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Seasonal incidence of major insect pests of brinjal and their correlation with weather parameters

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Abstract
The Seasonal incidenceof major insect pests of Brinjal and their correlation with weather parameters were studied during kharif 2017-18 at the Experimental Farm, Department of Agricultural Entomology, Vasantrao Naik Marathwada Agriculture University, Parbhani. The incidence of aphids was highest (8.5 aphids/three leaves) during 46th MW.Mites reached highest incidence (13.6mites/4cm^2/three leaves) in 47th MW. Highest incidence of whitefly (9.1 whiteflies/three leaves) was noticed during 38nd MW. Highest shoot and fruit infestation were found 10.2 per cent at 35th MW and 43.3 per cent at 46th MW respectively. Simple correlation studies revealed that aphids was positively significant correlated with bright sunshine hours (r=0.657*), jassids was negatively significant correlated with maximum temperature (r =-0.494*), whitefly was negatively significant correlated with wind velocity (r=-0.457*), minimum temperature (r = -0.791*), mites incidence was positively significant with bright sunshine hours (0.638*), Population of per cent shoot and fruit damage by *L. orbonalis* was positively significant with rainfall (r= 0.454*) and bright sunshine hours (0.696*) respectively.

Keywords: Brinjal, major insect pests, seasonal incidence, weather parameters

Introduction
Brinjal or eggplant (*Solanum melongena* L.) is an important Solanaceous crop of subtropics and tropics. It is native of India and is grown throughout the country (Choudhary, 1970). It is known as a "King of vegetables".

In India, brinjal is cultivated on an area of 729 thousand ha with an annual production of 12616 thousand million tonnes with productivity of 17.30 tonnes ha^{-1} during 2017-18. The total area under brinjal cultivation is 30 thousand ha in Maharashtra producing 690 thousand million tonnes annually with productivity of 23 tonnes fruits ha^{-1}. The West Bengal is a leading state in brinjal production (2,977 thousand MT) and area (161.50 thousand ha) in India. (Anonymous., 2017).

Insect pests are most limiting factor for accelaring crop yield. Brinjal is attacked by more than 70 insect pests (Subbaratnam and Butani, 1982), of which the major important ones are the shoot and fruit borer (*Leucinodes orbonalis* Guen: pyralidae), stem borer (*Euzophera perticella* Ragonot: Phycitidae), leaf hopper (*Amrasca biguttula biguttula* Ishida: Cicadellidae), aphid (*Aphis gossypii* Glover: Aphididae), whitefly (*Bemisiatabaci* Gennadius: Aleyrodidae), lace wing bugs (*Urentius echinus* Distant and *U. sentis* Distant: Tingidae), and non-insect pest, red spider mite (*Tetranychus macfurlanei* Baker and Pritchard) which cause about 70-92 per cent loss in the fruit yields (Vevai, 1970). The temperature, rainfall, relative humidity and wind speed are the chief weather parameters that largely direct the activity of a given species of insect. The studies on seasonal incidence give us an idea of environmental factors that regulate cyclic occurrence of the pests. Thus its study will help us in planning need based application of insecticides as it clearly reveals the peak activity as well as insect free periods during crop growth.

Material and Methods
Field experiments was conducted during *kharif* 2017-18 at the Farm of Department of Agril. Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). To study the seasonal incidenceof major insect pests of brinjal and their correlation with weather parameters. The experiment was conducted in unprotected plot which was non-replicated and the plot size was 10 m x 10 m which was divided in four quadrants. *Manjiri Gota* variety was used for experiment with spacing 75 cm x 75 cm.

Incidence of sucking pest complex

Incidence of aphid, jassid and whitefly were recorded at weekly interval son 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 are as elected from top, middle and bottom canopy of the plant.

Incidence of brinjal shoot and fruit borer (BSFB)

The incidence of Brinjal shoot and fruit borer was recorded on fiver and only selected plants by counting total number of shoots and fruits with the damage does starting from ten days of transplanting and continued till harvesting.

Relationship between weather parameters and major insect pests of Brinjal

Correlation between weather parameters and major insect pests of Brinjal was worked out. The weather data were collected from observatory of Department of Agricultural Meteorology, VNMKV, Parbhani on weekly basis. The weather parameter *viz*, rainfall, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, evaporation, bright sunshine hours and wind velocity were used for analysis.

3. Results and Discussion

The data on seasonal incidence of major insect pests of brinjal in relation to weather parameters is presented in Table 1 and Fig.1.

Table 1: Seasonal incidence of major insect pests of brinjal during *kharif* 2017

MW	Duration	Sucking pests				BSFB	
		Mean number per three leaves/plant					
		Aphid	Jassid	Whitefly	Mites in 4 cm2 leaf area	Per cent shoot infestation	Per cent fruit infestation
28	9-15 July	0.0	0.0	0.0	0.0	0.0	0.0
29	16-22 July	1.2	2.7	2.7	0.0	0.0	0.0
30	23-29 July	2.3	3.2	4.3	0.0	2.4	0.0
31	30-5 Aug	2.8	4.6	3.4	0.0	3.9	0.0
32	6-12 Aug	4.1	6.3	5.6	0.0	9.3	0.0
33	13-19Aug	3.3	9.0	8.5	0.0	8.6	3.7
34	20-26Aug	2.9	8.5	8.9	0.0	8.2	4.3
35	27-2 Sep	5.1	11.8	8.2	0.0	10.2	9.2
36	3-9 Sep	3.8	3.4	7.4	0.0	8.1	22.1
37	10-16 Sep	3.2	2.3	8.5	0.0	4.2	26.2
38	17-23 Sep	2.7	1.4	9.1	2.1	3.0	32.5
39	24-30 Sep	2.1	2.9	6.9	4.7	2.1	30.4
40	1-7 Oct	2.9	1.6	6.4	2.9	1.8	34.2
41	8-14 Oct	2.4	1.0	6.3	1.5	1.1	42.0
42	15-21 Oct	3.9	4.3	6.7	3.2	0.0	38.7
43	22-28 Oct	4.5	6.9	5.4	4.6	0.0	36.1
44	29-4 Nov	6.2	12.0	5.1	5.8	0.0	37.9
45	5-11 Nov	7.8	10.3	4.3	7.1	0.0	41.3
46	12-18 Nov	8.5	8.4	5.0	11.2	0.0	43.3
47	19-25 Nov	8.1	6.3	5.4	13.6	0.0	40.1

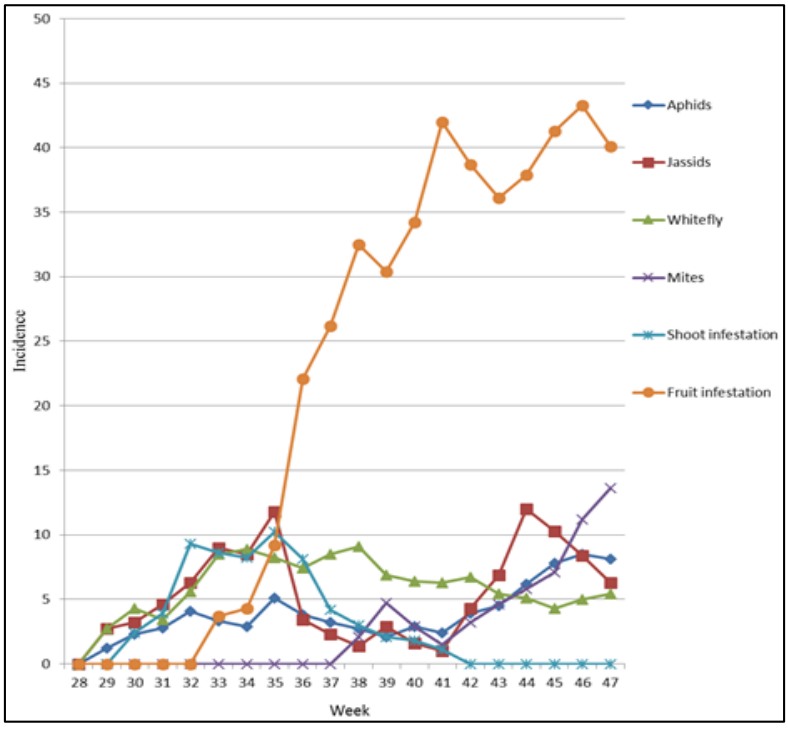

Fig 1: Seasonal incidence of major insect pests of brinjal

Aphid, (*A. gossypii*.): Aphid population was zero during 28th SMW. The incidence of aphids started from 29th SMW (1.20 aphids/three leaves) with first (4.1 aphids/three leaves), second (5.1 aphids/three leaves) and third peak 8.5 aphids/three leaves in 32th, 35th and 46th SMW, respectively. Rajput *et al.,* (2010) observed that *A. gossypii* population showed peak activity during 33rd SMW and 35th SMW in 2002-2003. Results showed that *A. gossypii* population was at peak in 34th-38th standard week.

Jassids (*A biguttula biguttula*): The incidence of jassids started from 29th SMW (2.70 jassids/three leaves) which reached its 1st peak (11.8 jassids/ three leaves) in 35th SMW and 2nd peak (12.0 jassids/three leaves) in 44th SMW. Kumar *et al*., (2014) observed incidence of *Amrasca biguttula biguttula* on brinjal commenced from 6th week after sowing *i.e.* 3rd week of August (34th SMW) with an average population level of 0.11 jassids/leaf during 1st year and in 2nd year, it started from third week of August (34th SMW) with an average population level 0.11 jassids/leaf. Maximum population was observed during third week of October (43rd SMW).

Whitefly (*B. tabaci*): The incidence of whitefly ranged from 2.70 whiteflies per three leaves (29th SMW) to 9.1 whiteflies per three leaves (38th SMW) which was peak incidence. Rajput *et al.,* (2010) observed the highest incidence of whitefly on during 41st SMW *i.e.* 8th-14th October. They further added that during 2002-03 the population of *B. tabaci* was low throughout the season with maximum population during 42nd MW.

Red spider mites (*Tetranychus urticae* Koch): The incidence of red spider mite (2.1 mites /4cm^2/three leaves) was initiated on brinjal in 38th SMW. The peak population (13.6 mites/4cm^2/three leaves) was observed in 47th SMW during experiment. Patil *et al* (2009), they reported that spider mites appeared much later on *kharif* crop than *summer* crop *i.e.* at 90 days after transplanting (1st week of November). The first peak incidence occurred in 46th standard week (November 12-18) with 28.73 individuals per 4 cm^2 leaf area.

Brinjal shoot borer (*L. orbonalis*): The infestation was ranged from 2.4 (30th SMW) to 1.1 per cent (41th SMW). During first two weeks of observation (28th to 29th SMW) no incidence was observed which increased in next 7 weeks and recorded peak of 10.2 per cent shoot infestation at 35th SMW. Thereafter the population went on decreasing and almost nil after 41th SMW. The reason might be the pest may get shifted to fruits. Bharadiya and Patel (2005) reported that the activity of shoot and fruit borer, *L. orbonalis* on shoots was started in the first week of September (4.9% incidence) and reached the peak level (17.1%) before migrating to fruits by fourth week of October. Kantipudi *et al.,* (2017) observed that the highest per cent shoot infestation in second week of September.

Brinjal fruit borer (*L. orbonalis*): The incidence of borer on the fruits started in 33th SMW coinciding with the setting of fruits. During next 15 weeks pest incidence was increased and recorded peak of 43.3 per cent at 46th SMW. Kantipudi *et al.,* (2017) reported the highest per cent fruit infestation of shoot and fruit borer in 3rd week of October during both years.

Correlation between major insect pests of brinjal in relation to weather parameters

The data on correlation between major insect pests of Brinjal and weather parameters is presented in Tables 2.

Table 2: Correlation of weather parameters with insect pests of brinjal

Weather parameters	Correlation coefficient ('r' value)					
	Aphid	Jassid	Whitefly	Mites	Per cent Shoot damage	Per cent Fruit damage
Rainfall	-0.423	-0.184	-0.313	-0.513*	0.454*	-0.290
Maximum temperature (^{0}C)	-0.111	-0.494*	-0.270	0.238	-0.513*	0.266
Minimum temperature (^{0}C)	-0.621*	-0.791*	-0.188	-0.381	-0.078	-0.235
Morning relative humidity (%)	-0.577*	-0.219	0.165	-0.660*	0.434	-0.537*
Evening relative humidity (%)	-0.717*	-0.413	0.216	-0.745*	0.508*	-0.628*
Bright sunshine (hrs)	0.657*	0.393	0.057	0.638*	-0.351	0.696*
Wind velocity (km/hr)	-0.544*	-0.206	-0.457*	-0.488*	0.166	-0.817*

* Significant at 5%

Aphids (*A gossypii*): population of aphids was negatively and significant correlated minimum temperature (r = -621*), morning relative humidity (r = -0.577*), evening relative humidity (r = -0.717*), positive and significant correlated with bright sunshine hours (r= 0.657*) and non–significant negative correlation was observed between aphid population and rainfall (r = -0.423), maximum temperature (r = -0.111), Mohapatra (2008) stated that among the weather parameters, temperature showed a positive correlation with *A. gossypii* while effect of rainfall was adverse. Ramya and Veeravel (2010) documented that the rainfall and wind velocity had negative correlation with pest infestation.

Jassid (*Amrasca biguttula bigutulla*): population of jassid was negatively significant correlated with maximum temperature (r = -0.494) and minimum temperature (r = -0.791*), while non-significant negative correlation was observed between jassid population and rainfall (r = -0.184), morning relative humidity (r = -0.219), evening relative humidity (r = -0.413), wind velocity (r = -0.206) and non-significant positively correlated with bright sunshine hours (0.393). Indira kumar *et al.,* (2016) seen the significant negative correlation with both maximum and minimum temperature and wind speed.

Whitefly (*B. tabaci*): Population of white fly was negatively significant correlated with wind velocity (r = -0.457*), while non-significant negative correlation was observed between whitefly population and rainfall (r = -0.313), maximum temperature (r = -0.270) and minimum temperature (r = -0.188) and non- significant positively correlated with bright sunshine hours (r =0.057), morning relative humidity (r = 0.165), evening relative humidity (r = 0.216). Indira kumar *et al.,* (2016) found significant negative correlation with maximum temperature and wind speed.

Red spider mite (*Tetranychus urticae*): Population of red spider mites was negative significant correlated with wind velocity (-0.488*), rainfall (r = -0.513*), morning relative humidity (r = -0.660*), evening relative humidity (r = -0.745*) while non-significant negative correlation was observed between red spider mites population and minimum temperature (r = -0.381), and positively significant with bright sunshine hours (r = 0.638*) and non- significant positively correlated with maximum temperature (r =0.238). Monica *et al.,* (2014) 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* : population of per cent shoot damage by *L. orbonalis* was negative significant correlated with maximum temperature (r= -0.513*) while non- significant negative correlation was observed between per cent shoot damage by *L. orbonalis* and minimum temperature (r = -0.078), bright sunshine hours (r= -0.351) and positively significant with rainfall (r= 0.454*), evening relative humidity (r = 0.508*) while non- significant positively correlated with morning relative humidity (r= 0.434) and wind velocity (r= 0.166). Savitha *et al.,* (2009) stated that shoot and fruit borer incidence showed positive correlation with maximum relative humidity, rainfall and wind speed.

Per cent fruit damage by *L. orbonalis:* population of per cent fruit damage by *L. orbonalis* was negative significant correlated with morning relative humidity (r = -0.537*), evening relative humidity (r = -0.628*) and wind velocity (r = -0.817*) while non- significant negative correlation was observed between per cent fruit damage by *L. orbonalis* and minimum temperature (r = -0.235), rainfall (r = -0.290) and positively significant with bright sunshine hours (r = 0.696*) while non- significant positively correlated with maximum temperature (r = 0.266). Kantipudi *et al.,* (2017) stated that fruit borer incidence showed negative correlation with evening relative humidity and morning relative humidity. Sharma *et al*., (2017) showed that positively non-significant correlated with maximum temperature, morning relative humidity, rainfall.

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