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Biology and Seasonality of Lace bug *Cochlochila bullita* (Stal) (Heteroptera: Tingidae) on Tulsi *Ocimum sanctum* L.

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Abstract

An experiment was conducted to study the biology and seasonal incidence of lace bug, *Cochlochila bullita* (Stal) infesting tulsi (*Ocimum sanctum* L.) at Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, India. The incubation period varied from 4-6.5 days (average 5.45±0.762 days) and 4-7.5 days (average 5.60±1.220 days) during June, 2018 and August, 2018 respectively. Similarly, the nymphal period of 1st instar lasted from 2-4.5 days (average 2.95±0.832 days) and 2-4 days (average 3.3±0.714 days), 2nd instar lasted from 2-4 days (average 3.10±0.738 days) and 2-4 days (average 3.15±0.668 days), 3rd instar lasted from 2-3 days (average 2.45±0.497 days) and 2-3.5 days (average 2.65±0.579 days), 4th instar lasted from 1.5-2.5 days (average1.90±0.316 days) and 1-3 days (average1.80±0.674 days), 5th instar lasted from 1-2.5 days (average 1.45±.599 days) and 1-2 days (average 1.60±.459 days) during two study periods, respectively. The total nymphal period varied from 8.5-15 days (average 11.85±1.749 days) and 9.5-15.5 days (average 12.5±2.160 days). The total life span of lace bug ranged from 41-52 days (average 46.85±3.448 days) and 43-55.5 days (average 48.45±3.840 days) during two consecutive studies. The lace bug population commenced in the field during second fortnight of June and attained the peak (35.00/10 cm twig) in the first fortnight of December. More lace bug was recorded during the winter season and population declined in the month of February. The lace bug population registered significant negative correlation with abiotic temperature. However multiple regression analysis of lace bug population with abiotic factors revealed limited influence of weather parameters on the population of the pest.

Keywords: biology, seasonality, lacewing bug, *Cochlochila bullita*

1. Introduction

Lacewing bug (*Cochlochila bullita* Stal) is a major pest in *Ocimum* cultivation (Kumar, 2013). *C. bullita* is widely distributed in the Paleotropics, particularly southeast Asia (including India and China) and Africa (Deckert and Gollner-Scheiding, 2006; Guilbert, 2013). This pest is not known to occur in the Western Hemisphere but has been intercepted multiple times at ports of entry in the United States (Allan, 2013). This pest was first reported in basil from the eastern part of India (Kumar, 2011). Bhattacharyya and Chakravorty (1984) have reported the incidence of *C. bullita* on tulsi plants in Kalyani, West Bengal. *C. bullita* occurs on several host plants belonging to the family Lamiaceae which include, holy basil (*O. sanctum*), sweet basil (*O. basilicum*), camphor basil (*O. kilimandscharicum*), mint (*Mentha* spp.), lavender (*Lavendula*

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spp.), safflower (*Carthamus tinctorius*), rosemary (*Rosmarinus officinalis*) and cat's whiskers (*Orthosiphon aristatus*) (Giliomee, 2014; Peng et al*.,* 2015). Cat's whiskers, *O*. *aristatus* seems to be less tolerant to *C*. *bullita* infestation as compared to Sweet basil, *O*. *basilicum* (Peng et al., 2019). Tulsi, *Ocimum sanctum* L. also known as holy basil is called the queen of herbs or elixir of life. It is an aromatic plant belonging to the family Lamiaceae. This species is believed to be originated in India. In India, there are two types of tulsi under cultivation *viz*., the green type or Sada tulsi and Krishna tulsi bearing purple leaves (Smitha et al., 2014). In the plains of north India, south India and Assam it may; however, be grown as both *kharif* and *rabi* crops. In actual practice, about 30-35 kg ha^{-1} oil, corresponding to 12-13 kg of flower oil and 18-22 kg of whole herb oil is obtained from this species (Panda, 2005). Main components of basil essential oil are linalool, camphor, 1, 8 cineole and germacren-D (Arabaci, 2004; Daneshian, 2013). Tulsi hybrid is now being cultivated in about 2000 hectares of land in India (Balyan and Pushpangardan, 1988) as ayurvedic and medicinal plant. Many scientific studies have revealed that tulsi is being used in various clinical conditions like anxiety, chronic cold, fever, snake and scorpion bites with wide therapeutic applications in bronchial asthma, malaria, arthritis, cataract conjunctives, diarrhea, gastric, hepatic, cardiovascular and immunological disorders. The plant is infested by a number of pests like lace bug, aphid, leaf roller in the sub-Himalayan terai region of West Bengal (Anonymous, 2018). Damage by the lace bug was more severe during last October to mid-January and a yield loss of 27.84% was recorded due to the infestation by this pest on tulsi (Anonymous, 2013). Both the temperature and humidity influenced the population built up and survivability of lace bug at Saharanpur (Jain and Dhiman, 2011). Dhiman and Datta (2013) reported that at Saharanpur the population of *Cochlochila bullita* commenced on the host plants during first week of April and attained peak in September and November. Kumar (2013) also found that population started in June and continued until December on *Ocimum sanctum* in Jharkhand province of India. There was a peak population of lace bug 63.8 in 2011 and 71.2 in 2012 plant^{-1} during August and September. All life stages of *C. bullita* are reported to cause rolling, withering and drying of leaf tips by piercing-sucking of the sap from the soft leaves (Sajap and Peng, 2010). The biology and seasonality of this pest had not been studied in this region. In view of the above fact, the experiment has been conducted to study the biology and seasonality of the pest in the sub-Himalayan Terai region of West Bengal.

2. Materials and Methods

Studies on the biology of lace bug, *C. bullita* was carried out twice under laboratory conditions at 24±1 °C temperature and 65±2% RH, during June, 2018 and August, 2018 at the Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari (89^{0}23'53" E longitude and 26^{0}19'86" N latitude), West Bengal, India. Adults of lacewing bug were collected from field and ten pairs of adults were kept in Petri dishes along with tender tulsi leaves. During biological studies oviposition, incubation period, nymphal duration and adult duration were observed. Adult female laid eggs which were deposited on the leaves and young branches. For the study of the incubation period, ten freshly laid eggs were taken out along with leaves and tender twigs and were kept on filter paper in three covered Petri dishes with enough moisture. To maintain sufficient moisture inside, water soaked cotton swabs were kept. Newly hatched nymphs were collected and transferred carefully using a wet camel brush on fresh leaves and tender twigs. The leaves were changed on alternate days and till formation of adults. While transferring on fresh leaves, the nymphs were examined for signs of moulting. After coming to adult stage, adults were separated in pairs and reared in Petri dishes on tulsi leaves. The longevity of adult was recorded. For seasonality study the crop was grown following normal recommended agronomical practices. The crop was kept free from insecticides to allow natural multiplication of population. Observations were recorded fortnightly from five randomly selected plants from each plot. Three randomly selected twigs from each plant were selected and mean number of aphids per 10 cm twig was counted. The data on different abiotic parameters were collected from the Agro-meteorology unit, UBKV, Pundibari. Simple correlation coefficient (r) and multiple regression equation were derived between the average lace bug population during a fortnight and the average fortnightly maximum and minimum temperature, maximum and minimum relative humidity and cumulative rainfall during that fortnight. Statistical analysis was done using OPSTAT statistical package.

3. Results and Discussion

Freshly laid eggs were dark brown in colour and oblong in shape with slightly tapered towards opercula. The incubation period was 4-6.5 days (average 5.45±0.762 days) and 4-7.5 days (average 5.60±1.22 days) during June, 2018 and August, 2018 respectively (Table 1). The present findings are satisfactorily supported by earlier worker Kumar (2013) who reported that the mean incubation period was 6.06 days on *O. sanctum*.

The nymphal period was 8.5-15 days (average 11.85±1.749 days) during June, 2018 and 9.5-15.5 days (average 12.5±2.160 days) during August, 2018. The nymphs passed through five instars to complete the nympahl period. Newly moulted nymphs were pale brown in colour. The first instar period was 2-4.5 days (average 2.95±0.832 days) and 2-4 days (average 3.3±0.714 days) during June, 2018 and August, 2018 respectively. The second instar was dark brown, later becoming somewhat black, more rounded shape and margin bears spines which were especially prominent on the abdomen. The duration of second instar was 2-4 days (3.10±0.738 days) during June, 2018 and 2-4 days (3.15±0.668

Table 1: Duration of different life stages of *C. bullita* on *Ocimum sanctum*

Sl. No	Life stages of insect	Duration (In days)			
		June (2018)		August (2018)	
		Data range	Mean ± SD	Data range	Mean ± SD
1.	Incubation period	4-6.5	5.45±0.762	4-7.5	5.60 ± 1.220
2. Nymph period					
	1st instar	2-4.5	2.95±0.832	2-4	3.3 ± 0.714
	2nd instar	2-4	3.10±0.738	2-4	3.15 ± 0.668
	3rd instar	2-3	2.45±0.497	2-3.5	2.65 ± 0.579
	4th instar	1.5-2.5	1.90±0.316	1-3	1.80 ± 0.674
	5th instar	1-2.5	1.45±0.599	1-2	1.60 ± 0.459
3.	Total nymphal period	8.5-15	11.85±1.749	9.5-15.5	12.5 ± 2.160
4.	Total developmental period (egg to adult emergence)	13.5-20	17.30±1.932	14.5-21.5	18.1 ± 2.306
5.	Adult longevity	26.5-34.5	29.55±2.544	28-35.5	30.35 ± 2.667
6.	Total life duration	41-52	46.85±3.448	43-55.5	48.45 ± 3.840

days) during August, 2018. The third instar was similar in all respect with that of second instar but it was little larger, more rounded and short cephalic spines present. The duration of the third instar was recorded as 2-3 days (average 2.45±0.497 days) and 2-3.5 days (average 2.65±0.579 days) during June, 2018 and August, 2018 respectively. The fourth instar increased in size, pronotum was larger and wider on the thorax compared to third instar, cephalic spines present. The duration of the fourth instar was 1.5-2.5 days (average 1.90±0.316 days) and 1-3 days (average 1.80±0.674 days) during June, 2018 and August, 2018 respectively. During the fifth instar body shape was similar to fourth instar except more elongated and the fifth instar period was 1-2.5 days (average 1.45±0.599 days) during June, 2018 and 1-2 days (average 1.60±0.459 days) during August, 2018. Kumar (2013) reported that nymphal period was 11.50 days which was more or less similar with present study.

The adult period was 26.5-34.5 days (average 29.55±2.544 days) during June, 2018 and 28-35.5 days (average 30.35±2.667 days) during August, 2018. Adults were tiny bugs, black in colour with hyaline wings, because of their wings being partially transparent and lace-like in architecture and a characteristic hollow, globular outgrowth on the dorso-lateral portion of thorax. Kumar (2013) reported that adult period lasted for 21.18 days. Total life cycle of *C. bullita* varied from 41-52 days (average 46.85±3.448 days) and 43-55.5 days (average 48.45±3.840 days) during June, 2018 and August, 2018 respectively.

In the field lace bug started coming in the second fortnight of June, 2018 (Table 2). The population kept on fluctuating in the rainy season and started increasing steadily in the

Table 2: Seasonal incidence of lace bug on *Ocimum sanctum* during 2018-19

Month and year	Fortnight	Lace bug/10 cm twig	Temp °C		R.H. (%)		R.F. (mm)
			Max.	Min.	Max.	Min	
March-2018	I	0.00	29.4	16.2	71.6	50.0	6.4
March-2018	II	0.00	30.6	16.8	70.9	48.3	94.8
April-2018	I	0.00	31.0	19.0	74.8	60.1	159.4
April-2018	II	0.00	29.6	20.4	79.1	69.5	54.2
May-2018	I	0.00	30.0	20.0	82.2	69.7	62.7
May-2018	II	0.00	31.8	22.0	86.1	70.4	174.4
June-2018	I	0.00	34.0	24.0	81.7	69.7	90.9
June-2018	II	6.40	31.2	23.8	90.8	78.9	243.6
July-2018	I	19.20	31.2	24.8	91.5	83.0	488.7
July-2018	II	13.80	33.8	26.2	86.3	74.8	132.7

Table 2: Continue...

Month and year	Fortnight	Lace bug/10 cm twig	Temp °C		R.H. (%)		R.F. (mm)
			Max.	Min.	Max.	Min	
August-2018	I	8.00	33.1	24.1	89.6	75.6	305.6
August-2018	II	6.60	33.9	26.3	86.3	74.7	63.7
September-2018	I	18.20	31.6	25.1	91.3	81.1	349.3
September-2018	II	27.00	33.0	24.8	86.7	71.3	69.8
October-2018	I	29.20	31.0	22.1	81.7	69.7	3.3
October-2018	II	24.40	30.8	19.1	70.6	58.4	0.6
November-2018	I	24.20	29.7	16.8	74.7	54.3	0.0
November-2018	II	31.20	28.3	13.5	75.6	49.1	0.0
December-2018	I	35.00	27.6	11.3	68.5	44.6	0.0
December-2018	II	29.00	24.3	10.2	83.6	52.2	5.8
January-2019	I	25.60	25.6	8.0	75.8	41.7	0.0
January-2019	II	29.00	26.3	10.0	81.3	44.1	0.5
February-2019	I	16.60	26.2	10.2	82.6	52.8	8.9
February-2019	II	9.40	25.8	14.2	79.8	56.0	4.7

month of September, 2018. The peak population (35.00/10 cm twig) was recorded in the first fortnight of December, 2018. The lace bug population started decreasing in the month of February, 2019. The present findings with respect to the seasonality of lace bug are partially supported by earlier workers (Dhiman and Datta, 2013; Kumar, 2013). This may be due to the variations of prevailing climatic conditions and crop physiological characteristics in different agro-climatic regions. Significant negative correlation was found between lace bug population with the maximum and minimum temperature (Table 3). Other meteorological parameters failed to show any significant association with the lace bug population. The

Table 3: Correlation coefficient (r) between lace bug population and weather parameters

Weather parameters	Max. Temp °C	Min. Temp °C	Max. R.H. (%)	Min. R.H. (%)	Rainfall (mm)
Correlation coefficient with lace bug population	-0.420*	-0.413*	-0.116NS	-0.352NS	-0.261NS

*Significant at p=0.05 level; NS: Non Significant

multiple regression analysis of the lace bug population with weather parameters has been worked out and the results have been presented in Table 4. Perusal of the results revealed that the abiotic parameters had insignificant cumulative influence on the population fluctuation of lace bug and together all the abiotic parameters were responsible for 23% variation in the lace bug population. The present findings are partially supported by the earlier reports of Jain and Dhiman (2011) who found that both temperature and humidity influenced the population built up and survivability of lace bug at Saharanpur, India.

Table 4: Multiple regression equation of lace bug population with weather parameters

Multiple regression equation	Coefficient of determination (R^2)
Y= 25.901 -1.381X1 + 0.557 X2 + 0.703X3 -0.580X4 - 0.009X5	0.23

X_1: Maximum temperature; X_2: Minimum temperature; X_3: Maximum relative humidity; X_4: Minimum relative humidity; X_5: Rainfall

4. Conclusion

Lace bug passed through five nymphal instars and the total life span ranged from 41-52 days (average 46.85±3.448 days) and 43-55.5 days (average 48.45±3.840 days) during two consecutive study periods. The lace bug population was more abundant during the winter season with a peak population in the first fortnight of December. The abiotic temperature significantly influenced the population build-up of lace bug. But cumulative influence of weather parameters was insignificant on the population of lace bug.

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