pests attacking the eggplant, shoot & fruit borer and sucking pests are major insect-pest of brinjal. Climate change, especially temperature increase, affecting insect physiology, behavior, development as well as species distribution and abundance of insects. So the pest abundance and distribution changes with abiotic factors and therefore meteorological parameters play a pivotal role in the biology of any pest. By keeping above point the present study was undertaken to study Influence of weather parameters on incidence of major pests of brinjal.

Materials and Methods

The experiment was carried out to study "Influence of weather parameters on incidence of major pests of brinjal" at the Research Farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* 2018-19. 'Ajay' variety of brinjal was transplanted in 10 × 10 m^2 plot area with spacing of 60 × 60 cm^2.

Method for recording observations

The data was recorded at 7 days of the interval on pest infestation after transplanting of brinjal crop and continued up to crop harvesting. Five plants per quadrate per plot was selected. The incidence of brinjal shoot and fruit borer was recorded on five randomly selected plants by counting total number of shoots and fruits with the damaged ones starting from ten days of transplanting and continued till harvesting. Observations on the population of sucking pests *i.e.* aphids, whiteflies and jassids were recorded at weekly intervals on three leaves selected from top, middle and bottom canopy of the plant commencing from ten days of transplanting and continued till harvesting. Population of red spider mites was recorded at weekly interval on three leaves per 4 cm^2 leaf area selected from top, middle and bottom canopy of the plant.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion is summarized under following heads:

Population dynamics of brinjal aphids *(A. gossypii)*

The data on population fluctuations of aphid, *Aphis. Gossypii* observed during *Kharif* 2018-19 (Table No. 1). It revealed that the aphid population was observed and after that, it showed the increasing trends and peak incidence of aphid recorded (9.2 aphids/3 leaves) at 44th SMW. The second peak was noticed at 48th SMW (8.9 aphids/3 leaves) and third peak was observed at 43th SMW (8.6 aphids/3 leaves), respectively. The above results are in accordance with the results reported by Potai and Chandrakar (2018) [29] who observed the infestation of *Aphis gossypii* from August (2016) to October (2016) with one distinct peak 40th SMW (39.24 aphids/per plant). Rajput *et al.*, (2010) [32] showed that *A. gossypii* population attained peak in 30th - 34th SMW. Mohapatra (2008) [22] studied the population dynamics of sucking pests on *hirsutum cotton* and influence of aphid, *A. gossypii* infested from 30th SMW to 50th SMW and Peak population of *A. gossypii* was attained during 35th SMW.

Population dynamics of brinjal jassids *(A. biguttula biguttula)*

The data on population fluctuation of jassid per three leaves, *Amrasca biguttula biguttula,* during *Kharif* 2018-19 (Table No. 1) revealed that the population of jassid was stated from during 29th SMW. The peak incidence of jassid ranged from 1.4 (29th SMW) to 11.3 (44th SMW) jassid/3 leaves. The peak was recorded in 43th SMW. (11.7 jassids/3 leaves). The present results are in conformity with the earlier researchers Shalini *et al*., (2017) [35] reveal that population of *A. biguttula biguttula,* on brinjal appeared from August to November during both years andwith peak incidence of (23.7 jassids/3 leaves) and (22.8 jassids/3 leaves) in 40th SMW in September during 2014 and 2015 respectively. Gangwar and Singh, (2014) [7] reported that the incidence of this pest was observed during August to December *i.e.* the population appeared in the first week after transplanting and its population continued building up throughout the crop growth. Kumar *et al*., (2014) [18] observed the maximum population of *Amrasca biguttula biguttula* on brinjal observed during the third week of October (43rd standard week).

Population dynamics of brinjal whitefly (*Bemisia tabaci*)

The data from (Table No. 1) revealed that the whitefly population on brinjal was ranged from 1.8 (29th SMW) to 6.4 (49th SMW) whiteflies/3 leaves plant. The population of whiteflies attained the peak of 12.3, 12.9, 13.3 and 13.8 at 42nd to 45th SMW. The earlier researchers reported a similar results of sucking pests incidence during *Kharif* season, Potai and Chandrakar (2018) [29] who reported that *Bemisia tabaci* was appeared in the second week of August to last week of October 2016 with one distinct peak 38th SMW (4.89 whiteflies/per plant). Furthermore, from Udaipur, Saini *et al*., (2017) [34] reported the incidence of white flies on chilli started from last week of July to November. The highest peak of whitefly (6.8 whitefly/ 3 leaves of the plant) was noticed during (37th SMW) *i.e.* 2nd week of September. Rajput *et al.*, 2010 [32] stated less population *B. tabaci* throughout the season (2001-02). The highest population was recorded in 41st SMW *i.e.* 8th–14th October. During 2002-03 the maximum population in 42nd and 43rd standard week 15th to 28th October. Prasad *et al*., (2008) [31] also reported the peak incidence of whiteflies on cotton was observed from 44th to 48th SMW (November).

Table 1: Seasonal incidence of major insect pests of brinjal during *kharif* 2018

SMW	Duration	Population of sucking pests/3 leaves				shoot infestation (%)	fruit infestation (%)
		Aphids	Jassids	White flies	Mites		
27	1-8 July	0.0	0.0	0.0	0.0	0.0	0.0
28	9-15 July	0.0	0.0	0.0	0.0	0.0	0.0
29	16-22July	0.8	1.4	1.8	0.0	0.0	0.0
30	23-29July	1.2	3.1	2.4	0.0	1.2	0.0
31	30-5Aug	4.8	2.2	4.4	0.0	2.3	0.0
32	06-12Aug	5.2	2.9	3.5	0.0	2.8	0.0
33	13-19Aug	5.8	3.2	2.8	0.0	4.0	0.0
34	20-26Aug	6.1	3.6	2	0.0	7.2	0.0
35	27-2Sept	4.3	5.8	4.7	0.0	8.6	3.4
36	3-9Sept	4.6	6.4	3.2	0.0	8.0	3.9
37	10-16Sept	8.4	6.9	6.8	3.9	14.3	4.2
38	17-23Sept	5.6	7.2	9.4	5.4	14.9	5.6
39	24-30Sept	4.8	8.9	10.4	6.8	15.7	9.8
40	1-7Oct	3.7	8.2	11.2	8.8	15.8	25.4
41	8-14Oct	3.4	9.5	11.9	10.2	17.2	30.7
42	15-21Oct	8.9	9.1	12.3	10.5	17.9	40.6
43	22-28Oct	8.6	11.7	12.9	11.3	15.8	36.5
44	29-4Nov	9.2	11.3	13.3	12.8	13.4	31.7
45	4-11Nov	3.2	9.4	13.8	8.2	10.2	35.8
46	12-18Nov	4.5	7.2	9.3	5.6	4.4	34.8
47	19-25Nov	3.9	6.8	7.5	5.8	0.0	35.4
48	26-2Dec	8.9	6.3	8.2	4.8	0.0	35.8
49	3-9Dec	5.1	5.6	6.4	4.2	0.0	34.2

Population dynamics of brinjal Mites (*Tetranychus urticae* Koch)

The population of red spider mite (3.9 mites /3 leaves/4 cm^2) was initiated on brinjal in 37th SMW during *kharif* 2018-19 (Table No. 1). The peak population (12.8 mites/3 leaves/4 cm^2) was observed in 44th SMW during the experiment (Table 3). The population dynamics of mites was observed from 37th SMW. It was attained the 1st, 2nd and 3rdpeak of 10.5, 11.3 and 12.8 at 42nd to 44th SMW respectively. These results are in conformity with the finding of Ghosh (2013) [8] who observed that the pest was active throughout the growing period with a peak population of 6.18 mites/leaf during 23rd SMW (last week of May) in the pre-*kharif* crop. Highest population (7.56/leaf) was found on the 42nd SMW (first week of October) in the post-*kharif* crop. Similarly, the high population of *T. cinnabarinus* was noticed by Kapoor *et al*., (1997) [16] from May to November except in July.

Population dynamics of brinjal shoot borer (*L. orbonalis)*

The data on the infestation of *L. orbonalis* on developing shoots of brinjal crop during *kharif* 2018-19, presented in Table No.1. The infestation was ranged from 2.8 (32th SMW) to 10.2 per cent (45th SMW). The incidence of shoot borer was observed third week after transplanting and it was continue upto 46thSMW. The peak of incidence was recorded 17.9 per cent shoot infestation at 42th SMW. Thereafter the population was in decreasing and pets might be shifted to fruits. The above results corroborate the findings of earlier researchers, Kantipudi *et al.,* (2017) [15] observed that the highest per cent shoot infestation in the second week of September. Gangwar and Singh (2014) [7] reported that *Leucinodes orbonalis* (Guenee) reported that infestation started from the last week of August and remained till last week of December *i.e.* this pest was found infesting the crop throughout the crop season. Jat *et al.,* (2002) [14] studied the seasonal incidence of *L. orbonalis* on aubergine *cv.* Pusa Purple Round, the infestation of shoot borer started from the fourth week of August and reached its peak in the last week of September. The pest started damaging the fruits from the first week of October, peaked in the fourth week of October and continued up to the second week of December. Studies made by Hanapur and Nandihalli (2003) [9] on the incidence of this pest during *kharif* season indicated that the infestation of *L. orbonalis* were relatively more during September. Bharadiya and Patel (2005) [3] stated that the activity of *L. orbonalis* was started in the first week of September (4.9%) incidence on shoots was maximum (17.1%) before migrating to fruits by the fourth week of October. Prasad and Logiswaran (1997) [30] revealed that the incidence of shoot borer was lowest in the 31st standard week (0.98%)

Seasonal incidence of brinjal fruit borer (*L. orbonalis*)

The incidence of *L. orbonalis* on fruits of brinjal during *kharif 2018*-19 is presented in Table 1. Incidence of *L. orbonalis* on brinjal was ranged from 3.4 to 34.2 per cent during 35 to 49 SMW of observation, at that time the *L. orbonalis* feeds on the shoots. The incidence of the borer on the fruits started in 35th SMW coinciding with the setting of fruits. During the next 15 weeks pest incidence was increased and recorded peak of 40.6 per cent at 42th SMW. Nandi *et al*., (2017) [27] recorded peak incidence during October at Bagalkot and Kumar *et al*., (2017) [19] recorded the highest incidence during 42th SMW in the month of October at Varanasi which is comparable with the data of the present study. Whereas, Kantipudi *et al.,* (2017) [15] reported the highest per cent fruit infestation of the shoot and fruit borer in the 3rd week of October during both years. The findings of the above workers are more or less in line with the present findings. The extent of fruit damage ranged between 4.03 and 57.01 per cent as reported by Tripathi *et al*., 1998[42]. The infestation in fruits was recorded in the second week of September and remained up to the third week of October, Singh and Singh (2003) [39].

Simple correlation between major pests of brinjal in relation to weather parameters

Aphids (*Aphis gossypii*): It is evident from the data (Table No. 2) of the relationship between weather parameters and aphids population indicated a non-significant positive correlation of with maximum temperature (r=0.215) and positive significant correlation with evapotranspiration (r=0.450*) and bright sunshine hour (r=0.477*). While, rainfall (r=-0.351), morning relative humidity (r=-0.094) and wind velocity (r=-0.194) shows non-significant negative correlation with the aphids population. Whereas minimum temperature (r=-463*), evening relative humidity (r=-0.428*), shows significant negative correlation with the aphids population. Similar results are reported by Jamwal and Kondoria (1990) [13] observed that negative correlation of rainfall with aphid incidence and the decline in aphid population would be attributed to washing out of nymphs and adults by the process of heavy downpour. Ramya and Veeravel (2010) [33] documented that the rainfall and wind velocity had a negative correlation with pest infestation. Singh *et al.,* (2005) [38] reported that 21-28^{0} temperature and 61-75% relative humidity were favourable for the build-up of the aphid population. Thus, the present findings are supported by earlier worker.

Jassid (*Amrasca biguttula bigutulla*)

It is evident from the data (Table No. 2) of the relationship between weather parameters and jassids population indicated a highly significant positive correlation of jassids with maximum temperature (r=0.743**), evapotranspiration (r=0.615**) and bright sunshine hour (r=0.657**). While rainfall (r=-488*) shows negative significant correlation whereas minimum temperature (r=-0.554**), evening relative humidity (r=-0.725**), and wind velocity (r=-0.608**) shows negative and highly significant correlation with the jassids population. And morning relative humidity (r=-0.317) shows negative non-significant correlation with jassids population. Significant positive correlation of jassid and weather parameters (maximum temperature) are reported by Patel *et al*., (2015) [28] at Navsari, as well as Shalini *et al*., (2017) [35] at Rohtak which are match with the correlation data of present results. Inee and Datta (2000) [11] also reported that the meteorological parameters played an important role in the population build-up of cotton jassids. Likewise, Ashfaq *et al.,* (2010) [2] also reported the negative association between jassid and relative humidity as well as rainfall in cotton. Iqbal *et al.,* (2010) [12] reported the negative correlation of the pest with rainfall in okra crop. Mahmood *et al.,* (2002) [21] found a negative correlation of jassid with relative humidity and rainfall while, positive with bright sunshine hours in brinjal.

Table 2: Correlation of weather parameters and insect pests of brinjal during 2018-2019

Weather parameters	Correlation coefficient ('r' value)					
	Aphids	Jassids	White Flies	Mites	% BSFB shoot infestation	%BSFB fruit infestation
Rainfall (mm)	-0.351	-0.488*	-0.484*	-0.381	-0.297	-0.379
Maximum Temperature (^{0}C)	0.215	0.743**	0.800**	0.764**	0.767**	0.554**
Minimum Temperature (^{0}C)	-0.463*	-0.554**	-0.582**	-0.585**	-0.057	-0.833**
Morning Relative Humidity (%)	-0.094	-0.317	-0.444*	-0.387	-0.106	-0.412
Evening Relative Humidity (%)	-0.428*	-0.725**	-0.762**	-0.744**	-0.322	-0.885**
Evapotranspiration (mm)	0.450*	0.615**	0.664**	0.652**	0.608**	0.507*
Bright Sunshine (Hrs)	0.477*	0.657**	0.678**	0.649**	0.435*	0.672**
Wind Speed (Kmps)	-0.194	-0.608**	-0.658**	-0.655**	-0.469*	-0.618**

* Significant at 5% level ** Significant at 1% level (t value- 0.421)

Whitefly

The data pertaining to simple correlation is presented in Table No. 2 for *kharif* 2018-19. The data showed that population of whitefly was negatively and significantly correlated with rainfall (r=-0.484*) and morning relative humidity (r=-0.444*), while minimum temperature (r=-0.582**), evening relative humidity (r=-0.762**) and wind speed (r=-0.658**) show negative, highly significant correlation with whitefly population. Likewise maximum temperature (r=0.800**), evapotranspiration (r=0.664**) and bright sunshine hour (r=0.678**) show positive and highly correlation. In previous findings significantly positive correlation of weather parameters (maximum temperature) is reported by Patel *et al*., (2015) at Navasari and Indirakumar *et al*., (2016) [10] at Coimbatore which is in agreement with the present results. Sharma *et al*., (1997) [36] also revealed that the whitefly, (*B. tabaci*) population showed a significant positive association with temperature and sunshine and a negative correlation with rainfall. With regards to mean temperature significantly positive correlation is reported by Tiwari *et al*., (2012) [41] at Meerut, which is match with current data of correlation of whitefly population Hence the above reports strongly supported the present findings.

Red spider mite

The data pertaining to simple correlation is presented in Table No. 2 for *kharif* 2018-19. The data presented in Table 2 showed that population of red spider mites was a negative and non-significant correlation with the rainfall (r=-0.381) and morning relative humidity (r=-0.387), while minimum temperature, morning relative humidity and wind speed shows positive and highly significant correlation with mite population. Similarly mite population shows positive, highly significant correlation with maximum temperature (r=0.764**), evapotranspiration (r=0.652**) and bright sunshine hour (r=0.649**). The findings of the present study are in conformity with the earlier studies, Tripathi *et al*., (2014) [43] reported a positive correlation between temperature and mite population and negative correlation with humidity and rainfall. Moreover, Monica *et al*., (2014) [24] found a significantly positive correlation between the population of *T. urticae* and the maximum temperature and significant negative correlation with the morning relative humidity which means when the temperature increased the mite population also increased and with increasing morning relative humidity, the mite population decreased.

Per cent shoot damage by *L. orbonalis*

The data pertaining to simple correlation is presented in Table 2 for *kharif* 2018-19. The data presented in Table 4 showed that population of per cent shoot damage by *L. orbonalis* was negative and non-significant correlation with the rainfall (r=-0.297), minimum temperature (r=-0.057), morning relative humidity (r=-0.106), evening relative humidity (r=0.322) likewise wind speed (r=-0.469*) shows negative but significant correlation with the population of per cent shoot damage. Maximum temperature (r=0.767**) and evapotranspiration (r=0.608**) shows a positive and highly significant correlation, while bright sunshine hour (r=0.435*) positive and significant correlation with per cent shoot damage. The present findings are in conformity with the earlier workers, Prasad and Logiswaran (1997) [30] observed that the incidence of shoot damage by *L. orbonalis* was significantly positive with maximum temperature, relative humidity and negative with minimum temperature during winter. While in summer a significant positive correlation was observed with relative humidity and rainfall. However, Chandrakumar *et al*., (2008) [4] reported that per cent shoot damage was significantly and positively correlated with maximum temperature, non-significant positive correlation with relative humidity and significantly negative correlation with minimum temperature and rainfall. Yogi and Kumar (2009) [44] reported the per cent shoot damage was significantly and positively correlated with maximum temperature. As well as Mean temperature significantly positive correlation was found with shoot damage in the present study which is comparable with correlation findings of Singh *et al*., (2000) [37] at Kanpur, Kumar and Singh (2013) [20] at Kanpur and Mutkule *et al*., (2017) [26] at Navsari.

Per cent fruit damage by *L. orbonalis*

The data pertaining to simple correlation is presented in Table 2 for *Kharif* 2018-19. The data presented in Table 4 showed that population of per cent fruit damage by *L. orbonalis* was negatively and no significant correlation with the rainfall (r=-0.379) and morning relative humidity (r=-0.412), while minimum temperature (r=-0.833**), evening relative humidity (r=-0.885**) and wind speed (r=-0.618**) shows negative but highly significant correlation with per cent shoot damage. Likewise, maximum temperature (r=0.554**) and bright sunshine hour (r=0.672) positive and highly significant whereas evapotranspiration (r=0.507*) shows positive and significant correlation with the per cent fruit damage by *L. orbonalis.* Thus the present findings are more or less corroborate to earlier workers Singh *et al*., (2000) [37] stated that there was a positive role of temperature and negative role of relative humidity on the multiplication of the pest. Muthukumar and Kalyanasundaram (2003) [25] revealed that the evaporation and sunshine hours had a positive association with *L. orbonalis* damage furthermore, Kantipudi *et al*., (2017) [15] evolved negative correlation between rainfall and evening relative humidity and the fruit infestation by *L. orbonalis*. However, Chandrakumar *et al*., (2008) [4] reported that the incidence of fruit damage was found positively correlated with maximum temperature and negatively correlated with evening humidity and rainfall

In earlier findings significantly negative correlation of minimum temperature with fruit damage due to *L. orbonalis* incidence was found in records of Mondal *et al*., (2014) [23] at Sriniketan, Deole (2015) [5] at Raipur, as well as Mutkule *et al*., (2017) [26] at Navasari which are similar with the present investigation results. While evening relative humidity significantly negative with fruit damage is reported in findings of Kumar *et al*., (2017) [19] at Varanasi and Mutkule *et al*., (2017) [26] at Navsari. Significantly negative influences of mean relative humidity on fruit damage found in the present study and match with the results of Koushik and Munjunatha (2013) [17] at Shimoga and Mutkule *et al*., (2017) [26] at Navsari.

Refernces

1. Anonymous. National Horticulture Board, Ministry of Agriculture, Government of India 85, Institutional Area, Sector-18, 2018. Gurgaon-122 015, India.
2. Ashfaq M, Muhammad NL, Khuram Z, Abida N, Mansoor-ul-Hasan. The correlation of abiotic factors and physico-

morphiccharateristics of (*Bacillus thuringiensis*) *Bt* transgenic cooton with whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) and jassid, *Amrasca devastans* (Homoptera: Jassidae) popultions. Afr. J. Agril. Res. 2010; 5(22):3102-3107.
3. Bharadiya AM, Patel BR. Succession of insect pests of brinjal in north Gujarat. Pest Manage. & Econ. Zool. 2005; 13(1):159-161.
4. Chandrakumar HL, Kumar CT, Kumar NG, Chakravarthy AK, Pattu Raju TB. Seasonal Incidence of major insect pests and their natural enemies on brinjal. Curr. Biotica. 2008; 2(1):63-73.
5. Deole S. Population dynamics of major insect pests of brinjal crop in summer season. J. Hill Agril. 2005; 6(2):180-183.
6. Dhandapani N, Shelkar UR, Murugan M. Bio-intensive pest management (BIPM) in major vegetable crops: An Indian perspective. Food Agril. & Environ. 2003; 1(2):333-339.
7. Gangwar RK, Singh DV. Study on Insect Pest succession of brinjal crop ecosystem in Western Region of Uttar Pradesh, India. J. Biol. Agril. & Healthcare. 2014; 4(17):116-119.
8. Ghosh SK. Incidence of red spider mite (*Tetranych usurticae* Koch) on okra (*Abelmoschus esculentus* (L.) Moench) and their sustainable management. Curr. Biotica. 2013; 7(1&2):40-50.
9. Hanapur RH, Nandihalli BS. Incidence and constructions of life table for the potato shoot borer, *Leucinodes orbonalis* Guene. Pest Manage. Hortil. Ecosys. 2003; 9:87-91.
10. Indirakumar K, Devi M, Loganthan R. Seasonal incidence and effect of abiotic factors on population dynamics of major insect pests on brinjal crop. Int. J. Pl Protection. 2016; 9(1):142-145.
11. Inee G, Dutta BC. Seasonal abundance of cotton jassid, *Amrasca biguttula biguttula* (Ishida) on okra. J. Agril. Sci. Soc. North-East Ind. 2000; 13(1):22-26.
12. Iqbal J, Ashfaq M, ul Hasan M, Sagheer M, Nadeem M. Influence of abiotic factors on population fluctuation of leaf hopper, *Amrasca biguttula biguttula* (Ishida) on okra. Pak. J. Zool. 2010; 42(5):615-621.
13. Jamwal R, Kondoria JL. Appearance and build-up of *Aphis gossypii G.* on chilli, brinjal and okra in Punjab. J. Aphidol. 1990; 4(1&2):49-52.
14. Jat KL, Pareek BL, Swaroop S. Seasonal incidence of shoot and fruit borer *(Leucinodes orbonalis Guen*.) on eggplant (*Solanum melongena L.*) in Rajasthan. Annals Biol. 2002; 18(2):165-169.
15. Kantipudi RK, Singh NN, Raju SVS, Mishra VK. Influence of abiotic factors on seasonal incidence of brinjal shoot and fruit borer *L. Orbonalis* guen. In Varanasi region. Int. J. Curr. Microbiol. & App. Sci. 2017; 6(4):1513-1518.
16. Kapoor VC, Paul M, Kapur J. Seasonal incidence of mite species infesting okra (*Hibiscus esculentus)* and brinjal (*Solanum melongena)* in Punjab. J. Agril. Sci. 1997; 67:325-326.
17. Koushik NR, Manjunatha M. Incidence of major insect pests of brinjal and their natural enemies under organic ecosystem. J. Eco-friendly Agril. 2013; 9(1):53-56.
18. Kumar B, Singh IB, Verma SK, Pal M. Seasonal incidence and management of *Amrasca biguttula biguttula* Ishida and *Epilachna vigintioctopunctata* Fabr. of brinjal. Pl. Arch. 2014; 14(2):1151-1154.
19. Kumar RK, Singh NN, Raju SVS, Mishtra VK. Influence of Abiotic factors on seasonal incidence of brinjal shoot and fruit borer. *Leucinodes orbonalis* Guen. In Varanasi Region. Int. J. Curr. Microbiol. & App. Sci. 2017; 6(4):1513-1518.
20. Kumar S, Singh D. Seasonal incidence and economic losses of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. Agril. Sci. Dig. 2013; 33(2):98-103.
21. Mahmood T, Syed IH, Khalid MK, Ghulam J, Mukhtar A. Population dynamics of leaf hopper (*Amrasca biguttula biguttula*) on brinjal and effects of abiotic factors on its dynamics. Asi. J. Pl. Sci. 2002; 1(4):403-404.
22. Mohapatra LN. Population dynamics of sucking pests in *Hirsutum* cotton and influence of weather parameters on its incidence in western Orissa. J. Cotton Res. Develop. 2008; 22(2):192-194.
23. Mondal P, Pramanik P, Kumar R. Impact of weather factors on population abundance of brinjal fruit and shoot borer, *Leucinodes orbonalis* (Guenee) in red lateraitic zone of west Bengal. An Int. Biann. J. Environ. Sci. 2014; 8(1&2):101-104.
24. Monica VL, Kumar A, Chand H, Paswan S, Kumar S. Population dynamics of *Tetranych usurticae* Koch on brinjal crop under north Bihar conditions. Pest Manage. In Hortil. Ecosyst. 2014; 20(1):47-49.
25. Muthukumar M, Kalyanasundaram M. Influence of abiotic factors on the incidence of major insect pests in brinjal (*Solanum melongena* L.). South Ind. Hortil. 2003; 51 (1/6):214-218.
26. Mutkule DS, Patel ZP, Ghetiya LV, Singh S, Mote BM. Effect of weather parameters on seasonal abundance of brinjal shoot and fruit borer in south Gujarat. J. Agromet. 2017; 19(2):178-179.
27. Nandi C, Narabenchi G, Jakatimath S, Prafulkumar MV. Seasonal Incidence of brinjal shoot and fruit borer, *Leucinodesorbonalis* Guene, (Lepidoptera: Crambidae) during kharif Seasonal. Int. J. Curr. Microbiol. & App. Sci. 2017; 6(12):088-1093.
28. Patel HV, Radadia GG, Chavda SK. Seasonal incidence of major insect pests of brinjal crop during summer season. Ins. Environ. 2015; 20(4):149-151.
29. Potai A, Chandrakar G. Studies on the seasonal incidence of major insect pests and its natural enemies on okra and their correlation with weather parameters. Int. J. Curr. Microbiol & App. Sci. 2018; 6(Special issue):204-210.
30. Prasad GS, Logiswaran G. Influence of weather factors on population fluctuation of insect pests on brinjal at Madurai, Tamil Nadu. Ind. J. Entomol. 1997; 59:385-388.
31. Prasad NVVSD, Rao NHP, Mahalakshmi MS. Population dynamics of major sucking pests infesting cotton and their relation to weather parameters. J. Cotton Res. & Develop. 2008; 22(1):85-90.
32. Rajput KP, Mutkule DS, Jagtap PK. Seasonal incidence of sucking pests and their correlation with weather parameters in cotton crop. Pestology. 2010; 34(3):44-51.
33. Ramya M, Veeravel R. Population dynamics of Aphis gossypii G. and its natural enemies on brinjal in relation to weather factors. Pest Manage. in Hortil. Ecosyst. 2013; 16(1):54-63.

34. Saini A, Ahir KC, Rana BS, Kumar R. Population dynamics of sucking pests infesting chilli (*Capsicum annum* L.). J. Entomol. & Zool. Studies. 2017; 5(2):250-252.
35. Shalini MV Yadav SP. Seasonal incidence of *Leucinodes orbonalis* and *Amrasca biguttula biguttula* on *Solanum melongena* (brinjal). Int. J. Enhanced Res. in Sci. Tech. & Eng. 2017; 6(6):14-17.
36. Sharma D, Bagmare A, Gupta A, Sharma D. Effect of weather parameters on build-up of key pests of soybean. J. Ins. Sci. 1997; 10(2):120-124.
37. Singh SV, Singh KS, Malik YP. Seasonal abundance and economic losses of shoot and fruit borer. *Leucinodes orbonalis* on brinjal. Ind. J. Ent. 2000; 62(3):247-252.
38. Singh S, Kumar A, Awasthi BK. Study of sucking and leaf feeding insect in relation to weather parameters on the brinjal crops. Veg. Sci. 2005; 32(2):210-212.
39. Singh YP, Singh PP. Biology of shoot and fruit borer (*Leucinodes orbonalis* Guen.) of eggplant (*Solanum melongena*) in medium high attitude hills of Meghalaya. Ind. J. Entomol. 2003; 65:147-154.
40. Sohi GS. Pest of brinjal. Entomological society of India. New Delhi. 1996; P. 148.
41. Tiwari G, Prasad CS, Kumar A, Lok N. Influence of weather factors on population fluctuation of pest complex on brinjal. Annals Pl. Protection Sci. 2012; 20(1):68-71.
42. Tripathi MK, Senapati B. Seasonal incidence of *Leucinodes orbonalis* Guenee in relation to weather parameters and crop growth stage of brinjal at Bhubaneshwar, Orissa. Orissa J. Hortil. 1998; 26:37-41.
43. Tripathi MK, Ashish K, Srivastava DK. Seasonal incidence of mites, Tetranychus urticae Koch and T. Ludeni Zacher on okra and brinjal crops. Annals Pl. Protection Sci. 2014; 22(1):52-55.
44. Yogi K, Kumar A. Studies on the biology and seasonal incidence of shoot and fruit borer of brinjal, *Leucinodes*, *orbonalis* Guen. Under Allahabad agro climatic conditions. Pestology. 2010; 34(7):76-82.