Influence of Rose Cultivar Conditions on Reproduction of Two-Spotted Spider Mite

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Abstract: The life history parameters of the two-spotted spider mite, *Tetranychus urticae* Koch on six rose cultivars (*Rosa hybrida* cv. Mabella Yellow, Sandra, Eiffel Tower, Huddly, Red Syntrex, and White Queen Elizabeth) had been performed. The experiment was maintained at 20, 25, 30±2ºC and 70±5% RH. Results documented that leaves of 'Mabella Yellow' cultivar appeared to be the less profitable plant material for rearing *T. urticae* than other rose cultivars used under the previous conditions. Highest temperature asserted to accelerate the period of life cycle 5.81 and 5.24 days, for both females and males respectively; and give a shortened ovipositional period of 15.20 days with highly reproduction yield of eggs (137.20 eggs/female) and daily mean of 9.03 eggs/day.

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1. Introduction

Tetranychid mites are very harmful phytophagous mites that are widespread in many crops and ornamental plants throughout the world. In particular, *Tetranychus urticae* Koch (Acari: Tetranychidae), a type of phytophagous mites, feeds on more than 150 species of economically important agricultural and ornamental plants including corn, cotton, cucumber, beans, tomato, eggplant, peppers, and roses (Sabelis, 1981; Krips *et al*., 1998; Takafuji *et al*., 2000; Baptiste *et al*., 2003; Fasulo & Denmark, 2004 and Kasap *et al*., 2004, 2007). The two-spotted spider mite is considered one of the most important pests of roses in greenhouses (Van de Vrie, 1985). Some studies on the biological aspects of this species on some ornamentals has been summarized by Patil *et al*., 2005; Romeih & Abo-Shnaf, 2007 and Silva *et al*., 2009. Rose is a good host plant for this tetranychid, especially when cultivated in protected environments. Edaphoclimatic conditions, nutritional aspects and population density variations influence mite behavior; thus, more research is needed to evaluate *T. urticae* biology on several host plants, especially on ornamentals. Environmental diversity may explain variations revealed by several authors. In spite of the economic importance of *T. urticae* for ornamental plants, very little research is available in Egypt about its biology on several species, including roses. However some of this work presented some biological aspects of this species on rose, and qualified the effects of host plant cultivars on the construction of a reproduction, which is considered important for the knowledge of its population dynamics and for future pest management programmes.

2. Material and methods

2.1. Experimental design

The stock population of *T. urticae* started with specimens collected from rose bushes located in Orman botanical garden, Giza governorate. Mites were reared on 3-cm diameter leaf disc arenas of each rose cultivar ('Red Syntrex', 'Huddly', 'Sandra', 'Mabella Yellow', 'Eiffel Tower', and 'White Queen Elizabeth') arising upside down on moisten cotton pad (10-cm diameter and 1-cm thick) in Petri dishes (12-cm diameter) under laboratory conditions of 20, 25, 30±2°C and 70±5% relative humidity, with only one egg left per arena, in a total of 25 arenas (Zhang *et al*.,1999). All ends of the leaves were covered with wet cotton to avoid escape of mites. Leaves were replaced every five days. Daily observations continued after eclosion(?) of the larvae to determine the duration of the different stages of development. After emergence of adults, newly emerged females and males of *T. urticae* were individually transferred together to a fresh and clean arena for copulation. Longevity and fecundity were daily observed.

2.2. Statistical analysis

Obtained data were statistically analyzed by the help of One Way ANOVA (F-test) using a computer programe (SAS Institute, 1988), which runs under WIN. The difference between means, was analyzed by probity analysis according to Duncan's multiple range tests (Duncan, 1955) in this programme.

3. Results and Discussion

Host plant cultivar, sex of mite species and temperature can have profound effects on biological and ecological characteristics of tetranychid mites, whereas the egg incubation time differed. Survival rates of eggs on the six rose cultivars were 100%.

According to Silva *et al*. (2009) egg incubation period of *T. urticae* on *Gerbera jamesonii* is of approximately 3.9 and 3.3 days, respectively for unmated and mated females. Laing (1969) reported more than seven days for this period, possibly a result of factors like the type of host plant and temperature. Patil *et al*. (2005) pointed that the incubation period of *T. urticae* on jasmine is 4.30±0.43 days in male and 4.46±0.27 days in female.

The duration of the phytophagous mite, *T. urticae* is influenced by several factors like temperature, mite sex, and food kind, whereas the six rose cultivars significantly affect the immature development time of both *T. urticae* females and males.

The developmental time of various stages of *T. urticae* on six rose cultivars are shown in Fig. 1. The ranges of total immature stages of female resulted in significant differences among the cultivars that were presented. Total development time of *T. urticae* males was significantly influenced by the rose cultivars and ranged between 12.01 and 7.88 at 20°C; 6.84 and 3.44 at 25°C; and 5.35 and 2.57 days at 30°C. Overall, total duration of immature stages of *T. urticae* males was shorter than females on all cultivars tested.

Skirvin and Courcy-Williams (1999) examined the influence of plant species on the population dynamics of the spider mite pest, *T. urticae* as a prerequisite to effective biological control on ornamental nursery stock. They found that its development times do not differ with plant species in a biologically meaningful way. Van de Vrie *et al*. (1972) emphasized the occurrence of the differences between males and females as to development rate. Specimens of different stages can vary considerably in relation to their exposure to environmental conditions.

The pre-oviposition, the oviposition, the post-oviposition times, and longevity decisions made by *T. urticae* when encountering with hosts of variable rose cultivars had been the subject of extensive experimental investigation, given in Table 1. No significant host plant effects were noticed on the pre-oviposition period of *T. urticae*. The oviposition period of *T. urticae* was significantly influenced by rose cultivars. Mites on 'White Queen Elizabeth' (32.33, 22 and 15.20) days at 20, 25 and 30°C; had the longest oviposition period, which was significantly different from those on the others. The female longevity of *T. urticae* was significantly longer on 'White Queen Elizabeth' (35.69, 25.02 and 17.83) days at 20, 25, and 30°C, respectively; than on the rest cultivars. In contrast, the shortest 20.13, 15.96, and 9.69 at 20, 25 and 30°C adult period was observed on 'Mabella Yellow', which was significantly different from the others (Table 1).

The longevity results of this work are similar with those of Shih *et al*. (1976) who demonstrated that the host plant affects fecundity more than longevity. Chahine and Michelakis (1994) pointed out that no difference is found in longevity when eggplant, tomato, and beans are used as hosts, but fecundity is indeed affected by the host plant. This indicates that the developmental cycle of *T. urticae* is influenced by several factors and research in other ornamental plants hosting need, for the plant structure may influence pest development.

The daily and total fecundity results of *T. urticae* are presented in Fig. 2. *T. urticae* laid the highest daily number of eggs on 'Eiffel Tower' (12.38), which was significantly more than on the other cultivars. This was followed by 'Red Syntrex', 'Huddly', while 'Sandra', 'Mabella Yellow', and 'White Queen Elizabeth' were comparably similar. On the other hand to the highest mean, the lowest 'Sandra' was not significantly different from the others.

Total fecundity of *T. urticae* was significantly different among the tested rose cultivars and was highest on 'White Queen Elizabeth' (137.20), followed by 'Red Syntrex', 'Huddly', 'Eiffel Tower', 'Sandra', and 'Mabella Yellow' (Fig. 2).

The reproduction and oviposition period results of this work differ from those of Patil *et al*. (2005) who reported females of *T. urticae* lay an average of 104±3.19 eggs in their ovipositional period of 14.5±2.55 days when reared on jasmine. Romeih and Abo-Shnaf (2007) emphasized that the total number of deposited eggs per female of *T. urticae* on Arabian jasmine (*Jasminum sambac*) differs according to temperature, whereas it vary from 30.90±0.74 eggs with a daily rate of 3.27±0.29 eggs/day to 25.13±1.64eggs with a daily rate of 0.98±0.12 eggs/day, as temperature changed from 30 to 20ºC. Mondal and Ara (2006) stated that the total number of eggs lay per female of *T. urticae* on bean leaves in her lifetime on average is 108.3 ±3.23 eggs/female up to 16 days. Kotsubo *et al*. (2004) stated that the total egg production of copulated females of *T. takafujii* Ehara and Ohashi was 190.7 on eggplants. Thus, the reproductive capacity of this mite species was higher than those of *T. urticae*.

The influence of several factors on mites, host cultivar among others may explain the differences encountered by the present results. Biology of this tetranychid is subjected to influences of all sorts of alterations in rearing conditions, and host cultivar indeed causes variation

in the total number of deposited eggs of *T. urticae*.

Fu *et al*. (2002) concluded that relatively higher temperatures were more suitable for *T. piercei* McGregor development and reproduction on bananas and more specifically that 25.8 to 32°C are the most favorable temperatures for the mite. This information was close to the data obtained in our experiment, in which 30°C accelerated the period of life cycle and resulted in a shortened ovipositional period with a high reproduction yield of eggs to give the mite a chance to cycled faster. This investigation is coincided with Romeih and Abo-Shnaf (2007) who documented that 30°C is the most suitable temperature for rearing *T. urticae* on Arabian jasmine. It can be concluded that hot and dry weather accelerates the life cycle of the genus *Tetranychus* (Haile and Higley, 2003).

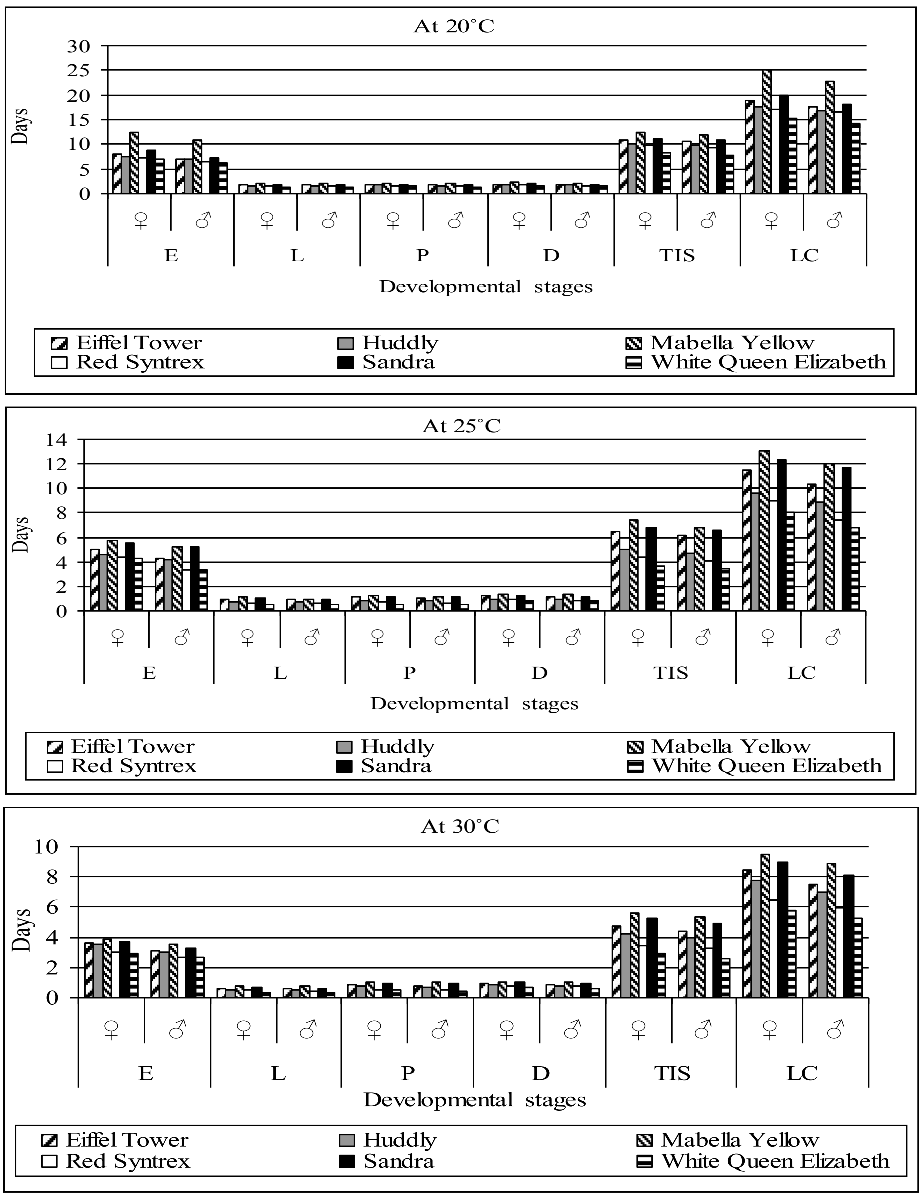

Fig. 1. Duration of *T. urticae* different stages in days reared on leaves of different rose cultivars (*R. hybrida*) at three temperature degrees and 70±5% RH [E: Egg, L: Larva, P: Protonymph, D: Deutonymph, TIS: Total Immature Stages, LC: Life cycle]

Table 1. Longevity and life span of *T. urticae* reared on different rose cultivars (*R. hybrida*) leaves at three temperature degrees and 70±5% RH

Temp. degree		Sex	*R. hybrida* cultivars					
			Eiffel Tower	Huddly	Mabella Yellow	Red Syntrex	Sandra	White Queen Elizabeth
20	Pre-oviposition	♀	1.75±0.17 a	1.28±0.42 b	2.00±0.57 a	1.18±0.50 b	1.78±0.65 a	1.14±0.53 b
	Generation	♀	20.62±0.83 c	18.97±0.55 d	27.04±0.77 a	18.30±0.51 e	21.69±0.75 b	16.52±0.65 f
	Oviposition	♀	24.50±0.53 d	25.89±0.78 c	16.88±0.83 f	26.90±0.88 b	22.38±0.74 e	32.33±0.87 a
	Post-oviposition	♀	1.40±0.46 bc	1.81±0.51 b	1.25±0.23 cd	1.85±0.24 b	1.34±0.23 c	2.22±0.62 a
	Longevity	♀	27.65±0.57 d	28.98±0.69 c	20.13±0.90 f	29.93±0.62 b	25.50±0.52 e	35.69±0.80 a
		♂	21.85±0.94 d	23.00±0.83 c	15.59±0.30 f	24.32±0.80 b	20.38±0.70 e	28.92±0.82 a
	Life span	♀	46.52±0.85 cd	46.67±0.73 c	45.17±0.74 de	47.05±0.69 b	45.41±0.64 d	51.07±0.70 a
		♂	39.52±0.75 cd	39.71±0.47 c	38.35±0.44 de	40.81±0.67 b	38.45±0.51 d	43.13±0.64 a
25	Pre-oviposition	♀	1.39±0.50 bc	1.25±0.75 c	1.78±0.30 a	1.14±0.28 cd	1.68±0.49 ab	1.02±0.51 d
	Generation	♀	12.84±0.73 c	10.85±0.92 d	14.88±0.59 a	10.09±0.54 de	14.04±0.72 ab	9.05±0.72 e
	Oviposition	♀	15.71±0.76 d	17.86±0.90 c	12.90±0.57 f	20.43±0.79 b	14.45±0.52 e	22.00±0.74 a
	Post-oviposition	♀	1.46±0.27 bc	1.68±0.31 b	1.28±0.25 c	1.86±0.48 ab	1.32±0.12 c	2.00±0.43 a
	Longevity	♀	18.56±0.73 d	20.79±0.83 c	15.96±0.51 f	23.43±0.77 b	17.45±0.84 e	25.02±0.68 a
		♂	15.19±0.55 d	17.09±0.87 c	12.53±0.45 f	19.16±0.69 b	13.50±0.55 e	21.68±0.67 a
	Life span	♀	30.01±0.81 cd	30.39±0.78 c	29.06±0.79 de	32.38±0.53 b	29.81±0.80 d	33.05±0.82 a
		♂	25.57±0.56 cd	25.97±0.62 c	24.57±0.63 e	26.57±0.40 b	25.22±0.76 d	28.48±0.75 a
30	Pre-oviposition	♀	1.09±0.50 b	1.06±0.37 bc	1.56±0.42 a	0.85±0.13 c	1.25±0.71 ab	0.80±0.20 c
	Generation	♀	9.50±0.69 c	8.82±0.63 d	11.06±0.83 a	7.34±0.55 e	10.23±0.70 b	6.61±0.76 f
	Oviposition	♀	8.63±0.52 d	10.67±0.87 c	7.13±0.64 c	12.10±0.88 b	8.00±0.53 dc	15.20±0.79 a
	Post-oviposition	♀	1.38±0.23 bc	1.47±0.36 b	1.00±0.23 cd	1.75±0.68 ab	1.19±0.22 c	1.83±0.49 a
	Longevity	♀	11.10±0.63 d	13.20±0.57 c	9.69±0.65 f	14.70±0.93 b	10.44±0.85 e	17.83±0.54 a
		♂	9.44±0.72 d	10.11±0.60 c	7.22±0.86 f	11.63±0.57 b	8.66±0.38 e	13.06±0.85 a
	Life span	♀	19.51±0.69 d	20.96±0.65 c	19.19±0.82 de	21.19±0.75 b	19.42±0.79 d	23.64±0.79 a
		♂	16.97±0.49 bc	17.06±0.47 bc	16.07±0.75 cd	17.58±0.71 b	16.80±0.56 c	18.30±0.71 a

Numbers in each column followed by different letters are significantly different (*P* = 0.05; Duncan's Multiple Range Test).

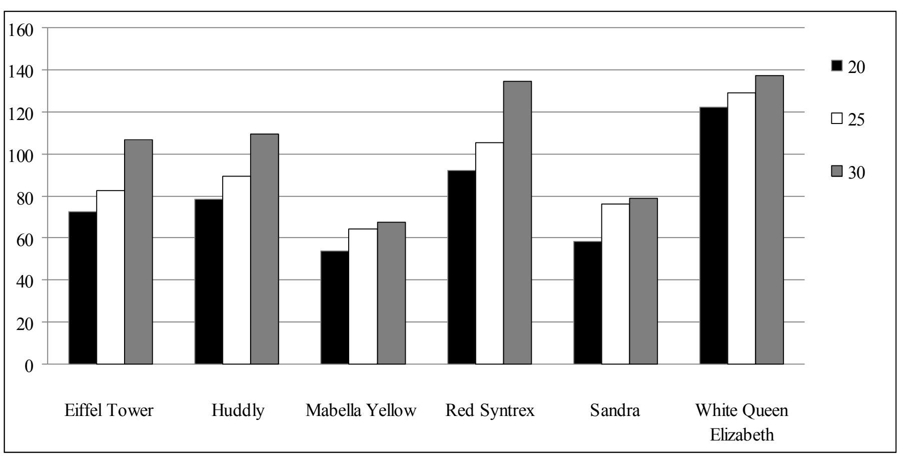

Fig. 2. Fecundity of *T. urticae* reared on different rose leaves cultivars (*R. hybrida*) at three temperature degrees and 70±5% RH.

Conclusions

In the present study, according jackknife estimation, Mabella Yellow was one of the least suitable cultivar for reproduction by *T. urticae* followed by Sandra. Cultivation of these cultivars in large areas might facilitate setting up integrated mite management programs in which biological control agents are combined with other pest control techniques to accomplish these goals.

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