Effect of Temperature and Host Plant on the Biological Aspects of *Tetranychus cucurbitacearum* (Sayed) (Acari: Tetranychidae)

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ABSTRACT

The life history of the spider mite, *Tetranychus cucurbitacearum* (Sayed) was investigated on six eggplant cultivars ("White", "Black Stream beity", "Baladi", "Black king", "Roma" and "Taska") at 25 & 35±2°C and 70±5% R.H. "Taska" cultivar shortened the life cycle to 10.08 and 6.93 days at 25 and 35°C; while "White" cultivar prolonged this period to 16.28 and 10.61 days. The high egg production per female was on Taska cultivar (70.70 & 47.58 eggs) with a daily rate of 7.08 & 5.50 egg/female at 25 and 35°C, respectively. The low egg production per female was on White cultivar (41.66 & 29.42 eggs) with a daily rate 7.38 & 7.99 egg/female, respectively at the same previous conditions.

Key Words: Biology, Spider mite, Reproduction, Eggplant, Cultivars.

INTRODUCTION

Eggplant, *Solanum macrocarpon* (L.) (Family: Solanaceae) is considered one of the most important vegetable crops. It is preferred by consumers and considered an economic crop that has a high rank locally. Also, it constitutes a huge part of exported crops to Arab and European markets. Eggplant is usually infested with several pests including the spider mites, *Tetranychus urticae* Koch and *T. cucurbitacearum* (Sayed) in Egypt (Farrag, 1975), *T. cinnabarinus* Boisduval, *T. kanzawai* Kishida, (Mansour & Karachi, 1994 and Morishita & Yano, 1996), and *T. ludeni* (Reedy 2001) in abroad. The spider mite, *T. cucurbitacearum* is a serious pest of a wide variety of economically important plants. It is confined to Delta and few areas in Upper Egypt (Farrag, 1975). Development from egg to adult often takes one to two weeks or more, depending on temperature, host plants humidity and other environmental factors (Zhang, 2003). Some studies on the biological aspects of this species on some different host plants were done by Hassan and Zaher, 1956; Abdel-Shaheed *et al.*, 1971; Attiah *et al.*, 1978 and Gomaa *et al.*, 1987. This work aimed to study the effect of six eggplant cultivars on some biological aspects of *T. cucurbitacearum*. This knowledge may prove useful to our understanding of the population dynamics of *T. cucurbitacearum* for future programs of control management of this pest.

MATERIALS AND METHODS

Leaves of six eggplant cultivars: "White"; "Black Stream beity"; "Baladi"; "Black king"; "Roma" and "Taska" were used as substrates for rearing the spider mite, *Tetranychus cucurbitacearum* (Sayed) at two different temperatures: 25 and 35±2°C and constant R.H. (70±5%). The stock culture started with one gravid female collected from eggplant cultivars in the farm of Faculty of Agriculture, Ismailia governorate. Eggplant leaf discs (2cm diameter) were placed on cotton bed in Phil dishes (20cm×15cm) with under surface upward. The cotton bed was kept wet by soaking with water twice daily so that the discs remained fresh. Newly deposited eggs of the same age were transferred singly, each to a leaf disc. Every dish contained 30 discs as replicates. Dishes with discs were kept in incubators with constant temperatures (25 and 35±2°C) and 70±5% R.H. Discs of all treatments were examined twice daily and all biological aspects were recorded until death of mite adults.

Statistical Analysis:

The data were analyzed using the One Way ANOVAs complete randomized procedure with Duncan's HSD test at P≤ 0.5 using the COSTAT 3.03system software (Quinn & Keough, 2002).

RESULTS AND DISCUSSION

Six different eggplant cultivars and two temperature degrees affected the duration of developmental stages as well as adult longevity and female fecundity of *T. cucurbitacearum* (Sayed) (Tables, 1 & 2).

Developmental rates of all mite stages are strongly influenced by temperatures. This fact has been well documented for many other tetranychid species (Laing, 1969; Hazen *et al.*, 1973 and Carey &Bradley, 1982). Total developmental times of

Table (1): Effect of temperature on duration of *T. cucurbitacearum* reared on six eggplant cultivars.

Stages	sex	Duration in days at two different temperatures and six cultivars					
		White		Black Stream beity		Baladi	
		25°C	35°C	25°C	35°C	25°C	35°C
Egg	♀	4.56±0.49a	3.50±0.78a	4.00±0.32b	2.60±0.63b	3.20±0.39cd	1.89±0.19c
	♂	4.21±0.33a	3.08±0.49a	3.50±0.54b	2.62±0.37b	2.90±0.13bc	1.54±0.46c
Larva A	♀	2.30±0.53ab	1.81±0.37a	2.25±0.39b	1.78±0.42a	1.94±0.24c	0.89±0.17b
	♂	2.08±0.20a	0.83±0.25a	1.58±0.40bc	0.63±0.30b	1.75±0.30bc	0.33±0.20c
Q.	♀	1.08±0.16a	0.68±0.22b	0.82±0.15b	0.71±0.18b	0.59±0.16c	0.46±0.14c
	♂	0.71±0.10a	0.42±0.10ab	0.58±0.10ab	0.46±0.10bc	0.54±0.10b	0.33±0.10ab
Protonymph A	♀	2.88±0.20a	1.92±0.19a	2.27±0.27b	1.63±0.38b	1.92±0.16c	1.17±0.19c
	♂	2.33±0.26a	0.83±0.26a	1.88±0.20bc	0.66±0.30bc	1.16±0.25d	0.50±0.00c
Q.	♀	1.13±0.20a	0.58±0.12b	0.85±0.17b	0.89±0.19a	0.80±0.10bcd	0.60±0.13b
	♂	0.96±0.10a	0.50±0.00a	0.50±0.00c	0.38±0.10bc	0.58±0.12c	0.33±0.13c
Deutonymph A	♀	2.79±0.47a	1.73±0.27a	2.02±0.20cd	1.80±0.27ab	1.79±0.18d	1.23±0.31c
	♂	2.04±0.60ab	1.16±0.20b	1.83±0.30ab	0.71±0.33c	1.54±0.40ab	0.54±0.18c
Q.	♀	1.54±1.88a	0.39±0.13a	1.33±0.30ab	0.81±0.22a	0.77±0.29b	0.73±0.17a
	♂	0.79±0.10a	0.29±0.10a	0.63±0.21b	0.83±0.49a	0.50±0.00c	0.54±0.49a
Total immatures	♀	11.72±2.23a	7.11±0.49ab	9.54±0.58b	7.62±0.90a	7.81±0.43c	5.08±0.62c
	♂	8.91±0.72a	4.03±0.68a	7.00±0.32b	3.67±0.70b	6.07±0.40cd	2.57±0.52c
Life cycle	♀	16.28±2.34a	10.61±0.80a	13.54±0.62b	10.22±1.30a	11.01±0.67d	6.97±0.69b
	♂	13.12±0.82a	7.11±0.57a	10.50±0.71b	6.29±0.86b	8.97±0.40cd	4.11±0.59c
Adult longevity	♀	8.79±0.59e	6.78±0.58e	13.42±0.74b	9.44±0.72 c	8.87±0.43e	6.66±1.03e
	♂	6.16±0.73c	5.13±0.34d	8.25±6.41b	5.90±0.73bc	6.58±0.49c	5.63±0.44d
Life span	♀	25.07±2.93a	17.39±1.384a	26.96±1.36c	19.66±2.02b	19.88±1.10e	13.63±1.72d
	♂	19.28±1.55a	12.24±0.91a	18.75±7.12b	12.19±1.59bc	15.55±0.89d	9.74±1.03d

Stages	sex	Duration in days at two different temperatures and six cultivars					
		Black king		Roma		Taska	
		25°C	35°C	25°C	25°C	35°C	25°C
Egg	♀	4.56±0.49a	3.18±0.35a	3.35±0.43c	2.75±0.50b	2.96±0.21d	2.02±0.44c
	♂	4.16±0.37a	2.87±0.21b	2.90±0.20bc	2.83±0.25b	2.83±0.20c	1.13±0.31c
Larva A	♀	2.54±0.49a	1.66±0.26a	2.14±0.29b	1.63±0.22a	1.69±0.18c	0.56±0.21c
	♂	1.95±0.10ab	1.13±0.31a	1.29±0.33d	0.54±0.10bc	1.58±0.40cd	0.29±0.10c
Q.	♀	0.89±0.25b	0.87±0.16a	0.77±0.16b	0.71±0.09b	0.54±0.09c	0.47±0.07c
	♂	0.58±0.10ab	0.58±0.13a	0.54±0.10b	0.45±0.10ab	0.37±0.13b	0.29±0.10c
Protonymph A	♀	2.23±0.34b	1.70±0.14b	2.35±0.29b	1.77±0.19b	1.72±0.22c	0.89±0.16d
	♂	1.91±0.40ab	0.79±0.20ab	1.92±0.13c	1.00±0.15 a	1.16±0.25d	0.66±0.10bc
Q.	♀	0.71±0.20cd	0.70±0.09b	0.80±0.09bc	0.73±0.13b	0.64±0.18d	0.73±0.13b
	♂	0.66±0.12b	0.50±0.00ab	0.50±0.16c	0.40±0.10abc	0.50±0.00c	0.50±0.10abc
Deutonymph A	♀	2.58±0.33b	1.60±0.19ab	2.15±0.24c	1.75±0.30ab	1.83±0.19d	1.58±0.16c
	♂	2.08±0.20a	1.37±0.31a	1.92±0.20ab	0.66±0.13c	1.66±0.13b	0.71±0.10c
Q.	♀	0.85±0.19b	0.45±0.09a	0.75±0.21b	0.79±0.09a	0.70±0.29b	0.68±0.12a
	♂	0.75±0.00a	0.37±0.13a	0.63±0.20bc	0.50±0.16a	0.50±0.00c	0.42±0.13a
Total immatures	♀	9.80±0.89b	6.98±0.41b	8.96±0.59b	7.38±0.40ab	7.12±0.47c	4.91±0.45c
	♂	7.93 ±0.54a	4.74±0.37a	6.80±0.50bc	3.55±0.20b	5.77±0.57d	2.87±0.20c
Life cycle	♀	14.36±1.10b	10.16±0.48a	12.31±0.81c	10.13±0.67a	10.08±0.61d	6.93±0.63b
	♂	12.09±0.80a	7.61±0.40a	9.70±0.53c	6.38±0.26b	8.60±0.67d	4.00±0.18c
Adult longevity	♀	12.94±0.69c	10.22±0.87b	12.09±0.66c	7.63±0.71d	14.86±1.61a	12.49±0.50a
	♂	9.54±1.03a	6.15±0.54b	8.16±0.68b	5.29±0.50c	10.30±0.84a	6.96±0.68a
Life span	♀	27.30±1.79b	20.38±1.35b	24.40±1.47d	17.76±1.38c	24.94±2.22e	19.42±1.13d
	♂	21.63±1.83b	13.76±0.94b	17.86±1.12c	11.67± 0.76c	19.90±1.51d	10.96±0.86d

Table (2): Longevity and fecundity of *T. cucurbitacearum* adult female reared on six eggplant cultivars at two temperatures and 70±5% R.H.

Eggplant cultivars	Temp.	Period in days				Fecundity	
		Pre-Oviposition	Oviposition	Post-Oviposition	Generation	No. of eggs	Daily rate
Taska	25°C	2.75±0.35 a	9.90±1.44 a	2.21±0.33 a	12.83 ± 0.59e	70.70±22 a	7.08±2.58 a
	35°C	2.10±0.38 a	8.64±0.45 a	1.75±0.32 a	9.03 ± 0.55c	47.58±13.01 a	5.50±1.61 bc
Black king	25°C	2.25±0.32 c	8.73±0.83 bc	1.96±0.45 ab	16.61 ± 1.10b	35.75±5.36 b	4.09±0.67 b
	35°C	1.92±0.33a	6.47±0.59 b	1.83±0.27a	12.08 ± 0.47 ab	33.25±8.24b	5.13±1.39 d
Baladi	25°C	1.58±0.39 d	5.41±0.69 d	1.88±0.19 a	12.59±0.92 e	31.50±9.05 b	5.82±1.74 a
	35°C	1.23±0.27 b	3.98±0.85 d	1.45±0.36 bc	8.20±0.74 c	33.15±11.47 b	8.32±1.18a
Black Stream beity	25°C	2.45±0.35 b	8.95±0.55 b	2.02±0.37 a	15.99±0.80c	45.58±12.04 b	5.09±1.21 b
	35°C	1.84±0.19 a	6.25±0.68 b	1.35±0.40 c	12.06±1.50ab	41.41±11.74 b	6.62±1.45 cd
Roma	25°C	2.08±0.27 c	8.10±0.73 c	1.91±0.34 ab	14.39±0.85 d	35.50±5.53 b	4.38±0.72 b
	35°C	1.45±0.17 b	4.56±0.64 c	1.62±0.16 ab	11.58±0.76 b	34.50±7.39 b	7.56±1.07ab
White	25°C	1.52±0.29 d	5.64±0.43 d	1.63±0.27 b	17.80±2.51a	41.66±6.40 b	7.38±1.01 a
	35°C	1.25±0.28 b	3.68±0.48 d	1.85±0.27 a	11.86±0.85a	29.42±5.66 b	7.99±1.46 a

Numbers in each column followed by different letters are significantly different (*P*= 0.05; Duncan's Multiple Range Test immature males and females of *T. cinnabarinus* (Boisd.) were not significantly influenced by the eight strawberry varieties (Kazak and Kibritçi, 2008). These results were different than our findings, whereas the eggplant cultivars and temperature had significant differences on the total immature stages of *T. cucurbitacearum*, as it averaged (11.72 & 7.11) days for White at 25°C and (7.11 & 4.91) for Taska at 35°C, respectively.

Hot and dry weather accelerates the life cycle of spider mites (Haile and Higley, 2003). Therefore, high temperature provided in the laboratory could be a reason for the shorter developmental time of *T. cucurbitacearum* as observed in the current investigation. Rearing the mites at 35°C shortened its developmental time and enabled its populations to grow dramatically fast than at 25°C. The female life cycle being the shortest when reared on leaves of "Taska" cultivar (10.08 and 6.93 days) at 25 and 35°C, respectively. On the other hand, the longest one was observed on leaves of "White" cultivar (16.28 and 10.61) at the previous temperature degrees, respectively. The obtained result of life cycles is similar to that obtained by (Van de Vire *et al.*, 1972 and Abd El-Mohsin 2011). Male showed similar trend as female but with slightly shorter periods (Table 1). Laing (1969) found nearly similar developmental time for males and females (16.1 and 16.9 days), respectively which differed from what was reported here (Table 1). Again,Van de Vrie *et al.* (1972) emphasized the occurrence of the differences between males and females as to development rate. The influence of several factors to mites, temperature among others, may explain the differences encountered by the authors.

Elongated longevity at decreased temperatures has been observed in many tetranychid species (Boudreaux, 1963). This was also observed in *T. cucurbitacearum* (Sayed), whereas longevity prolonged to (14.86) days on "Taska" at 25°C; than on the other cultivars. In contrast, it decreased to 8.79 days at the same temperature on "White", which was significantly longer than those reared at 35°C (Table 1). The mite adult longevities in this work were similar to those of Abd El-Mohsin (2011) who stated that, female longevity of *T. urticae* recorded the shortest period (7.63 days) when reared on leaves of watermelon cultivar "Aswan" at 30°C, and the longest (11.44 days) at 25°C. Chahine and Michelakis (1994) reported that, no difference was found in adult longevity when egg plant, tomato and beans were used as hosts, but fecundity was indeed affected by the host plant. This indicates that, the developmental cycle of *T. cucurbitacearum* is influenced by several factors.

The respective durations of pre-oviposition, oviposition and post-oviposition of *T. cucurbitacearum* on six eggplant cultivars are summarized in (Table 2). Slightly significant host plant and temperature effects were observed on the pre-oviposition and post-oviposition periods. The oviposition period was significantly influenced by host plant cultivars and insignificantly by temperature. Females on "Taska" cultivar had the longest oviposition period, which was significantly different from those on the rest cultivars, where it ranged between 9.9 and 8.64 days at 25 and 35°C, respectively.

The eggs were laid by female individualy and the daily fecundity of *T. cucurbitacearum* are presented in table (2). The maximum number of eggs was deposited between the 2nd and 5th days of the oviposition period. This result coincided with those presented by Abd El-Mohsin (2011) who reported that daily egg production of *T. urticae* reached its peak on fifth day on watermelon "Aswan" cultivar at 30°C (7.74 eggs/♀/day); egg production decreased gradually thereafter.

The high egg production per female of *T. cucurbitacearum* reached 70.70 and 47.58 eggs with a daily rate of 7.08 and 5.50 egg/female at 25 and 35°C, respectively on "Taska" cultivar followed by 45.58, 41.66, 35.75, 35.5, 31.5 eggs on Black stream beity, White, Black king, Roma and Baladi cultivars at 25°C, respectively (Table, 2).

However, similar result on the reproduction of *T. cucurbitacearum* was recorded by Kim *et al.* (2008) who pointed out that the number of eggs laid per female of *T. urticae* was 78.0 eggs at 37°C on eggplant leaves.

The study revealed shorter period of life cycle for *T. cucurbitacearum* at 35°C and 70% R.H. that enabled this species to undertake several generations per hot months in summer. These characteristics give it the power to increase rapidly to very high numbers on suitable hosts and destroy it.

Finally, it can be concluded that, "White" cultivar is one of the least favorable cultivar for mite production than others, as it prolonged the period of life cycle and giving the less egg production.

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