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Food consumption of the coccinellid predator, *Stethorus punctillum* reared on the two-spotted spider mite, *Tetranychus urticae* under different constant temperatures

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ABSTRACT

Food consumption of the predator, *Stethorus punctillum* Wiese reared on immature and mature stages of the prey, *Tetranychus urticae* (Koch) was studied under laboratory conditions at three different constant temperatures (15, 25 and 35ºC). The larval instars consumed more immature prey individuals at 15ºC, followed by 35 ºC then 25ºC. Adult males of the predator consumed more individuals of immature preys at 35ºC, followed by 25 ºC then at 15ºC, while the predator females relatively consumed more prey individuals than the males, at the same temperatures.

When the larvae of the predator reared on mature stages of the prey, they consumed more prey individuals at 15ºC, followed by 25ºC then at 35ºC. The adult males and females of the predator consumed almost the same numbers of the prey individuals. They consumed the highest number of preys at 35ºC, followed by 25ºC, while the lowest consumed number was recorded at 15ºC.

Key words: *Stethorus punctillum* Wiese**,** *Tetranychus urticae* (Koch), food consumption, temperatures.

INTRODUCTION

Tetranychus urticae (Koch) (Acari: Tetranychidae) is one of the most polyphagous species of the Tetranychidae, attacking vegetables in greenhouses and of several other agricultural outdoor crops causing economic damage (Ripa *et al.,* 2006). *T. urticae* is adapted to various environmental conditions and is distributed worldwide, causing loss of yield and quality or the death of the plants by sucking out the contents of plant sap (Geest, 1985; Granham, 1985; Rott and Ponsonby, 2000 a&b).

There are several important natural enemies of *T. urticae* (Granham, 1985). All known species of Order Coleoptera, Family Coccinellidae are predator of spider mites (Felland and Hull, 1996; Hoy and Smith, 1982 and McMurty *et al*., 1970). The coccinellids *Stethorus punctillum, S. gilvifrons*, *S. punctum picipes* were the most effective natural enemies of the phytophagous mite species included *Tetranychus urticae* Koch, *T. piercei* McGregor, *Panonychus citri* McGregor and *P.ulmi* (koch) (Lui and Lui 1986; Lorenzato, 1987; Wen, 1988; Pasualini and Antropoli 1994; James *et al.,* 2001; Cakmak and Aksit 2003; Perez *et al.,* 2004 and Gencer *et al.,* 2005).

The present laboratory work was carried out to study some biological aspects of *Stethorus punctillum* and its efficacy as a biological control agent under different rearing conditions.

MATERIALS AND METHODS

The predator, *Stethorus punctillum,* was collected from different plant leaves, especially the castor oil plant leaves, which were infested with the red spider mite, *T. urticae*. Adults of *S. punctillum* beetle reared on potted bean plants artificially infested with *T. urticae* maintained for 2-3 months before testing their efficiency. Wooden cage (50x50x50 cm) were used for maintaining the culture of *S. punctillum* and *T. urticae*. Cages were covered with nylon cloth on top and glass door in the front for daily services and watching.

The prey consumed by *S. punctillum* was studied through out the larval and adult stages at each tested temperature (15, 25 and 35ºC). The predator was offered 50 immature and 30 mature prey individuals daily. Fifteen replicates were carried out for each tested temperature.

A- Larval stage of *S. punctillum*

1- Feeding on immature *T. urticae*

Leaf disc (2.5cm) was artificially infested with fifty immature of prey individuals. Each newly hatched larva of the predator was kept separately on the leaf disc in the experimental cell (4x3x3cm). The cell was covered and incubated at constant conditions (25±2ºC, 18L: 6D photoperiod and 65±5% RH). The cell was checked daily and the number of consumed preys was calculated. The predatory larva was transferred to new fresh leaf disc infested with the same number of immature prey. This procedure was repeated until the pupation of the predator's larva.

2- Feeding on mature *T. urticae*

Leaf disc (2.5cm) was infested artificially with thirty mature prey individuals. Each newly hatched larva of the predator was kept separately on the leaf disc in experimental cell. The cell was covered and incubated as mentioned above. This procedure was repeated until the pupation of the predator larva.

B- Adult stage of *S. punctillum*

Feeding on immature and mature *T. urticae*

Leaf disc (2.5cm) was artificially infested by fifty immature prey individuals. Each newly emerged predator's adult was kept separately on the leaf disc in the experimental cell. The cell was covered and incubated as mentioned before. The previous steps were repeated with substitution the immature preys with thirty mature individuals. The experimental cells checked daily until the death of the predator's adult. The whole experiment was replicated five times at each tested temperature.

Statistical analysis: Data were subjected to analysis of variance (ANOVA) using "SPSS" a computer statistical program. Mean values were compared using Duncan's Multiple Range test.

RESULTS

Food consumption

A- Larval stage of *S. punctillum*

Data in Tables (1 and 2) showed that food consumption of the predator was markedly affected with temperature under investigation. When the predator was fed on immature stage of *T. urticae*, the highest number of consumed preys was recorded at 15ºC for all larval instars, followed by 35ºC then 25ºC. Statistically, there were significant differences ($P<0.01$) between the number of consumed preys at each temperature. The corresponding figure when the predator fed on mature stage, it was

observed that the highest number of consumed prey was recorded at 15ºC for all larval instars, followed be 25ºC then 35ºC. Statistically, there was a significant difference (P<0.01) between the number of consumed preys.

Table (1): Average number of *Teteranychus urticae* immature stages consumed by *Stethorus punctillum* larval instars at different constant temperatures

Predator larval instars	Mean ± SE			F-value
	15ºC	25ºC	35ºC	
1st	23.55±0.84 c	15.93±0.57 a	20.69±1.23 b	26.863**
2nd	33.05±1.31 b	27.52±0.72 a	29.58±1.31 a	7.965**
3rd	72.85±2.12 c	40.89±1.03 a	56.17±2.02 b	115.101**
4th	214.95±9.15 c	92.33±1.72 a	162.50±12.05 b	92.750**

Table (2): Average number of consumed *Teteranychus urticae* mature stage by *Stethorus punctillum* larval instars at different constant temperatures

Predator larval instars	Mean ± SE			F- value
	15 ºC	25 ºC	35 ºC	
1st	11.15±0.51 a	6.11±0.36 c	7.92±0.47 b	37.236**
2nd	16.55±0.77 a	13.96±0.66 b	8.79±0.46 c	25.712**
3rd	33.25±0.32 a	18.81±0.93 b	13.06±1.09 c	89.752**
4th	67.74±2.67 a	43.52±1.44 b	37.29±1.81 c	59.382**

B- Adult stage of *S. punctillum*

Feeding on immature and mature stages of *T. urticae*

Data in Table (3) showed that adult male of the predator consumed the highest number of the prey at 35ºC, followed by 25 then 15ºC, for either immature or mature prey. The female predator relatively consumed more prey individuals than the male at the same tested temperatures. Statistically, there was a significant difference (P<0.01) between the number of consumed preys (Table 3).

Table (3): Average number of consumed *Teteranychus urticae* mature and immature stages by *Stethorus punctillum* adult stage at different constant temperatures

Stethorus punctillum	*T. urticae* stages		Mean ± SE			F-value
			15ºC	25ºC	35ºC	
	Male	Immature	36.55±0.51 c	54.95±0.78 b	106.35±2.39 a	790.702**
		Mature	8.62±0.18 c	17.63±0.24 b	37.50±0.70 a	1699.470**
	Female	Immature	38.33±0.56 c	54.13±0.89 b	120.95±3.44 a	758.050**
		Mature	10.73±0.30 c	18.45±0.28 b	38.65±0.80 a	1005.294**

Means in a raw followed with the same letter(s) are not significantly different at 5% probability.
**= Highly significant

DISCUSSION

The present study examined the activity of the coccinellid predator, *S. punctillum* (the mite destructor) under three different constant temperatures (15 ºC, 25ºC and 35ºC). Generally, it was observed that, the degree of temperature had different impacts on its activity and the food consumption rate. The optimum activity

of this predator under laboratory conditions was around 20 ºC and 25ºC. Whereas it reached, the maximum at the highest tested temperature (35ºC) and it's minimum at 15ºC. These results are in agreement with Shoeib (2001).

At 15ºC, the development of the larval instars became sluggish, and larvae takes longer periods to metamorphose because of the low temperature, so, the larval instars (1^{st} to 4^{th}) consumed more preys. This consumption rate was more than the other rates at 25 ºC and 30°C, respectively. It was observed that the predator's larvae consumed somewhat more preys, which may be referred to its need to cumulate high quantity of its food requirement to be able to proceed with its development and metamorphose to the pupal stage. At 15°C, no results were manipulated by other authors. Our obtained results at 25 ºC and 35ºC, are in agreement with the results reported by Zhou *et al.* (1991); Iskander *et al.* (1994) and Ragkou *et al*. (2004) for their work on *S. punctillum* and Kheradpir *et al*. (2006) for their study on *S. gilvifrons*.

2- Feeding on mature *T. urticae*

Our results revealed that, at 15ºC, the four larval instars of the predator, also, consumed more number of preys than those eaten at either 25ºC or 35ºC. These results were in agreement with Iskender *et al.* (1994) for *S. punctillum* at the same temperature.

It is clear that, the predator's larvae consumed more preys at 15ºC than other tested temperature, that is because of under this degree of temperature, the rate of development of the larvae became slower than at other tested temperatures, so that, the larvae spent longer periods and needs to prey on more spider mites to fulfil its requirement for development and metamorphoses. The aforementioned results indicated that the larval stage of the predator were more active and consumed more prey individuals at higher temperatures than at low one.

B- Adult stage of *S. punctillum*

In the present study, it could be concluded that the adult males and females of the predator consumed the lowest number of preys (immature and mature preys) at 15ºC. While the highest number of consumed preys (immature and mature preys) was recorded at 25ºC and 35ºC, respectively. Adult females were relatively consumed more number prey individuals than males at the same tested temperatures. These results are in accordance with those reported by Lui and Lui (1986) for *S. siphonulus* Kapu; but were mismatched with those reported by Iskander *et al.* (1994) for *S. punctillum*; Chang & Leu (1986) for and Liu (2002) for *S. siphonulus* on citrus red mite, *Panonychus citri*

Our obtained results were contradicting with those reported by Shin *et al*. (1991) on their work on Naher and Haque (2005) on *S. punctillium* as a predator for *T. urticae*.

It could be concluded that the optimum temperature for mass-rearing the predator *S. punctillium* under laboratory conditions was 25 ºC ±2ºC.

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ARABIC SUMMERY

الاستهلاك الغذائى للمفترس (ستيثورس بنكتيلم)عند تغذيته على العنكبوت الاحمر (تترانيكس يورتيكا)تحت درجات الحرارة المختلفة

رضا فضيل على بكر [1] ، محمد أحمد جسرها [2] ، نهى عونى محمد جنيدى [1] ، ناجى عبد اللطيف فرج [2] هدى حسن على البحيرى [2]

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تمت دراسة تأثير دراجات الحرارة المختلفة (15-25-35ºم) على الكفاءة الافتراسية للمفترس الحشرى *Stethorus punctillum*.

- أوضحت النتائج المتحصل عليها أن الاعمار اليرقية للمفترس كانت أكثر استهلاكا للاعمار اليرقية للعنكبوت الأحمر عند تربيتها تحت درجة حرارة 15ºم، يليها درجة الحرارة 35 ثم درجة الحرارة 25ºم.

- أوضحت النتائج أنه فى حالة الحشرة الكاملة، فقد وجد أن الذكر كان أكثر استهلاكا للأعمار اليرقية للعنكبوت الأحمر يوميا، وذلك عند تربيته تحت درجة حرارة 35ºم، تليها درجة الحرارة 25ºم ثم درجة الحرارة 15ºم، بينما كانت الإناث أكثر استهلاكا نسبيا مقارنة بالذكور.

- عند تربية المفترس على الاطوار الناضجة للعنكبوت الأحمر، وجد أن الأعمار اليرقية للمفترس كانت أكثر فى معدلات استهلاكها لأفراد العنكبوت الأحمر عند درجة الحرارة 15ºم تليها درجة الحرارة 25 ثم درجة الحرارة 35ºم.

- أوضحت النتائج المتحصل عليها أن المعدل اليومى للاستهلاك فى إناث المفترس مساويا للمعدل اليومى للاستهلاك فى الذكر للمفترس، حيث سجل اعلى معدل استهلاك لأفراد العنكبوت الأحمر عند درجة حرارة 35ºم، تليها درجة الحرارة 25ºم، بينما كانت اقل معدلات الاستهلاك لأفراد العنكبوت الأحمر عند درجة الحرارة 15ºم.