

## Bionomics of *Stethorus gilvifrons* Mulsant (Coleoptera : Coccinellidae)

by

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The available literature reveals that not much attention has been paid to the study of the bionomics of coccinellid beetles including the genus *Stethorus*. However, Kapur (1942, 1948) and Puttarudriah and Channabasavanna (1953, 1955) have listed a large number of such insects from India and have also given brief accounts on their life-history. Contributions made by Collyer (1953a, b) and Putman (1955) on the life history, behaviour and ecology of *Stethorus punctillum* Weise are worthy of mention. The present paper, however, deals with the bionomics of *Stethorus gilvifrons* Mulsant.

**Material and Methods:** Mass collection of the immature stages of *S. gilvifrons* was made from the mite infested castor plants. On emergence, the adults were separated and removed for the study of copulation and egg laying. To study copulation, oviposition and hatching, fifty pairs of freshly emerged adults were separated in individual petridishes. A leaf bearing heavy infestation of mite was placed in the petridish on a moist blotting paper which was changed at regular intervals. Stereoscopic binocular microscope was used to study the mating behaviour and the process of oviposition. After oviposition, the eggs were separated and observed regularly for hatching. After hatching, the first instar larvae were transferred to mite infested leaves and were kept for the life history studies. The rate and amount of feeding at different stages were studied in ten replicates and the mean value has been calculated. The sex-ratio at emergence and longevity of the male and female were also studied.

**Results : Life-history : Copulation :** The adults breed freely in laboratory and in fields when the mite population remains in abundance. The mating has been observed throughout the year. After emergence the precopulation period lasts for 1-3 days. The duration of copulation varies from 50 minutes to 6 hours. Usually the first copulation lasts longer. One fertilisation is sufficient for the oviposition but usually copulation takes place more than once and generally during the day time.

**Oviposition :** The preoviposition period lasts for 1-4 hours after copulation during which the female feeds voraciously. Usually the eggs are laid under the web formed by the mites or on the lower surface of leaves along the veins. The eggs are laid singly at regular intervals during day time. Even

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2-5 eggs have also been observed at one place. During oviposition, the female walks on the leaf surface and locates a suitable place with the help of its ovipositor. The whole process takes place in about 10-15 seconds. The female repeats the same process and lays on an average 253 eggs during its life-span. The daily production of eggs varies greatly (27-53) depending on temperature, relative humidity, food, age and diapause of the female.

*Egg:* Freshly laid egg is smooth, elongated and silvery white in colour. Towards the approach of hatching it turns pale to yellow in colour and gives an orange tinge in the centre. It measures about 0.23 to 0.26 mm. by 0.34 to 0.39 mm. with both the cephalic and caudal ends bluntly rounded. As the development proceeds, a fully formed embryo becomes visible through the chorion. The incubation period lasts from 5-9 days (average 6.3 days) depending on the prevailing season. Copulation and oviposition continue throughout the life of female.

*Hatching:* The chorion of the mature egg bursts to form an irregular opening at the cephalic end. The head of the grub comes out first, followed by the thoracic segments and legs. The legs move vigorously in air and the posterior part of the grub pushes itself out of the shell. Any support to the legs at this time helps the larva to come out more easily. It takes about 20-25 minutes for the whole body to leave the shell.

*First instar:* The newly hatched grub is 0.52 to 0.27 mm. in length and 0.144 mm. in width across the head capsule. The head, legs and few tubercles on the body segments are slightly darker than the whole body which fairly pale in colour. The grubs are very active and move freely in search of food. Under conditions of scarcity of food cannibalism may be seen. As soon as the prey is made available they readily attack them and suck the internal fluid only. As they grow older, they feed voraciously. The larval duration varies from 1-3 days (average 2.1 days) and the predatory efficiency is 20.5-23.7.

*Second instar:* The old integument is thrown off as exuviae by rupturing at the cephalic and subsequently at the mid-dorsal line of the body. The size of the grub increases from 0.89 to 1.08 mm long and 0.184 mm broad. The newly emerged second instar is slightly dark yellow in colour with distinct setae on the head and body segments. The stage lasts for 2-4 days (average 2.7 days) and the predatory efficiency varies from 30.1 to 35.6.

*Third instar:* The grub measures 1.21-1.85 mm long and 0.235 mm in breadth. The head and body tubercles grow still darker than the earlier instars. The larval period varies from 2-5 days (average 3.4 days) and the predatory efficiency increases from 37.3 to 43.8.

*Fourth instar:* The mature larva is elongated and oval, widest in the middle segments of the body. The head is dark brown in colour and each abdominal segment has four distinct dark patches. The length of the body varies from 2.16 to 2.60 mm and the width of the head capsule is 0.303 mm. The average duration of this stadium is 3-7 days (average 4.9 days) and predatory efficiency varies from 42.6 to 48.9.

*Prepupal stage:* The fully mature grub ceases feeding and becomes sluggish. In this inactive form it remains attached to the leaf surface for 10-12 hours (average 11.20 hours) and sheds the exuviae. The larval skin splits longitudinally in a medio-dorsal line by the up and down body movement. Consequently, the skin is pushed down and the body remains attached to the substratum by the oral rudiments anteriorly and anal suckers posteriorly.

*Pupa:* The fresh pupa is pale in colour. After 2 hours the integument hardens and turns dark brown. The head is directed caudad and the elytra cover the body. There are no visible spots on the integument but large number of rigid spicules are present on the elytra. It measures about 1.8 mm long and 1.0 mm in its greatest width. The pupal period lasts for 4-7 days (average 5.5 days).

*Emergence:* Just before emergence of the adult the puparium becomes completely dry and scaly. It breaks irregularly at the cephalic end and the beetle emerges out. The newly emerged imago is pale to yellowish in colour with no marking on the body parts. It has thin crumpled and papery elytra which gradually turn hard horny. The beetle is delicate and weak but soon regains its strength. The colour of the body changes from light brown to black. It leaves the exuviae and wanders in search of food. The freshly emerged beetles if allowed to starve do not survive more than 3 days; some of them may die even after six hours.

*Adults:* The male and female are not distinguishable on superficial characters. The females are short oval but longer than the males which are more oblong with slightly convex body. The length of the body varies from 1.0 to 1.5 mm and the width of the head capsule is 0.42 mm. The head capsule is subquadrangular, dorsoventrally flattened and bears prognathous mouth parts. In male there is wide emargination in the medio-caudal margin of the sixth abdominal sternite while in female each half of the ninth sternite is spatulated and provided with few widely separated setae. The tarsi are apparently three jointed; the terminal one is dilated and bilobed at the free end. It bears a pair of stout and sharply pointed claw. The longevity of male varies in 11-19 days (average 14.4 days) and that of the female in 14-21 days (average 18.1 days). The predatory efficiency in both cases varies from 37.6 to 41.5.

*Seasonal history:* The beetles show their appearance on the trees several days after hatching of eggs of castor mites. These insects start multiplying in large number in July and reach peak in November. In all there 8 germinations during the active season July-March. Most of the generations overlap, therefore, all stages of its development can be found in the field at any time during this period. Each generation takes an average of 26.7 days to complete. The population of the beetles being maximum in October-January. The prevalence of hot weather in April-June results in the disappearance of mites resulting in conditions unfavourable to the adults undergo diapause. Very few larvae are found after March even though the mite population still remains on the plants.

*Habits: Mode of feeding:* The grubs feed by piercing the body wall of the prey and sucking the internal contents of eggs and mites, leaving their exoskeleton. This whole process does not take more than 4-5 minutes to an individual. The adults seize the prey by means of their forelegs, puncture the abdominal tergite by piercing their mandibular incisors and masticate the entire food. The parts of the exoskeleton of adult mites are sometimes discarded but the beetles ingest the immature mites to a greater extent. A single beetle devours a full grown mite within 2-3 minutes. It continues feeding the prey one after another until satisfied.

*Rate of feeding:* The number of mites and eggs consumed by the grub was recorded at every 24 hour interval by counting their exoskeleton. It has been noticed that a single grub during its life period could consume about 32.6 nymphs and 38.0 eggs per day. The adult beetles prefer to feed on deutonymphs and adult mite with special liking to the ovipositing females. On an average the male could devour about 43.6 adults and 31.7 nymphs (average 37.6) while the female feeds on about 49.8 adults and 33.2 nymphs (average 41.5) per day. These beetles consume slightly more mites at higher temperature than at lower.

*Alternative host:* The castor mite, *Tetranychus telarius* Linn. forms the major food of *S. gilvifrons*. These beetles also attack and feed on *Anystis* sp. Both adult and grub attack at all stages of *T. telarius* but adults prefer to feed on a mixed population of *Anystis* and *T. telarius*. Starving adults and grubs feed on *Macrosiphum* sp. to a very limited extent. The grubs feed on the honey dew of aphids but later on remain adhere to the sticky secretion. Cannibalism among the adults as well as the grubs is a general practice under conditions of scarcity of food.

*Sex-ratio:* Closer observations show that during the early and late period of their active season male beetles exceed females but in the mid-season females predominate. The sex-ratio usually remain 2:1 (947:481).

*Importance in mite control:* *S. gilvifrons* is an important predator of *T. telarius*. Its power of dispersal is such that it is found even in a small population of the mites. The predatory efficiency, as indicated, helps in reducing the rates of increase of mites and delay the appearance of plant injury. A comparatively small population of beetles can therefore, destroy a large number of mites and can control the extent of their damage under economic level.

*Summary:* *Stethorus gilvifrons* Mulsant feeds on the castor mite, *Tetranychus telarius* Linn. and has assumed a status of an important predator. A detailed biology of the predator has been described. A single female lays about 257 eggs during its life span and the incubation period lasts from 5 to 9 days depending on season. The grub, pupa and adult live from 8 to 19, 4 to 7 and 11 to 21 days respectively. They emerge in July, reach peak in November and aestivate during early April. The various stages usually overlap and there are 8 generations during the active season. Predatory efficiency, feeding habit and rate of feeding of the adult and larval instars have been thoroughly worked out. The adults feed on *Anystis* sp., and both adults and grubs feed on *Macrosiphum* sp. as their secondary choice to the castor mite. The sex-ratio has been determined which usually remains 2:1. The importance of this insect in the mite control has also been stated.

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