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STUDIES ON SOME ETHOLOGICAL ASPECTS OF *COCHLOCHILABULLITA*STAL (HETEROPTERA-TINGIDAE), A SERIOUS PEST OF SWEET BASIL, *OCIMUM BASILICUM* LINN (LAMIACEAE)

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ABSTRACT

C. bullita *is an important tingid pest of* ***O. basilicum*** *which deposit eggs inside the host tissue usually in the veins of the leaf and tender stem. Rostral sensory setae help in the selection of oviposition site and saw like ovipositor makes deep puncturation for egg deposition from enemies as well as during extremes of cold and heat parental care is observed. Nymphs remain in aggregated form with the female. Negative phototropic responses have been observed for all nymphs and adults and prefer to live in the diffused light. During winter nymphs come on the dorsal surface of leaves or bark to the sun or warm up themselves. Moulting process lasts for 86 to 120 minutes and next nymphal instar or adult emerges out through the split exuvium of previous instar or 5th instar nymph. During winter, low population of nymphal instars occurs and these two remain in quiescent stage and prolong nymphal developmental period. Clusters of nymphs in the groups of 10 to 15 were seen inside the curled leaves to avoid cold weather.*

KEYWORDS: ***C.bullita***, ***O. Basilicum***, *Ethology, Oviposition Behavior, Parental Care, Phototaxic and Moulting Behavior, Hibernation*

INTRODUCTION

Cochlochilabullita Stal (***Monanthiaglobulifera*** Walker) though is of small-sized tinged bug, yet it inflicts heavy damage to the scented plant, ***Ocimumbasilicum*** Linn Heavily damaged plant gives a burnt appearance as every part of the plant, viz, leaves, stem, inflorescence and seeds and damaged by desapping and saliva injection. The seasonal occurrence of ***C.bullita*** was studied at Saharanpur by Jain and Dhiman(2011) on ***O. sanctum*** while on ***O. basilicum*** by Dhiman and Dutta (2013). Its biology was worked out by Palaniswami & Pillai (1983) and Sajap and Peng (2010). In relation to insects, ethology has made considerable strides of progress during the past few decades. Considerable attention has been focused on chemical signals in economically important insects visual signals of some insects and their role in reproduction activities have been investigated. Acoustic signals in insect's fascilitate congregation, sexual attraction and aggregation activities. Hence, different ethological parameters of this bug have been investigated in the field as well as in the laboratory.

MATERIALS AND METHODS

For the purpose of ethological studies rearing of ***C. bullita*** was carried out and for this 5th instar nymphs of approximately same age, along with fresh leaves and twigs of host plant ***O. bajilicum***, were collected by hand picking method from the field area (Saharanpur) as well as from Kitchen gardens of the houses in polyethylene bags.

These were brought alive in the laboratory and restored in hurricane glass lantern chimneys and in plastic jars till their final moults. The newly emerged pairs were sorted out from the culture and kept separately for further rearing. The rearing on potted plants covered by fine wire mesh was also carried out in laboratory insectary. Observations were carefully taken during 2011 and 2012 with the aid of a magnifying hand lens (20 X). To ascertain the oviposition site and oviposited eggs several dissections of the tender stem, leaves veins and petioles were made under the binocular microscope.

RESULT AND DISCUSSIONS

Among several ethological aspects, oviposition behavior, parental care, phototaxic and moulting behavior as well as hibernation were studied.

Oviposition Behavior

Oviposition in this tingid begins seven days after mating. The females of ***C. bullita*** selected leaf petiole, veins of a leaf or tender stem of the host plant for oviposition, preferable in the midvein and petiole. Probing of a suitable oviposition site is done with the help of sensory setae of terminal rostral segment tip and antennae. After the selection of suitable site, female releases its ovipositor by sideways movements of the terminal segment of the abdomen. The ovipositor blades which bear saw like denticles, are thrusted into leaf tissue where the eggs are deposited, but, prior to the release of eggs, the abdomen is straightened and then fixed downward in therhythmic rocking motion of several times. The ovipositors then moves sideways and then the egg is finally deposited. Along with ovipositor, the terminal segment of the abdomen also enters the leaf tissue partially during the act of oviposition. All the three pairs of legs of the ovipositing female are well spreaded and claws usually tarsi are firmly planted on the leaf giving the firm grip to the bug. The fore and mid legs are drawn anteriorly, while the hind legs are drawn posteriorly. The antennae are fixed backward against the head prior to oviposition for 2-4 second. It takes 5-10 minutes for the first egg to be deposited and subsequent eggs are laid in 20-25 minutes. Immediately after depositing an egg, the ovipositors are withdrawn. Usually, ***C. bullita*** deposit eggs in rows and less frequently single or in groups of two and more. When the field conditions were created in a laboratory in the plastic jars, they preferred to lay the egg in leaf petiole, midvein and side veins of the leaf. Entire egg is inserted in the leaf tissue except for the opercular part which is exposed outside. On the laid site, blackish spot develops after a few hours. The largest number of eggs deposited by a single female in one day was nine eggs. Immediately after oviposition the female bug cleans its ovipositors with tarsi of hind legs having setae and spines and then ovipositors are retracted into the genital chamber. Feeding commences immediately after a short time of oviposition. Oviposition is noticed in the laboratory, preferably, in morning and evening time and rarely at the noon. A sticky substance secreted by accessory gland glued the egg in the host tissue. In other tinged bugs Mishra and Sen-Sharma (1986) said that eggs of ***L. decora*** are laid on the undersurface of leaves in irregular rows and are inserted in the tissue of midrib. Patel and Kulkarney(1955) stated that in ***U. echinus***, the eggs were laid marginally inwards from the upper surface of leaf closer to each other. Trigattnanat (1983) said that eggs were deposited by ***Mananthiaglobulifera*** and young branches singly or in the cluster. Sajap and Peng (2010) mentioned that ***C. bullita*** deposited eggs in young branches and leaves of ***O. basilicum.***

Parental Care

Parental care can be observed in many members of Tingidae to protect their younger ones from extremes of high as well as low temperature. In its most primitive state, parental care is limited to the physical protection of the eggs which

is extended by the female parent. Female ***C.bullita*** lays eggs within leaf tissue of ***O.basillicum*** to protect them from desiccation and natural enemies.

Although, the true parental case is not observed in ***C. bullita*** but this behavior exists in extreme of hot (May to June) and cold (December to February) conditions. The adults hide their younger nymphs, i.e., first to 3rdmistake under their over in aggregation to protect them from extreme of high as well as low temperature (40^0C, 15^0 to 10^0C).

Both sexes take part in these behaviors. The activity was confirmed experimentally. A glass trough was taken and a watch glass full of water was placed in it. Now 10 nymphs of each stage and 10 adults of either sex were released in the trough along with food (leaves of ***O. sanctum***). The trough was covered with muslin cloth and then placed in the temperature and R.H. control Cabinet. The temperature was raised to 35^0C. After half an hour, it was observed that first to fourth instar nymphs came under the males as well as females which made a cover for them. The same experiments were repeated at low- temperature 10^0C and the same results were found. It is concluded that in adverse condition both male and female bugs give protection to their nymphs. Moreover, during winter months left over nymphs gregariously remain together inside the curled leaf. Hardin and Tallamy(1992) reported maternal care in ***G.tillae*** and ***G.solani***, Feath (1989) said that lace bug, ***Corythuchahewetti*** females remain in close proximity to their broods from the egg to adult stage. Presence of the mother increases the persistence and probably the survival of nymphs and those nymphs recognize their mother or vice versa. Gregarious means of parental care in the nymphs of ***T. scrupulosa*** and ***C. bullita*** have been observed by Jain (2001) and Sajap and Perg (2010).

Phototaxic behavior

C.bullita showed generally, negative phototropic response and prefers to live in low intensity of light in the gregarious mode of life, i.e, in the shadow area. It was observed in the field that during summer months (May to July) when the days are with long photoperiod (LD, 14:10) and intensity of solar light is on the peak, the clusters of bugs were found on undersurface of leaf and sometimes inside the curled leaf nearby the base of the stem of the food plant. This bug prefer to live in the diffused light and in cloudy days when the intensity of light get lowered, their life activities increases and they come in open areas of the plant. i.e, an upper dorsal surface of leaf, stem and inflorescence. Maximum copulation was observed in these days. A high intensity of life reduces the mating as well as feeding activities.

During winter months (mid November to February), days with short photoperiod (LD. 10:14) mating intensity of ***C.bullita*** decreases and due to decline in temperature of the environment, activities of the bug declines and incubation and nymphal period is increased when, the photoperiod begins to increases during last week of February or March (LD, 12:12), the activities of the bug increases. Reproductive activities such as copulation and oviposition begins.

The photoperiod also plays an important role in the ecdysis of nymphs preferably of is 4th and 5thnymphal instars. As a matter of fact, in rainy months when the solar rays are not available to nymphs for a longer duration, moulting process is delayed. This is one of the factors which lengthen the life cycle of ***C.bullita***.

In the field, when the light was thrown by a torch on the gregarious population of bugs, they dispersed to other places in search of diffused light. However, when they could not get such place of hiding with the effect of continuous light, then they stopped moving, became motionless on the leaf surface; switching off torch resulted in quick movement in such bugs. It was also observed that when the photo phase was reduced by 6 to 4, the reduction in mating activities was

observed. Further, during winter months, nymphs and adults are also seen on the dorsal surface of leaf bathing sun to get warm.

It was further observed during experimentation that ***C. bullita*** showed the negative phototropic response for different colors of light. For the same, different colored bulbs of 15-watt intensity, viz., blue, green, orange, red, and yellow color were used and the electric supply was maintained form a tube well electric supply which was situated near the study site area. Similarly, 100 and 500 watt bulbs were also used as intensity source of light. Data of response of ***C. bulliba*** towards the different colors of light are recorded in table-1. An examination of this table clearly indicates that ***C. bullita*** is not attracted towards the various color of different intensities of light used in the experiments. They avoid light and moved to dark during the night. Thus, there is a negative phototropic response. In other tingids, Sruham and Tuncer (2010) observed in the adults of ***P. prasina*** a significant attraction to the yellow colours in free choice test. Jain (2010) also mentioned positive response of ***E. capitatus*** towards yellow light than other.

Moulting Behaviour

The first instar nymph undergoes 5 moults before emerging into adults. During moulting, a longitudinal slit appears extending from the middle of the head to the metathorax. The moulting nymphs firmly holds host surface by claws. First of all, head comes out through the slit, later on antennae, rostrum and legs becomes the face and at last stage of ecdysis, the abdomen is pulled out for completion of this process. The newly emerged nymph is shiny, whitish color and later on body color changes to dark black or brown on exposure to air. The emerged nymph after taking some rest, moves forwards and starts feeding on tender leaf or twig of a host plant. Entire process of moulting lasts for 86 to 180 minutes, the average being 128 minutes. Pahaniswami and Pillai (1983) mentioned 2 to 4 hours duration in the same bug. In ***C. bullita***, arrestation of ecdysis process occurs during extremes of cold of winter.

Hibernation

C. bullita occurs almost throughout the year in its natural habitat on different food plants. During winter months i.e, mid of Nov. to February, all stages of the bug except first and second instars remain in aggregated form under the lower surface of the leaves of the main host plant, ***O. basilicum***, as well as on other host plants of the bug. The bugs in such form remain under semi quiescent stage due to marked effect of low temperature and do not perform any life activities like feeding, reproduction and migration etc. However, during daytime, they come on the dorsal surface of a leaf, get the heat of the sun and become active till evening. Arrestation of development and ecdysis in nymphs also occurs during extremes of cold and foggy days. During December to February, adults were rarely seen and the nymphal population was extremely low. Roonwal (1952, reported overwintering eggs in ***T. scupulosa***), Singh and Mann (1986) reported hibernation in the adults of ***U. hystracellus*** under the fallen leaves of brinjal plant from November to March.

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APPENDIEX

Table 1: Phototaxic Response of *C.bullita* on Different Colours of 15,100 and 500 Watt Bulbs

Date and Time of Experiment Started		Colour of Bulb Used	No. of Bugs Attracted	Response of Bugs + or -
Date	**Time**			
On Different Colours of 15 Watt Bulbs				
06-05-2012	6 am	Blue	Nil	- ve
08-05-2012	8 am	Green	Nil	- ve
11-06-2012	5 pm	Red	Nil	- ve
12-06-2012	7 am	Orange	Nil	- ve
14-07-2012	10 am	Yellow	Nil	- ve
On Different Colours of 100 Watt BULBS				
07-11-2012	11 am	Blue	Nil	- ve
10-11-2012	11 am	Green	Nil	- ve
11-11-2012	8 am	Red	Nil	- ve
12-11-2012	10 am	Orange	Nil	- ve
19-11-2012	7 am	Yellow	Nil	- ve
On Different Colours of 500 Watt Bulbs				
14-04-2013	11 am	Blue	Nil	+ ve
19-04-2013	6 pm	Green	Nil	- ve
20-04-2013	10 am	Red	Nil	- ve
24-04-2013	7 pm	Orange	Nil	- ve
26-04-2013	8 pm	Yellow	Nil	- ve