CHAPTER-H

SUMMARY

*Ocimum sanctum* L. (Tulsi) is an important medicinal plant grown in every pious Hindu family since ancient time. Its leaf extract and inflorescence have medicinal property. It is an important constituent of many Ayurvedic cough syrups and expectorant. In Homoeopathy, the fresh mature leaves are given to children with nasal catarrh and cough, asthma, fever, constipation and worms. The oil is reported to possess antibacterial and insecticidal properties. The plant is used as a pot-herb; leaves are used as condiment in salads and other foods. Tulsi juice is beneficial in treatment of ringworm and other skin disease. The herb is useful in the teeth disorder. It is good medicine for headache. It has also anticancer property. The aqueous extract of seeds is active against gram positive bacteria and mycobacteria. Thus, Tulsi (*Ocimum sanctum* L.) is also an herbal remedy for a lot of common ailments. This plant is infested by *Eusarcocoris capitatus* Distant (Heteroptera: Pentatomidae), which causes extensive damage to the *O. sanctum*. It is a phytosuccivorous bug, drains out sap from the seeds and inflorescence of this plant. It has piercing and sucking mouthparts by which it drains out content of the host part. It occurs in Saharanpur during March to November or upto first week of December, while during late December to first week of March; it hibernates in adults stage to avoid unfavorable climatic condition. All nymphal instars and adults suck the newly set seeds content as well as of flowers during July to October when temperature and moisture content are suitable for breeding. The damaged seeds, loss viability, weight and become unfit for germination.
In laboratory water soaked seeds of Tulsi were supplied as food and 96.0 to 99.67 per cent with an average of 97.83±13.94% damage was recorded to the seeds of *O. sanctum*, while those kept under control germinated upto 78.4 to 83% after 30-45 days. Two hundred field collected seeds of *O. sanctum* were sown in the well manured and irrigated soil. It was observed that only 5 per cent seeds were germinated. The fatty oil (eugenole) obtained from the seeds of *O. sanctum* has great commercial value. *E. capitatus* feeds preferably on the fatty content of the seeds and this causes a great loss to the yield of oil. The loss of weight in the seeds of *O. sanctum* due to the feeding of this pest varied from 48.38 to 55.0 per cent and thus oil extraction is approximately reduced to 50.0 per cent. When *O. sanctum* seeds are not available generally in the months of April to July, they feed on the seeds of other host plant such as *Ocimum basilicum*. Like wise, fresh flowers of *O. sanctum* are taken as food source by all five nymphal instars and adults of *E. capitatus*. After feeding on leaf, a punctured decolorized area is left and chlorophyll content in that part is lost. Such leaf lateron turns brown and wilts up. Punctuation on the leaf can be seen without the aid of artificial light after feeding is over. Carbohydrates and fat are taken from seeds while amino acids, water, minerals and vitamins are taken from leaf sap. Biology of this pentatomid bug, *Eusarcocoris capitatus* was carried out in detail both in laboratory as well as in field. A close vigil was kept on precopulation, copulation, oviposition behaviour, oviposition period, hatching and description of each instars of *E. capitatus*. Experiments were carried out during three consecutive years 2007-2009. The result of laboratory rearing revealed that there is a clear cut sexual dimorphism in male and female. Male is darker brown having black punctuations dorsally and more dark brown punctuations
ventrally than female. Average total length of male is $3.207 \pm 2.10$ mm and average width $2.229 \pm 1.18$ mm while total average length of female $5.275 \pm 3.24$ mm and width average $3.33 \pm 1.32$ mm. The bug needs a pre-copulation period 3 to 15 days, average being $7.28 \pm 3.86$ days and a copulation period of 2 to 35 hrs. with an average of $17.07 \pm 9.05$ hrs. Re-engagement of copulation takes place after 5 to 291.05 hrs. with an average of $54.92 \pm 60.80$ hrs. and average period of copulation was $13.503 \pm 6.79$ hrs. Female *E. capitatus* takes 4 to 122 hrs. with an average of $28.58 \pm 28.61$ as pre-oviposition period. It depends upon climatic conditions and food factors. Its eggs are deposited on the inflorescence in between the flowers and seeds glued by a sticky secretion deposited by ovipositing female along with laid eggs. Generally, 14 eggs were laid but sometimes 2 eggs were also laid after first copulation. Eggs were laid singly or in the group of 2 or 3 eggs and rarely in cluster. A female lays on an average 80 eggs during her life time. Eggs are laid in four batches. First batch of egg consisted average 8 eggs after first copulation. Average 6, 4 and 3 eggs were laid without any copulation in second, third and fourth batch respectively. Many times copulated female laid comparatively less eggs than once copulated female. Fecundity decreased with the increase in age. Newly laid egg is milky white in colour, cylindrical in shape and on its cephalic end there is a ring of comma ($\gamma$) shaped 10 to 16, with an average number being $12 \pm 4.93$ micropylar processes. Its colour changes gradually milky white to dark red as the development of embryo inside it proceeds. It needs an average $3.98 \pm 2.42$ days incubation period. During hatching operculum part having micropylar rings ruptures which may separates off completely or remains attached at one side. Through, opened egg, first instars nymph comes out. Duration of hatching was average $5.24 \pm 1.61$
min. After hatching, the egg shell along with exuvium of the post natal moult is left between the flowers which appear to be white membrane. The newly emerged nymph dries its body and then moves forward and starts feeding on the host soft tissue such as flower buds, newly set seed etc. There are five nymphal instars, and 5 to 7 generations of *E. capitatus* per year. One generation is completed on an average 28.16±7.721 days. The newly emerged 1<sup>st</sup> instar nymph is reddish black in colour. Later on, it changes gradually to reddish brown on exposure to atmosphere. It measures average being 0.934±0.63 mm in length and average 0.674±0.67 mm in width. Wing buds are absent and three dorsal abdominal scent glands openings are present and they can be distinguished by bulged out openings and dense punctuations at the base of scent gland opening. After which it moults into second instar nymph. The newly emerged second instars are pinkish white in colour which changes into reddish dark brown with brown punctuations on exposure to air. It measures average 1.09±1.0 mm in length and average 0.709±0.67 mm in width. Like that previous instar wing buds are also absent and three dorsal abdominal scent glands opening are now more prominent with dark punctuations. After that it moults into third instar nymph. It measures average 1.96±1.04 mm in length and average 1.56±1.03 mm in width. Small wing buds start appearing and touches first abdominal tergum. Abdominal scent glands are like preceding instars except bigger in size. Like that previous instar moult into fourth instar nymph. It is pinkish white in colour at the time of emergence and gradually turns into blackish brown with dark brown punctuations. It measures average 2.165±2.10 mm in length and average 1.61±1.55 mm in width. Wing buds are prominent, may go to beyond second abdominal tergum. Second and third abdominal scent glands are more
prominent than previous instars. Three scent gland markings and lateral margins of abdomen are same as in third instars except proportionally bigger in size. After this, it moults into fifth instars which pinkish white in colour at the time of emergence after that turns into dark brown with black punctuations on exposure to air. Its body measures average 2.905±1.72 mm in length and average 1.92±0.98 mm in width. Wing buds are larger and extends upto the third abdominal tergum. Abdominal scent glands are like preceding instars and are much more bulged out. Duration of first, second, third, fourth and fifth instar nymphs were average 4.28, 4.71, 4.91, 5.0 and 5.32 days respectively. After completing the nymphal life the fifth instar nymph moults into imago. After moulting and resting, the imago turned into adult move forward and starts feeding. It takes 6 to 32 hrs. with an average of 17.13±8.16 hrs. to become fully developed dark brown coloured adult. Longevity increases with increases in temperature upto 30°C thereafter it decreases. Maximum survivality of both the sex was recorded at 30°C (average 52±18.24 and 39±12.04 days for female and male respectively) and minimum at 45°C (only in hrs.). 100% mortality occurs within few hours at 0% R.H. and minimum mortality in adults population occurred at 90% R.H. with maximum longevity period. However, for each sex 70-90% R.H. was observed optimum level for the survivality of adults. However, no true migration is observed in case of *E. capitatus* but the local flights were recorded within the territory indifferent seasons. When the climatic condition become unsuitable, it goes to other suitable host plants such as *Ocimum basilicum* for the purpose of feeding, moulting, sheltering and breeding, performing efficient flight for short distance. The unsuitability arises due to extreme lowering of temperature, 0°C to 5°C in winter and high temperature upto 45°C in summer, low R.H. 0 %
and absence of food plants. In field *E. capitatus* shows generally positive phototropic response and prefers to live in medium intensity of light. However, in the morning hours these can be seen on dorsal surface of the leaf and at 7:00-8:00 a.m. these can be seen on the inflorescence. In the evening hours too, these can be seen on the under surface of the leaf and between the flower. In cloudy days when intensity of light gets lowered, the life activities of the bugs increases and they come in open area of host plant like inflorescence and leaves. It is further observed that the photoperiod plays an important role in the copulation of *E. capitatus*. Low intensity of light is required to initiate the copulation which always occurs in evening time (before two hour of sun set). High intensity of light reduces the mating as well as feeding activity. Further, the female *E. capitatus* lays egg in between the flower to avoid the direct sunlight exposure. Laboratory experiments revealed that *E. capitatus* were highly attracted towards yellow light, and least towards green light and dark (releasing point). No response was observed towards red light. Some chemicals like- camphor, magnesium oxide, glucose, fructose, maltose, sucrose and some extend to glycogen and L-agrinine, L-tyrosine, DL-isoleusine, threonine, L(+) cystein, 4-aminobutyric acid and towards the oleic acid showed positive response. Both nymphs and adults of *E. capitatus* preferred kabuli chana (*Cicer arietinum*), moong (*Vigna radiata*), maize (*Zea mays*), wheat (*Triticum astivum*) and most preference was observed towards *O. sanctum* and *O. basilicum*. It protects itself by camauflage and warning coloration as well as by the use of chemical defence. A jet spray of scent fluid from metathoracic and abdominal scent gland is emitted on the enemy. By taking quick flight, flee rapidly, hide in between flowers and seeds, it can protect itself against predation. Various predators and parasitoids
were observed during field investigation as well as in laboratory rearing. These are *Harpector marginatus*, Formacid ants (*Camponotus compresis, Solenopsis geminata* and *Myrmecocystus* species), *Praying mantis* (*Hierodula* species) and *Araneus* species of spider. Among these, the predator *H. marginatus* and *Praying mantis* have good potentiality for controlling this injurious bug (*E. capitatus*). The biocontrol efficacy of *H. marginatus* was average 6.39 percent per day while the killing capacity of *Praying mantis* per day ranged average 48 percent in lab and 6.72 percent in field. *Trissolcus* species has been recorded as an egg parasitoid of *E. capitatus*. Parasitization per cent has been recorded as 23.41 percent in field cages. *Trissolcus* species acts as good biocontrol agent for *E. capitatus* than that of other natural enemies. In view of this, present study on life history, ecology and biocontrol of this bug will arm the economic entomologists to device suitable control measure for this injurious pest of holy basil.

__________________________________________________________