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Life table of Citrus red mite, *Panonychus citri* (McGregor) (Acarina, Tetranychidae) in laboratory conditions

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Summary

Experiments were conducted in small cabinets at 26 ± 1 °C and 60 ± 5 RH under 16 : 8 light: dark photoperiod. Fifty individuals were used for the construction of the life table.

Experiments were conducted on arenas of excised pieces of sour orange (*Citrus aurantium* L.) leaf (3 cm in diameter) placed upperside-up on a water-satured foam mat in petri dishes. Each piece of leaf was surrounded by a 1 cm wide strand of filter paper a sufficicant water lavel maintained in the dish to contain Citrus red mite.

From the life table constructed the following parameters were obtained. The net reproduction rate (R_o) was 16.086 female/female, intrinsic rate of increase was 0.186 female/female/day, and the generation time (T_o) was 14.9 days.

Introduction

More than 80 species have been reported to be citrus pests in Turkey, but about only 15 species carry an economic importance (Uygun et al., 1992). Some mite species, ***Phyllocoptruta oleivora*** Ashm., ***Aceria sheldoni*** Ewing, and ***Panonychus citri*** (McGregor) are among the important pests (Uygun et al., 1991; Uygun et al., 1992).

P. citri reported to be an important pest of citrus trees and has been studied by several authors (Düzgüneş, 1977; Ragusa, 1983; Ashihara, 1987), has gained a special status and become a very serious pest in orchards where broad specturum insecticides are used widely. It feeds on foliage and fruits resulting fruit retardation and yield loss, defoliation might occur at high population densities.

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P. citri was first reported on citrus in Turkey by Düzgüneş (1952), but no detailed studies have been done due to its lou pest priorily. It is now released from the natural enemy feeding pressure in many citrus orchards in Çukurova due to elimination of natural enamy complex by heavy application of insecticides and about to became a main pest at certain localities.

Since no detailed data is available in Turkey, it was, aimed to determine same biological parameters of ***P. citri*** under the laboratory conditions.

Materials and Methods

The stock of Citrus red mite used in this research was obtined from the citrus groves in Çukurova, and cultured on citrus seedlings. Experiments were conducted on arenas of excised pieces of sour orange (***Citrus aurantium*** L.) leaf (3 cm in diameter) placed upperside-up on a water-satured foam mat in petri dishes. Each piece of leaf was surrounded by a 1 cm wide strand of filter paper. a sufficicant water lavel maintained in the dish to contain Citrus red mite.

These units were held in small cabinets in which temperature, humidty, and photoperiod could be controled.

Two or three gravid females were placed on leaf discs for 24 hrs to allow to by eggs and than taken away. The eggs in each cell were observed daily until adult stage to determine the incubation period and duration of immature stages. All but one female removed from the cells, males were untouched for mating, if necassary males were added to cells. Observations were made daily to determine fecundity, oviposition, and postoviposition periods. Daily observetions continued until all individuals of the original cohort died.

The data obtained from daily observation were used to construct the life table (Southwood, 1966), and the intrinsic rate of increase, r_m, was calculated from the equation.

$$\Sigma\, l_x.m_x \,.\, e^{-r_m x} = 1$$

Where e is the base of natural logarithm; x, the age of individual in days; l_x, the proportion of individuals alive at day x, or age specific survivorship; and m_x, the number of offspring/female/day x, or age specific fecundity. The other parameter obtained from the life table was the net reproduction rate, R_o, which was calculated as the sum of the $l_x.m_x$ column in life table.

The mean generation time, T, was then calculated from the formula;

$$T = \log_e R_o / r_m$$

Experiments were conducted at 26 ± 1 °C and 60 ± 5 RH under 16 : 8 light : dark photoperiod. Fifty individuals were used for the construction of the life table.

Results and Discussion

Developmental time and female longevity

The developmental time of eggs and immature stages are given in Table 1, and the duration of various periods for adults females are in Table 2.

Table 1. Duration of the immature stages of ***Panonychus citri*** (days)*.

Stages	Minimum	Maximum	Average
Egg	4	7	5.5
Active stages (Larva, protonymph, deutonymph)	2	8	5.7
Total	6	15	11.2

* Both sexes were combined.

The mean total developmental time from egg to adult was 11.2 days. The average duration of incubation was 5.5 days. The active stages (larva+protonymph+deutonymph) remaind an average of 5.7 days before reaching to adult stage (Table 1).

The adult females lived an average of 11.6 days, with a range of 4 to 23 days. The duration of the oviposition period ranged from 3 to 15 days, with an average of 8.9 days (Table 2).

Table 2. Duration of various periods for adult females of ***Panonychus citri*** (days).

Period	Minimum	Maximum	Average
Preoviposition	1	5	2.2
Oviposition	3	15	8.9
Postoviposition	0	3	0.5
Total	4	23	11.6

The preovipositional time averaged 2.2 days. The postovipositional time was very short (average of 0.5 days), most of the females died within a day or so after the last egg was laid. Females laid an average of 35.4 eggs during their lifetimes.

Childers (1983) reported that the developmental time and adult longevity of ***P. citri*** was 12 days, and 23 days, respectively , at 24-25 °C and 50-70% RH, with an oviposition period of 11-14 days on citrus. Ragusa et al. (1983) found that the developmental time, oviposition period and adult longevity of P. citri on lemon were 10.12, 14.56, and 17.15 days at 26±0.5 °C and 70 % RH. Another study on lemon fruits indicated that the developmental time of ***Panonychus citri*** at 30 °C and 33 °C (30-40 % RH in both) was 7.86 and 8.17 days, respectively (Delrio and Monagheddu, 1986). Chiavegato (1988) compared the biology of ***P. citri*** on lemon fruits and leaves at 25±1 °C and 58±5 % RH, and found that developmental time on fruits and leaves was 12.8 days and 12.1 days; and adult longevity was 28.9 days and 13 days, respectively. Ashihara (1987) reported that the adult longevity was 7.8 days on leaves of sour orange at 25 °C.

The resutlts for developmental time obtained around 25 °C are very similar with the results obtained in this study. The differences encountered in the literature might be due to the differences in experimental conditionues or host plants. However the adult longevity, 11.6 days, obtained in this different greatly from those reported in above literature; it was only close to that obtained by Chiavegato (1988).

The total average of eggs laid during the lifetime of females was reportied to be 17-37 by Childers (1983), 72 by Ragusa et al. (1983), 37 by Delrio and Monagheddu (1986), 37.1 by Ashihara (1987); and 77.2 and 37.7 on leaves and fruits of lemons, respectively, by Chiavegato (1988). The average number of eggs per female obtained in this study (35.4) compares well with some of the literatures cited above. The differences observed migh be again due to the differences in experimental conditions.

Life Tables

The life table and the parameters calculated for ***P. citri*** are given in Table 3. ***P. citri*** had a mean generation time (T) of 14.9 days. The net reproduction rate (R_o) was 16.08 female individuals per generation. The inteinsic rate of increase (r_m) for ***P. citri*** was 0.186 females for famale per day.

Delrio and Monagheddu (1986) constructed life tables for ***P. citri*** at various experimental temperature levels and found that the net reproductive rate (R_o) showed a maximum at 24 °C (33.7 per generation) and maintained high values up to 30 °C. They reported that mean generation time (T) decreased with increase in temperature, ranging from 158.9 days at 11°C to 11.7 days at 33 °C. They also reported that intrinsic rate of increase (r_m) increased with temperature, reaching a maximum of 0.229 females for female/day at 30 °C and then decreasing at 33 °C.

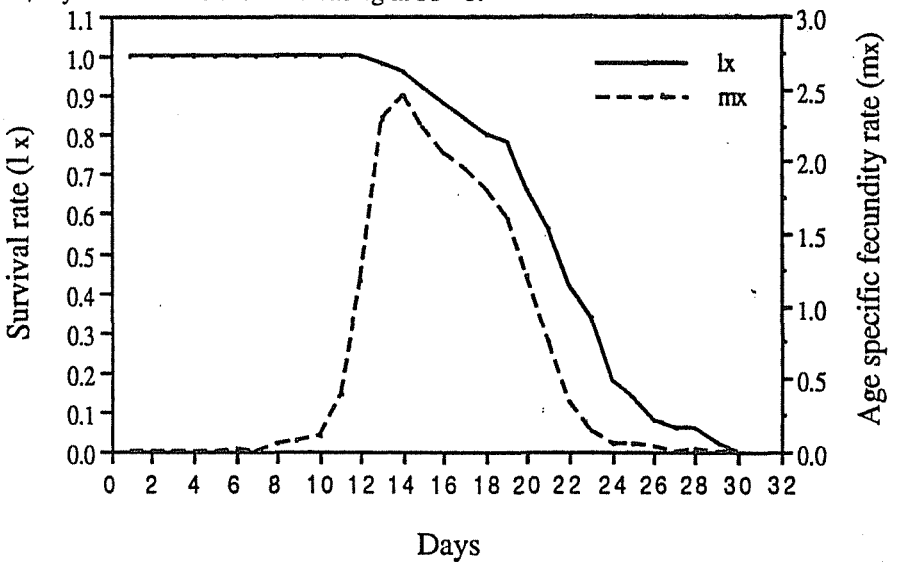

Figure 1. Survivorship curve (l_x) and age spcific fecundity rate (m_x) of ***Panonychus citri.***

The parameters T and Ro obtained in this study showed similar values to those obtained by Delrio and Monagheddu (1986) at 27 °C, but r_m value was smaller then that of even 24 °C.

Survivorship curve indicated that the mortality rate ***P. citri*** was zero up to 12 th day and than survival rate started to decrease almost linearly reaching to zero by 30th day. The m_x value (age specific fecundity rate) started to increase by 7th day, reached to a pech by 14th day and declined gradually showing similar decreasing trend to that of survivorship curve (Figure 1). The l_x and m_x curves indicated that ***P. citri*** females deponsite most of its eggs by the half of its oviposition period and started to die gradually.

Survivorship (l_x) curve and age specific fecundity rate (m_x) are shown in Figure 1.

Table 3. Life table of ***Panonychus citri.***

x	l_x	m_x	$l_x \cdot m_x$	$l_x m_x \cdot e^{(-r_m x)}$
1	1.00	0.00	0.000	0.00000
2	1.00	0.00	0.000	0.00000
3	1.00	0.00	0.000	0.00000
4	1.00	0.00	0.000	0.00000
5	1.00	0.00	0.000	0.00000
6	1.00	0.01	0.010	0.00327
7	1.00	0.00	0.000	0.00000
8	1.00	0.05	0.050	0.01126
9	1.00	0.08	0.080	0.01495
10	1.00	0.10	0.100	0.01551
11	1.00	0.40	0.400	0.05150
12	1.00	1.17	1.170	0.12502
13	0.98	2.30	2.254	0.19989
14	0.96	2.45	2.352	0.17312
15	0.92	2.25	2.070	0.12646
16	0.88	2.06	1.813	0.09192
17	0.84	1.96	1.646	0.06928
18	0.80	1.81	1.448	0.05058
19	0.78	1.60	1.248	0.03618
20	0.66	1.21	0.799	0.01921
21	0.56	0.76	0.426	0.00850
22	0.42	0.35	0.147	0.00244
23	0.34	0.15	0.051	0.00070
24	0.18	0.06	0.011	0.00012
25	0.14	0.06	0.008	0.00008
26	0.08	0.03	0.002	0.00002
27	0.06	0.00	0.000	0.00000
28	0.06	0.02	0.001	0.00001
29	0.02	0.00	0.000	0.00000
30	0.00	0.00	0.000	0.00000

R_o = 16.086

r_m = 0.186

T = 14.9

Özet

Laboratuvar koşullarında Turunçgil kırmızı örümceği, *Panonychus citri* (McGregor) (Acarina, Tetranychidae)'nin yaşam çizelgesi

Turunçgil kırmızı örümceği, ***Panonychus citri*** (McGregor)'nin yaşam çizelgesi 26 ± 0.5 ve % 60 ± 5 bağıl neme ayarlı 16 saat periyoduna sahip iklim dolaplarında turunç (***Citrus aurantium*** L.) üzerinde oluşturulmuştur.

Bu amaçla petri kapları içinde nemli süngerler üzerinde yaklaşık 3 cm çapında turunç yaprak diskleri oluşturulmuş ve her bir yaprak diskine yumurta bırakması için 2-3 adet çiftleşmiş dişi birey bırakılmıştır. Yumurtaları bırakıldıktan sonra günlük kontrollerle bireylerin yaşam oranı, dişi bireylerin verdikleri yavru sayıları ile yaşam çizelgesi için gerekli olan veriler elde edilmiştir. Deneme 50 tekerrürlü olarak kurulmuştur.

Bu araştırmada ***P. citri*** 'nin Net üreme gücü (R_0) 16.086 dişi / dişi, Kalıtsal üreme kapasitesi (r_m) 0.186 dişi / dişi / gün ve Ortalama döl süresi (T) 14.9 gün olarak ortaya çıkmıştır.

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