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Bioecology of *Sticholotis cribellata* Sicard (Coleoptera: Coccinellidae), a potential predator of *Melanaspis glomerata* (Green) (Homoptera: Diaspididae)

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ABSTRACT: ***Sticholotis cribellata*** **Sicard (Coleoptera: Coccinellidae) is recorded for the first time as a predator of *Melanaspis glomerata* (Green). Its host range and seasonal incidence are detailed and the immature stages described and illustrated. The egg, larval, and pupal stages lasted for 6.9, 19.5, and 8.6 days, respectively, and adult longevity was 40.41 days. The average fecundity was 48.9 eggs/ female. The larvae and adults consumed on an average 653.95 and 1822.49 *M. glomerata* crawlers, respectively, throughout their life span. *S. cribellata* appears to be a promising bioagent of *M. glomerata* in view of its high feeding potential and amenability to large scale mass multiplication.**

KEY WORDS: Bioecology, *Melanaspis glomerata*, predator, *Sticholotis cribellata*, sugarcane

Melanaspis glomerata (Green) is a serious pest of sugarcane in several parts of India and is known to occur only in India. Many indigenous parasitoids and predators have been recorded on this pest (Sankaran and Mahadeva, 1974). Several exotic bioagents, mostly coccinellid predators, were introduced against *M. glomerata* from East Africa and the West Indies in the early 1970's (Sankaran, 1974). Out of the eight coccinellids introduced, only *Sticholotis madagassa* Weise was recovered from Andhra Pradesh (Sankaran and Mahadeva, 1974), Haryana and Uttar Pradesh (Pawar *et al.*, 1984); however, the beetle failed to establish permanently in the colonised areas (Singh, 1994). Among indigenous predators, *Chilocorus nigrita* (F.) and *Pharoscymnus horni* (Weise) exert some control and attempts have not been made to explore the potential of lesser known indigenous predators against this pest.

During surveys for natural enemies of *M. glomerata* in Karnataka, Andhra Pradesh and Maharashtra, *Sticholotis cribellata* Sicard was found feeding on *M. glomerata* in Karnataka. It has been recorded earlier feeding on an undetermined scale infesting bamboo in Bangalore (Puttarudriah and ChannaBasavanna, 1955 and 1956). Perusal of literature revealed that nothing was known about this predator. Therefore, the present investigation on its bioecology, host range and seasonal incidence was taken up to help understand its potential role in suppressing *M. glomerata*.

MATERIALS AND METHODS

The seasonal incidence of *S. cribellata* on

M. glomerata was studied at Gauribidanur on sugarcane variety CON 84/131 (on which it was observed for the first time) by sampling and counting in the field at regular interval from August to December, 1999-2000. Observations were also made on agave and rose, on which this coccinellid was collected later.

The immature stages were studied under a Stereozoom WILD M10 microscope and the terminology used for larval description follows that of Gage (1920). Feeding behaviour of the grubs and adults was studied under the microscope. Mating behaviour was studied by confining four pairs in a glass tube (15x2.5 cm) with cotton swab soaked in honey (50%). Observations were recorded on the number of attempts made for mating, number of successful matings and time taken for mating.

Biology was studied in the laboratory on *M. glomerata* reared on sugarcane setts at 27 ± 2°C and 60±5% R.H. Eggs were removed every six hours with a moist camel hair brush and kept in jars (25x15 cm) containing sugarcane setts infested with *M. glomerata*. Twenty freshly emerged first instar grubs were confined individually in Petri-dishes, covered with muslin cloth and secured with rubber band. Crawlers of *M. glomerata* on sugarcane leaves were provided as feeding. Observations on the developmental time were made at 12 hours interval and the dates of moulting into the next instar were recorded.

For studying the feeding potential, 200 crawlers of *M. glomerata* along with a fresh leaf of sugarcane were provided every day until emergence and subsequent death of adults. The scales fed were counted on the next day. The number of scale nymphs fed by the grubs was worked out from the mean consumption of the individuals that had reached the pupal stage. Each treatment was replicated ten times. The number of scales fed by the adults was worked out by taking the mean of five individuals. Sugarcane leaves and scale crawlers were changed every day as scale crawlers settled on leaves only for 24 hours and the leaves also started drying in this period. Data thus collected were subjected to analysis of variance.

RESULTS AND DISCUSSION

Description of immature stages

Egg

Bright golden yellow, oblong oval and apically narrowed (Fig. 1), smooth. Laid singly or in small groups of 2-3 under crevices and shields of the scale.

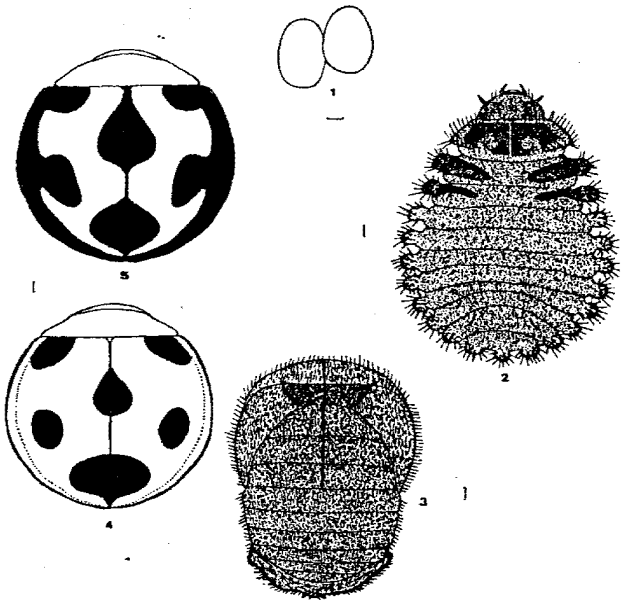
Grub

Body elongate, fusiform to turbinate, almost parallel sided in the middle in early instars, when full grown somewhat tear drop shaped (Fig. 2), with the posterior half expanded and almost parabolic, anterior half narrowed towards head. Head chitinized and dark brown, antennae lighter, yellow; rest of the body reddish brown to buff, with a pinkish hue, anterior margin of pronotum and all pairs of parascoli much paler, greyish white; thoracic plates dark brown, chalazae with light brown to yellowish setae. Ventral side uniformly pinkish, pleated with a few scattered setae.

Head subconical, apically narrowed, epicranial suture absent; frontal suture conspicuous, "U" shaped, with the lateral arms stopping just below the antennae. Antennae three-segmented, basal segment broadest and dome-like, second segment much reduced, annular, third segment roughly twice as long as the second and cylindrical.

Maxillary palpi strongly curved and sickle shaped with the apical segment elongate and acutely pointed.

Pronotum subtrapezoidal, nearly as long as meso-and metanotum combined; anterior margin of pronotum with about two dozen chalazae arranged more or less in a single row, a little below the margin; pronotal plate roughly "M" shaped. Mesonotal plate subtriangular, with its inner margin narrowly rounded, with a median lighter



Figs. 1-5. *Sticholotis cribellata* Sicard. 1-Egg, 2-Final instar grub, 3-Pupa, 4 and 5-Adult.
Scale markers = 0.10mm

area. Metanotal plate elongate, curved around metanotal spiracle. Ventral side with legs short, not reaching the sides, prosternal legs shorter and more closely spaced than meso- and metasternal legs; tarsal claw with a subquadrate basal tooth.

Abdominal segments I-IX visible, strongly transverse; segments I-VII with a pair of spiracles; segments I-VIII with a pair of lateral parascoli; segment IX not clearly delineated from the eighth, with a single median parascolus; each segment with three pairs of small pits - one dorsal, one dorsolateral and one adjacent to the parascoli - clearly marked and glabrous. Dorsal side of the body with dense microtrichiae, chalazae smaller than those on parascoli and yellowish white setae.

Pupa

Yellowish brown, densely setose, with its caudal end attached to the substrate, last larval skin attached to the caudal end (Fig. 3).

Adult

Adult beetle reddish brown (Fig. 4-5) with black elytral markings as figured; typically with six elytral spots (Fig. 4), but in the commonly encountered form (Fig. 5), lateral margins black and fused with lateral spots.

Hosts and distribution

Sticholotis cribellata was observed feeding

on *M. glomerata* on sugarcane in Gauribidanur (Karnataka) and *Hemiberlesia lataniae* (Signoret) on agave in Thondebhavi (Karnataka). Besides these, it was also found feeding on *Pinnaspis strachani* (Cooley) on *Croton sparciflorus* and agave, *Aonidiella aurantii* (Maskell) on rose and an undetermined scale on agave in and around Bangalore.

It was found on heavy infestation levels of *M. glomerata*, but was more common on *H. lataniae* on agave, irrespective of level of infestation. In sugarcane and agave, immature stages and adults were found deep inside the leaf sheath near the nodal region. Puttarudriah and ChannaBasavanna (1956) also reported similar behaviour on bamboo scale. This indicates the ability of *S. cribellata* to enter into the leaf sheath and feed on the scales.

Table 1. Biology of *Sticholotis cribellata*

Parameter	Duration (days)	Mean± SD
Egg period (days)	5-9	6.90±1.07
Larval period (days)		
I instar	3-7	4.70±1.22
II instar	3-5	4.30±0.77
III instar	4-6	4.80±0.77
IV instar	5-7	5.70±0.80
Total larval period	15-25	19.55±1.93
Pupal period (days)	7-11	8.60±1.14
Adult longevity (days)		
Female	39-43	40.41±1.31
Male	28-34	31.60±2.01
Fecundity (Egg/female)	28-70	48.90±14.50

Seasonal incidence

The predator first appeared in August when only one beetle was collected from ten randomly selected canes. In the same season *S. cribellata* was found to feed on *H. lataniae* on agave in Thondebhavi. Its population ranged from one to two beetles/10 canes during September. In the second week of October, its population peaked to 5 beetles/ 10 canes and later declined to one beetle/ 10 canes in the last week of November. After November, it was not found till harvesting of canes (January) which coincided with rise in temperature.

Observations taken on flowering shoots of agave indicated that the population of *S. cribellata* peaked in the last week of December, 1999 (12 beetles/five heavily infested shoots) and disappeared from the first week of January 2000. However, it was found to feed on *H. lataniae* on agave plants grown in shade in Bangalore even in March, 2000 when temperature was low (26° C). In June, it was found in very few numbers feeding on *P. strachani* infesting *C. sparciflorus* in Devanahalli area near Bangalore, which indicated

its availability almost throughout the year on one or another host.

Feeding behavior

When feeding on *H. lataniae*, first instar larvae attacked crawlers and newly settled first instar nymphs. The second instar larvae fed on the body fluids of first and second instar scale nymphs. The third and fourth instar larvae were able to feed completely on the adult scales. But in the presence of crawlers, all the larval stages preferred only crawlers. Adult beetles lifted the waxy cover or shield and fed on the exposed immature stages and adult scales. Mode of feeding was similar to that reported for other sticholotidines such as *S. marginalis* Kapur (Ahmad and Ghani, 1971) and *Pharoscymnus flexibilis* (Mulsant) (Ghani and Ahmad, 1966). Adults and newly hatched larvae devoured their own eggs and third and fourth instar larvae ate younger larvae and even pupae in the absence of hosts. Cannibalism is a common phenomenon in many aphidophagous and coccidophagous coccinellids. This indicates its ability to survive in instances of non-synchronisation of oviposition and availability of scale.

Mating behavior

Mating occurred 4-5 days after emergence and lasted for 8-23 minutes. Repeated mating occurred at the interval of 24-48 hours. During its lifetime, a single female mated 4-5 times with the same or different males. In addition, several unsuccessful attempts were made by the male for mating. Oviposition started 5-6 days after mating. There was a post-oviposition period of about 8-9 days.

Biology

The biological parameters of *S. cribellata* are presented in Table 1. The mean egg period (6.9 ± 1.07) was similar to that of *S. madagassa* (6.0 days) recorded by Jalali and Singh (1989).

Mean larval duration of *S. cribellata* (19.5 ± 1.93 days) was comparable with that of *S. madagassa* (19.8 days) (Jalali and Singh, 1989). The average larval survival in *S. cribellata* was 87.80 per cent.

The mean pupal period of *S. cribellata* (8.6 ± 1.14 days) was higher than that of *S. madagassa* (6.6 days) on *M. glomerata* (Jalali and Singh, 1989). The survival of pupae at room temperature was 91.20 per cent.

The female longevity was 40.41 ± 1.31 days, comparable to that recorded on different hosts for *S. madagassa* (42.7 days) (Jalali and Singh, 1989). Females survived longer (39-43 days) than males (28-34 days). The oviposition period was 22.23 days. Maximum oviposition was observed between the 6th and 18th days, when 29-32.85 per cent of the eggs were laid. Average fecundity was 48.90 ± 14.5 eggs per female and egg viability ranged from 87 to 93 per cent. Oviposition rate was highly variable and ranged 0-19 eggs per day. Jalali and Singh (1989) recorded high average fecundity of 72 eggs per female in *S. madagassa* when reared on *M. glomerata*.

Feeding potential

The grub consumed 19.2 ± 5.47 crawlers per day and the adult consumed 45.1 ± 4.08 crawlers per day. On the same host, larva and adult of *S. madagassa* consumed 14.8 and 30.4 crawlers per day, respectively (Jalali and Singh, 1989). Larval and adult feeding potential of *S. cribellata* compared favourably with that reported for *S. madagassa* by Jalali and Singh (1989).

The results of this study indicate that *S. cribellata* has good feeding potential and the ability to enter into the leaf sheath and feed on emerging scales on nodal regions. Indigenous predators except *C. nigrita* and *P. horni*, have not been utilized to their complete potential. Therefore, *S. cribellata* can be considered as a supplementary predator and may prove useful against *M. glomerata*, if multiplied in large numbers in the laboratory and synchronised releases are made.

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