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Orijinal araştırma (Original article)

Life history of the brown mite *Bryobia rubrioculus* Scheuten (Acari: Tetranychidae) on two apple varieties in laboratory conditions

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Summary

Development duration and reproduction rate of the brown mite *Bryobia rubrioculus* Scheuten (Acari: Tetranychidae) were examined on two different apple cultivars (Golden Delicious and Starking Delicious) at 25±1 °C, 65±10 % RH and 16:8 L:D under laboratory conditions. Immature development time of *B. rubrioculus* was faster on golden delicious (18.5 days) than that on starking delicious (20.5 days). The survival time of *B. rubrioculus* was 14.2 days on golden delicious, while it was 18.8 days on starking delicious. Females laid on average 1.3 and 1.2 eggs per day and 14.2 and 20.1 eggs over their entire life time on golden delicious and starking delicious apple cultivars, respectively. The net reproductive rate (R_o) was higher on starking delicious (17.62 female/female) than that on golden delicious (12.54 female/female). Mean generation time (T_o) was longer on starking delicious (26.82 days) than that on golden delicious (23.87 days). Consequently, values of the intrinsic rate of increase (r_m) of *B. rubrioculus* on the two cultivars were similar (r_m= 0.107 female/female/day for starking delicious, r_m= 0.106 female/female/day for golden delicious).

Key words: Apple cultivars, *Bryobia rubrioculus*, development, fecundity, longevity

Anahtar sözcükler: Elma çeşitleri, *Bryobia rubrioculus*, gelişme, üreme, ömür

Introduction

Bryobia rubrioculus Scheuten (Acari: Tetranychidae) is widespread in deciduous fruit orchards in America, Europa, Asia and Japan. This mite is thelytokuos and overwinter as egg stage on the bark of fruit trees. *B. rubrioculus* causes whitish-grey spots on the upper surface of young or spur

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leaves by sucking (Ehara, 1959; Herbert, 1962, 1965; Vrie et al., 1972; Jeppson et al., 1975; Düzgüneş, 1977; Sabelis, 1986; Osakabe et al., 2000).

In Turkey, *B. rubrioculus* is one of the important pest on apple orchards and widely distributed in the all apple growing areas. Yield loss caused by *B. rubrioculus* was remarkably different between localities and apple varieties in Turkey (İncekulak & Ecevit, 2002; Yanar & Ecevit, 2005; Kasap & Çobanoğlu, 2006, 2007). However, population development and fecundity of *B. rubrioculus* were not deeply investigated. In addition, Kasap & Çobanoğlu (2006) reported that the population of *B. rubrioculus* was higher on starking delicious than that on golden delicious in the same orchard, and this might be due to the morphology of leaf surfaces of starking delicious apple variety. Therefore, the present study was primarily designed to provide data on population development parameters of *B. rubrioculus* on two common apple cultivars under laboratory conditions.

Material and Methods

Bryobia rubrioculus was collected on apple orchards in Van on June 5, 2003. The mites were reared on apple seedling rootstocks at least five generations in a rearing chamber (25±2 °C, 65±10 % RH and 16:8 photoperiod) prior to the study. This culture was used as the source throught out this study. All experiments were conducted in a laboratory at 25±1 °C, 65±10% RH and 16:8 photoperiod. Golden Delicious (hairless of leaf surface variety) and Starking Delicious (hairy of leaf surface variety) apple cultivars were used in all experiments. These varieties are the common apple varieties in Turkey (Gül & Erkan, 2001). Leaves of golden delicious and starking delicious were placed on a layer of filter paper over a distilled water-saturated polystyrene pad in a 100x15 mm petri dish. Each leaf was covered with filter paper that had a 40 mm diameter opening in the center as a barrier to prevent the mites from escaping. Water was added daily to keep the filter paper and polystyrene pad moist and to cover the base of the petri dish to prevent the mites from escaping. Only fully expanded leaves from 3 year old apple seedlings were used. All leaves were placed ventral-side up. Leaf discs were renewed weekly. A female *B. rubrioculus* was transferred from the stock culture to the leaf. Approximately 30 adult females from the stock culture were introduced onto each leaf disc and allowed to lay eggs for a 12 h period. The eggs laid on the leaf were kept individually in the cells for subsequent observations. The developmental stages were observed at 12 h intervals until they grew up to adulthood. Presence of exuvium was used as the criterion for successful molting to the next developmental stage. Egg laying and survival rates were recorded daily. Pre-oviposition, oviposition and post-oviposition periods in the adult stage were also monitored. Data on developmental time, longevity, and fecundity were analysed

by t-test (P<0.05). Population growth rates on apple varieties were calculated by constructing life tables (Birch, 1948): $1 = \Sigma e^{-r*x} l_x * m_x$. Age-specific survival rates (l_x) and number of female offspring (m_x) for each age interval (x) day were used for the data of life tables. From these data, the net reproductive rate (R_0 = female offspring/female/generation), the intrinsic rate of natural increase (r_m = female offspring/female/day) and the mean generation time ($T_0 = \ln(R_0/r)$, in days) were estimated (Laing, 1968). After r_m was computed from the original data (r_{a11}) the difference in r_m was tested for significance by estimating the variance using the Jackknife method, which facilitated calculation of the standard errors of r_m estimates. The Jackknife pseudo-value (r_j) was calculated for the n samples using the following equation (Sokal & Rolf, 1994): $r_j = nxr_{a11} - (n - 1)xr_i$. The mean values of ($n$ 1) Jackknife pseudo-values for mean growth rate in each treatment were subjected to analysis of variance followed by t-test (P <0.05). These analyses were conducted using SAS statistical software.

Results

While *Bryobia rubrioculus* development time from egg to adult was 18.5 days on golden delicious it was 20.5 days on starking delicious. (Table 1; P<0.05).

Table 1. Duration of the various stages and reproductive rate of *Bryobia rubrioculus* Scheuten (Acari: Tetranychidae) females on two different apple varieties at 25 ±1 °C temperatures (Mean±SD)[1]

	n	Golden	n	Starking	*F* ratio
Egg	23	8.7 ± 0.17 a	30	9.3 ± 0.13 b	1.37
Larvae	23	3.0 ± 0.13 a	17	3.7 ± 0.24 b	2.44
Protochrysalis	23	2.8 ± 0.19 a	17	3.6 ± 0.19 b	1.32
Deutochrysalis	23	4.0 ± 0.25 a	17	3.8 ± 0.09 a	1.96
Total	23	18.5 ± 0.42 a	17	20.5 ± 0.32 b	2.39
Preoviposition	12	2.0 ± 0.30 a	12	1.8 ± 0.30 a	1.20
Oviposition	12	9.0 ± 1.27 a	12	13.6 ± 1.28 b	1.17
Postoviposition	12	3.2 ± 0.62 a	12	3.3 ± 0.58 a	1.37
Total Longevity	12	14.2 ± 1.56 a	12	18.8 ± 1.19 b	2.06
Daily Fecundity	12	1.3 ± 0.12 a	12	1.2 ± 0.09 a	1.38
Total Fecundity	12	14.2 ± 1.86 a	12	20.1 ± 1.91 b	1.13

(Total: Total development time (egg to adult)) n: Numbers of replicates included in analysis
[1]Means in a row followed by the same letter are not statistically different (P>0.05: t-test)

Female longevity was longer on starking delicious (18.8 days) than that on golden delicious (14.2 days) (P<0.05). Due to difference in oviposition period duration, the total fecundity on starking delicious (20.1 eggs) was higher than that on golden delicious (14.2 eggs) (P<0.05). However, egg number laid per day was not significantly different between the cultivars (Table 1; P>0.05).

The mean generation time (T_o) of *B. rubrioculus* was longer (26.82 days) on starking delicious than that on golden delicious (23.87 days). Net reproductive rate (R_o) was higher (17.62 female/female) on starking delicious than that on golden delicious (12.54 female/female) (Table 2).

Table 2. Net reproductive rate (R_0), intrinsic rate of increase (r_m) and generation time (T_0) of *Bryobia rubrioculus* Scheuten (Acari: Tetranychidae) on two different apple cultivars

Varieties	R_0 (female/female)	r_m (female/female/day)	T_0 (days)
Golden delicious	12.54	0.106 ± 0.002 a	23.87
Starking delicious	17.62	0.107 ± 0.003 a	26.82
F ratio		2.35[1]	

[1]r_m values followed by different letters are significantly different within columns ($P \leq 0.05$: t-test)

The intrinsic rate of natural increase (r_m) was not different between the two cultivars (P= 0.05); 0.106 female/female /day on golden delicious and 0.107 female/female/day on starking delicious (Table 2). The age-specific fecundity reached the first peak on golden delicious on the 21st day (1.67 eggs/ female/day) and on starking delicious on the 23rd day (1.83 eggs/female/day) after the adult emergence (Figure 1).

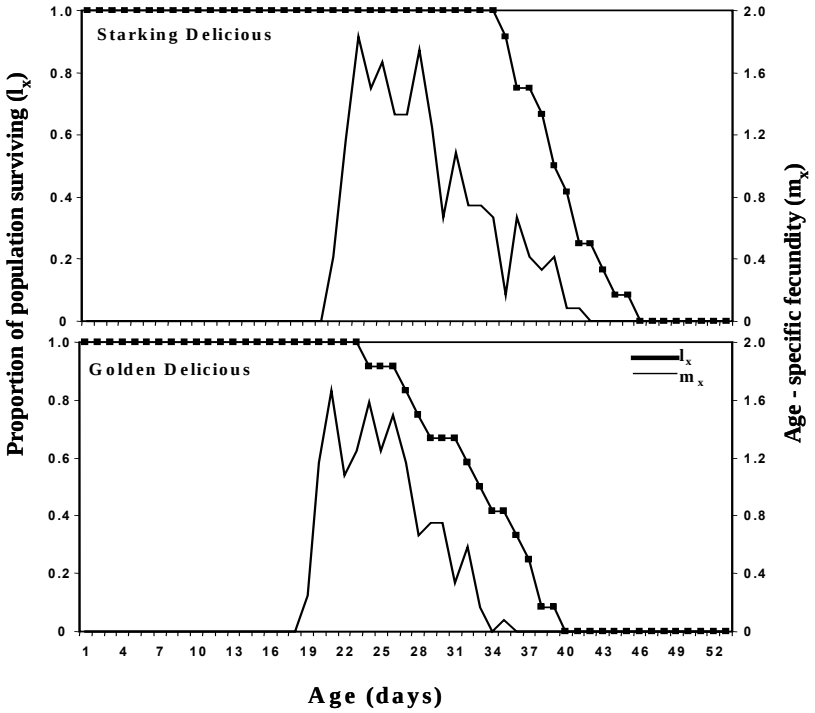

Figure 1. Survivorship curve (l_x) and age-specific fecundity rate (m_x) of *Bryobia rubrioculus* Scheuten (Acari: Tetranychidae) on starking delicious and golden delicious apple cultivars.

Discussion

B. rubrioculus showed the same performance on two apple cultivars under laboratory conditions, due mainly to the same intrinsic rates of natural increase (r_m). *B. rubrioculus* laid more eggs and lived longer period on starking delicious than those on golden delicious. However, *B. rubrioculus* development time on golden delicious was shorter than that on starking delicious. Karaat (1991) reported that host plants have a more significant effect on reproductive potential of tetranychids than that on developmental rate. Kasap (2004) stated that different apple cultivars have a more significant effect on reproductive potential than that on developmental rate of *Tetranychus urticae* Koch. However, Bengston (1970) reported that apple cultivars have a significant effect both on developmental times and reproductive potential of *T. urticae*. Additionally, Crooker (1985) indicated that the chemical constitution of the leaf may influence fecundity, mortality and development of the immature stages of spider mites, especially the host plant nitrogen content. Tomczyk &

Kropczynska (1986) reported that the feeding time and population density of spider mites depend on the length of their stylets and host plant leaf characteristics. Vrie et al. (1972) stated that the different plant species or varieties affect the increase potentials for tetranychid mites, and these differences may be associated with the nutriment produced by plant. Yano et al. (1998) reported that the leaf characteristics of the host plants are significantly related to oviposition rates of *T. urticae* and they play a role in the direct defence to *T. urticae*. In the present study, although there was no difference between the intrinsic rates of natural increase (r_m) of *B. rubrioculus* fed on two apple cultivars, there were significant differences between the total development times, the longevity and reproductive potentials on two apple cultivars. The r_m value is an important parameter, describing the growth potential of a population under climatic and food conditions, because it reflects the overall effects of temperature and food on development, reproduction and survival characteristic of the populations (Southwood, 1978). These variations determined on two different apple cultivars might be due to the chemical contents, the food quality and the leaf texture of the host plants. These leaf characteristics are significantly related to oviposition and development rates of *B. rubrioculus* and they can play an important role in the direct defence to *B. rubrioculus*.

Herbert (1962) reported that the duration of the developmental stages of *B. rubrioculus* was 34, 26, 18 and 17 days at 10 °C (50 °F), 12.7 °C (55 °F), 15.5 °C (60 °F) and 18.3 °C (65 °F) in the laboratory, respectively. The longevity of *B. rubrioculus* adults was the same at 12.7 and 15.5 °C (26.7 and 26 days, respectively), but, at 10 and 18.3 °C it dropped to 12.9 and 13.3 days respectively (Herbert, 1962). In the same temperatures, the number of egg laid by *B. rubrioculus* was 8, 34, 39 and 34 respectively (Herbert, 1962). Although the temperature employed was different from our study, these results were comparable to the present study findings. The number of egg laid by *B. rubrioculus* (Herbert, 1962) was relatively higher than the results of present study. The differences in results may be attributed to differences in host plants, temperatures, local populations and time of year at which the studies were carried out.

Özet

Kahverengi akar *Bryobia rubrioculus* Scheuten (Acari:Tetranychidae)'un laboratuvar koşullarında iki farklı elma çeşidi üzerinde yaşam tabloları

Kahverengi akar *Bryobia rubrioculus* (Acari: Tetranychidae)'un laboratuvar koşullarında 25±1 C^0 sıcaklık, % 65±10 orantılı nem ve 16 saatlik aydınlanma ortamında iki farklı elma çeşidi (Golden Delicious and Starking Delicious) üzerinde biyolojisi

incelenmiş ve yaşam çizelgeleri oluşturulmuştur. *B. rubrioculus*'un golden delicious elma çeşidi üzerinde toplam gelişme dönemlerinin süresi (18.5 gün), starking delicious üzerindekinden (20.5 gün) daha hızlı olmuştur. *B. rubrioculus*'un ömrü golden delicious üzerinde 14.2 gün iken starking delicious üzerinde ise 18.8 gün olarak belirlenmiştir. *B. rubrioculus* bireyleri, golden delicious ve starking delicious çeşitleri üzerinde sırası ile günlük ortalama 1.3 ve 1.2 yumurta bırakırken ömrü boyunca ortalama 14.2 ve 20.1 yumurta bırakmışlardır. Akarın net üreme gücü (R_o), starking delicious üzerinde (17.62 dişi/dişi), golden delicious üzerindeki değerden (12.54 dişi/dişi) daha yüksek olarak belirlenmiştir. Ortalama döl düresi (T_0), starking delicious üzerinde (26.82 gün), golden delicious üzerindekinden (23.87 gün) daha uzundur. *B. rubrioculus*'un her iki elma çeşidi üzerindeki kalıtsal üreme kapasitesi (r_m) değeri ise, birbirine yakın olarak saptanmıştır (starking: r_m= 0.107 dişi/dişi/gün ve golden: r_m= 0.106 dişi/dişi/gün).

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