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BIOLOGY AND PREDATION OF *STETHORUS PUNCTILLUM* WEISE (COLEOPTERA: COCCINELLIDAE) FEEDING ON *TETRANYCHUS URTICAE* KOCH

G C Biswas, W Islam[?] and M M Haque[1]

Institute of Biological Sciences, Rajshahi University, Bangladesh
[1]Department of Zoology, Rajshahi University, Bangladesh

Abstract

The duration of hatching, larval instars and pupal stages of *Stethorus punctillum* feeding on two-spotted spider mite, *Tetranychus urticae* were investigated in different seasons under laboratory conditions. The highest values of different developmental stages were obtained during winter. Higher temperature significantly reduced the duration of different developmental stages. No significant effect of relative humidity was exerted on the development stages of *S. punctillum*. The predation rate of fourth instar larva of *S. punctillum* was the highest whereas the first instar larva consumed the lowest number of prey. The fourth instar larva of the predator consumed 135.8 eggs, 126.4 larvae, 96.6 nymphs and 72.8 adults per day separately. But the first instar consumed 41.6 eggs, 36.2 larvae, 26.8 nymphs and 16.8 adults during the same period.

Keywords: Developmental durations, predation, *Tetranychus urticae, Stethorus punctillum*

Introduction

Tetranychus urticae Koch, commonly known as spider mite, is the most important polyphagous species of tetranychid pests and attacks over 300 host plants including vegetables, fruits trees and ornamentals. This pest is distributed worldwide causing loss of quality and yield or the death of the host plants by sucking out the cell-contents of the leaf (Granham 1985, Rott and Ponsonby 2000). The species of the genus *Stethorus* Weise have been identified as potential biological control agents of spider mites in agricultural crops (Hull 1977, Hull *et al*. 1976, Roy *et al*. 1999). Putman (1955) reported *S. punctillum* is one of the most important predators of tetranychid mites in peach orchards. Roy *et al*. (2002) studied the development of *S. punctillum* and *T. mcdanicli* at 12 constant temperatures ranging from 10-38°C and modeled their development rates as a function of temperature. Rott and Posonby (2000) examined the predatory behavior and activity of *S. punctillum* larvae on *T. urticae* and its response to environmental factors and host plant species under glasshouse conditions. Raworth (2001) studied larval voracity, the lower developmental temperature threshold and the developmental time of *S. punctillum*. In Bangladesh no important research has yet been done except Naher *et al.* (2005), who studied the predation efficiency of *S. punctillum* on two-spotted spider mite. Lack of research on the biology and its beneficial utilization leads to the present work.

Materials and Methods

Culture of *T. urticae* and *S. punctillum*: *T. urticae* were collected from Lady's finger plants from Rajshahi City area and reared on 30-potted lady's finger plants as stock culture in the premise of the Institute of Biological Sciences, Rajshahi University. In addition a stock culture of *S. punctillum* was maintained on the prey (*T. urticae*). Regular observations were made on the leaves of mite-infested lady's finger. During winter and rainy season the potted plants were protected with polythene shade.

[?] Corresponding author: mwislam2001@yahoo.com

Biology: During intensive observation the leaves containing *S. punctillum* eggs were collected immediately after egg laying and transferred in the glass boxes in clear plastic box (1264 cm^3) in which a hole (84 cm^2) was cut in the lid and covered with 70µ nylon mesh. The eggs were observed regularly. After hatching the larvae were reared in the same manner up to the emergence of adult. Sufficient food (*T. urticae* of various stages) was supplied regularly. Duration of hatching period, 1st, 2nd, 3rd, 4th larval instars and pupal stages; fecundity, longevity and sex ratio were recorded during three seasons (viz. winter, autumn and summer). The temperature of the laboratory was recorded regularly.

Predation trial: Mature infested lady's finger leaves were collected from potted plants. Leaf discs (9 cm^2) with specific mite stage were made from the infested leaves having at least 200 preys. A specific stage of *S. punctillum* was released on each disc. The leaf discs with prey and predator were placed on wet cotton wool within a plastic container of 90 mm diameter and 30 mm height, covered with a plastic lid having a hole of 8 mm diameter. The containers were then placed inside an incubator having a constant temperature of 28ºC and after 24 hours the numbers of preys were counted. Daily consumption was calculated by subtracting the number of *T. urticae* individuals left from the number of individuals given on the leaf disc. Consumption of *T. urticae* by four larval and adult stage of *S. punctillum* on different stages, viz., egg, larva, nymph, egg+nymph, adult, adult+nymph of *T. urticae* was studied with 25 replications of each.

Results

The mean duration of different developmental stages, fecundity, longevity and sex ratio of *S. punctillum* in three rearing seasons are presented in Table 1. The duration of different developmental stages are recorded shorter in summer than in winter. *S. punctillum* laid the highest number of eggs in autumn when the average room temperature recorded as 27^{0}C, but it laid the lowest number of eggs at higher temperature (31^{0}C). *S. punctillum* lived a longer duration in winter than other seasons.

Table 1. Developmental duration (in days) of *S. punctillum* at 23, 27 and 31^{0}C temperatures.

Temp (^{0}C)	Hatching period	1st instar	2nd instar	3rd instar	4th instar	Pupal	Fecundity	Longevity	Sex ratio
23 (winter)	4.78 ?0.55	3.11 ?0.58	2.56 ?0.51	3.22 ?0.43	3.94 ?0.54	5.11 ?0.58	166.35 ?3.79	61.55 ?1.43	1:1.05
27 (autumn)	4.28 ?0.03	2.78 ?0.03	1.94 ?0.04	2.67 ?0.03	3.50 ?0.03	4.39 ?0.03	213.25 ?3.53	46.05 ? 0.87	1:0.94
31 (summer)	2.72 ?0.46	1.67 ?0.59	1.39 ?0.50	1.83 ?0.62	2.50 ?0.51	3.06 ?0.64	125.85 ?1.88	36.20 ?0.99	1:0.93

The predation rate of *S. punctillum* belonging to adult and different stages of *T. urticae* during 24 hours is shown in Fig. 1. The 4th instar larva of *S. punctillum* consumed the highest number of preys. It devoured 135.80 eggs during 24 hours, whereas an adult of it consumed 82.60 eggs during the same period. The predation efficiency of the predator gradually increased from 1st to 4th instar larva.

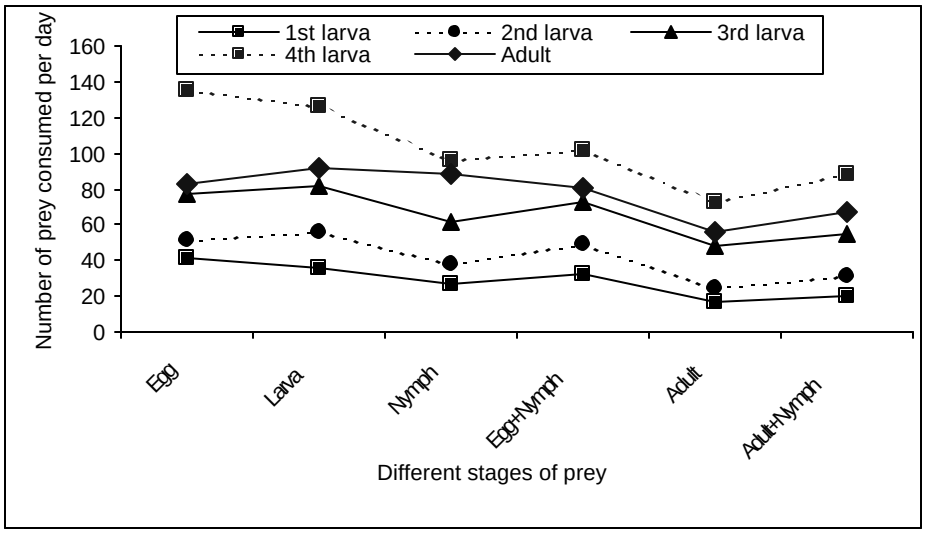

Fig. 1. Number of prey (*T. urticae*) consumed by different stages of (predator) *S. punctillum* / day.

Discussion

The present findings depict four larval instars of *S. punctillum*, which are similar for most of other coccinellids including *Stethorus* spp. Larval stages were different from each other in body shed exoskeletons as well as size of the head capsule. After passing a pupal stage it emerges into light yellow coloured adult, which turned to a uniform black-brown colour during later stage. Studies on biological aspects have been conducted on several species of *Stethorus*. Most of the species completed their life cycle (egg-egg) in two weeks under optimal temperature conditions (Pavlova 1975, Singh and Ray 1977).

The effect of temperature on the developmental stages of *S. punctillum,* studied in Europe by Bravenboer (1959) at 21-23°C; and Berker (1958) at 15-35°C interval. Roy *et al.* (2002) studied development of *S. punctillum* and *T. mcdanieli* at 12 constant temperatures ranging 10-38°C (?0.5°C) and modeled their development rates at a function of temperature. The present findings are very similar to the above results that the higher temperature accelerates the developmental rate reducing the developmental period.

Jiang *et al.* (1982) found the longevity of *S. punctillum* as 32-53 days at 24-28°C. The longevity of other species of *Stethorus* are reported as 30-61 days for *S. pauperculus* at 24-26°C (Puttaswamy and Channabasavanna 1977), 17-42 days at 12-30°C for *S. vagans* (Khan 2000), 48-57 days at 24°C for *S. loi* (Shih *et al*. 1991). The observed longevity of *S. punctillum* in the present experiment is 26-62 days t 23-31°C. This result agrees well with the above others. The sex ratio of *S. punctillum* remained more or less 1:1, which is similar to *S. nigripes* (Richardson 1977) and other species of *Stethorus* (Shih *et al*.1991, Khan 2000)

The highest mean fecundity recorded in the present experiment is 213.35 at 27°C, which is lower than other species of *Stethorus* as reported by Puttaswamy and Channabasavanna (1977) as 339 eggs for *S. pauperculus*, Richardson (1977) as 281 eggs for *S. nigripes*. Even Putman (1955) reported the total fecundity of *S. punctillum* 1290 eggs per female for the same species. But Khan (2000) reported that female of *S. vagans* laid 190 eggs. Most likely the opiposition period and longevity is the major factor of less fecundity.

The present study shows that *S. punctillum* effectively feed on *T. urticae*. Garcia-Mari and Gonzalez-Zamora (1999) reported that several predators along with *S. punctillum*, appeared naturally in strawberry plantings, successfully control the *T. urticae* population in Valencia, Spain. Among these predators *S. punctillum* was important one and control spider mites and maintained them below damaging level. Peterson *et al*. (1995) noted that *S. bifidus* fed on tetranychids like *T. urticae* and *Panonychus ulmi*. Hull (1995) reported that *S. punctum* consumed all stages of mites; adult consumed 75 to 100 mites/day and a larva devoured up to 75 mites/day. The larva passes through four larval stages in about 12 days, feeding on all stages of mites, he added. Zadeh and Pormirza (1999) studied the feeding rate of different life stages of *S. punctillum* on the red spider mite and observed that first, second, third and fourth instars and adult insect consumed 6.80±0.07, 23.50±2.40, 37.30±4.50, 92.90±4.60 and 211±5.20 mites respectively/day.

Ragkou *et al*. (2004) conducted laboratory experiments on daily consumption and predation rate of different instars of *S. punctillum* feeding on *T. urticae* and reported that the first instar larva consumed 16.67, 18.56, 19.56 and 14.33 eggs, larvae, nymphs and adults respectively. The consumption of adult prey is similar to the present study but the rest are much lower than our findings. According to them, the daily consumption of prey tends to be higher in the higher stages of predator, even in the adult stage. This phenomenon supports our results.

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