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Effect of host on egg population fluctuations of brown mite *Bryobia rubrioculus* (Scheuten, 1857) (Acari: Tetranychidae) in western region of Iran

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Abstract. The brown mite, *Bryobia rubrioculus* (Acari: Tetranychidae) is one of the most important pest of spider mite around the world. In recent years, it has been damaged in orchards of Iran specially in Hamedan province. The winter eggs have an important role in increasing population mite hence, frequency of winter egg populations were recorded on four fruit trees orchards; sweet cherry (*Prunus avium*), sour cherry (*Prunus cerasus*), plum (*Prunus domestica*) and apple (*Malus domestica*) in this province located in the west region of Iran. The mean consecutive counts of the eggs were: 286.52, 18.93, 11.40 and 12.28 (eggs). It was also determined that sweet cherry was a more susceptible hosted whereas plum and apple were unsusceptible for this mite in the region. These results may be used as a useful factor to management strategy controlling mite's population.

Key words: *Bryobia rubrioculus*, Brown mite, egg population, fruit trees, Iran.

Introduction

The super family Tetranychoidea has built up high population levels in some orchards (Duso et al. 2004). Amongst brown mite, *Bryobia rubrioculus* (Scheuten, 1857) is a worldwide mite pest of apple, pear, peach and other deciduous fruit trees (Jeppson et al. 1975). It is known to be thelytokous by most authors (Helle & Pijancker 1985). This spider mite is an important pest on sour cherry (*Prunus cerasus*), sweet cherry (*Cerasus avium*) and plum (*Prunus domestica*) trees in western region of Iran (Khanjani & Haddad Irani-Nejad 2006). *Bryobia rubrioculus* was reported from west region of Iran on sweet cherry, plum and clover grown in orchards (Eghbalian 2007, Khanjani 2004, Keshavarze-Jamshidian 2004, Sepasgozarian 1976, Khalil-Manesh 1972). The brown mite has been also found in large numbers in apple orchards in the Kermanshah province, Iran (Darbemamieh et al. 2011). Eghbalian (2007) stated that the mite thrives during the cooler spells in and around Hamedan province (Iran), where it produces five generations in low-lands and four generations in up-lands, and more than 90% of *B. rubrioculus* eggs hatched around 25 °C ambient temperature.

The mites cause considerable damage in some apple orchards in Turkey (Kasap 2008), and the other parts of Asia, Europe and North America (Ehara 1959, Herbert 1962, 1965, Helle & Pijnacker 1985, Incekulak & Ecevit 2002). In Van region (Turkey), the population density of *B. rubrioculus* was observed to be different among localities and apple varieties and also economic importance of this mite was remarkably increased (Kasap & Çobanoğlu 2006). This mite density on Pharping local pear tended to be higher than that on European pear and varied among individual trees (Osakabe et al. 2000). Eggs are normally laid around the young branches of fruit trees, consisting of two types of eggs, summer and winter eggs. Despite the morphological similarities between the two types of eggs, the summer eggs tolerate more heat while winter eggs are more resistant to the cold spells. Its feeding damage appears as whitish-grey spots on the upper surface of young leaves (Herbert 1965, Vrie et al. 1972, Jeppson et al. 1975, Sabelis 1986). Hatching of the overwintering eggs begins in late February and continues throughout the blooming season on almonds in California (Hoy 1985). The brown mites can also complete their development cycles on other plant species such as pear, peach and almond (Baker & Turtle 1994). It prefers feeding on young leaves of host plants and sometimes percentage of damaged buds correlates with number of wintered eggs (Osakabe et al. 2000). According to Meyer (1974) and Herbert (1962) they feed only during the cooler times of the day. Beers (2007) found that this mite species had been a well-established pest in most fruit orchards for a long time in the Pacific Northwest region. It was noted that populations of brown mite are recurring on a few Washington apple orchards and it is currently listed as a pest of pear trees in California.

The main objectives of this study were: a) to determine the abundance of egg populations, b) compatibility and adaptation of *B. rubrioculus* to different hosts in orchards and, c) to produce a forecasting model for population levels.

Materials and methods

The experiments were conducted in two different orchards of Abbasabad, around Hamedan, Iran (34° 47´ 22.98" N, 48° 28´ 32.07"E, 1890 m a.s.l.) in winter 2009 and the samples were transferred to Bu-Ali Sina University's Acarology laboratory for processing. Four tree species selected as the host plants (sweet cherry, sour cherry, plum and apple) and the experiment was conducted in three replications with three subsamples (modified format of Summers & Baker 1952). The branches were randomly cut from four sides in three heights level of the trees' canopy (Herne & Putman 1960). Each sample was consisted different diameters with 50cm long. They were taken and stored in. In January and February, 2009, 92 branches with different diameters were randomly chosen in each sampling times. After separating the branches into five diameter groups (dg), they were orderly packed and were stored in a refrigerator with 2 °C. The count of egg population was performed under a dissecting microscope at magnifications up to 70X.

Statistical analysis

The mean egg population of the spider mite collected on the branches of four fruit tree species were compared using proc GLM and means (lsmeans) procedures (SAS, 2002). If the model was significant, then means comparisons were made using the Fisher protected Tukey test (P<0.05). Since types of the data are whole numbers, standard deviation may be proportional to the mean and/or their effects may be multiplicative, therefore they were logarithmically transformed (Gomes & Gomes 1983). The relationship between population and the host was described using linear regression: $Y= a+bx_1+x_2+x_3$

Where y is the egg populations or egg densities on the tree species (as dependent variables), x is diameters of the branches, surface areas of the branches and tree species (independent variable), a is the intercept and b is the slop of the fitted line.

Results

The eggs of the brown mites were small, globular and dark bright red and they were deposited in group or singular in irregular on high branches, buds and secondary branches cracks and damaged parts the tree skin (Figure 1). While the buds were enlarging, a white-gray layer simultaneously appeared around the winter eggs. Later on, the layers were opened and more eggs appeared, then the gray layer disappeared while bud growths were completed and egg hatching was in early April.

The results showed that the mean number of eggs of the two sampling periods were significantly different on any host species (Table 1) and also, for the diameter groups of the branches (Table 2).

It is obvious that the egg number of four tree species on five diameter groups differed and the highest of egg number on all of diameter groups was on sweet cherry specially on dg5, whereas on sour cherry at diameter groups: 3, 4 and 5 was higher than apple and plum. The results obtained showed that sweet cherry and sour cherry with high egg populations were the best hosts to lay eggs for the mite at this area and likewise, apple and plum were the non preference hosts for the brown mite, for that they had a minimum population of mite eggs.

The GLM procedure was utilized and means of tree diameters sliced within tree species for egg populations. Interaction of tree species and selected diameter groups were significantly different. Therefore, dividing tree species into different diameter groups has been justified and estimation of the egg distribution was an informative trait on these hosts (Table 3).

The egg population on apple and plum was the lowest while, there was not any significant difference between them in this aspect. The results elucidated that the population of eggs in these hosts from diameter group 1 to 5 had been decreased (Figures 2, 3), on the contrary on sweet cherry and sour cherry the population of egg increased from diameter 1 to 5 and there was a significant difference among the low and high diameter groups on each host (Figures 4, 5).

Regression equation showed that the egg population of *B. rubrioculus* on sweet cherry and plum at first depended on diameter group and then to area surface of the branches (S), therefore it was a significant difference in the model whereas on sour cherry and apple only area surface of the branches was effective in this equation. So that the same is observed,

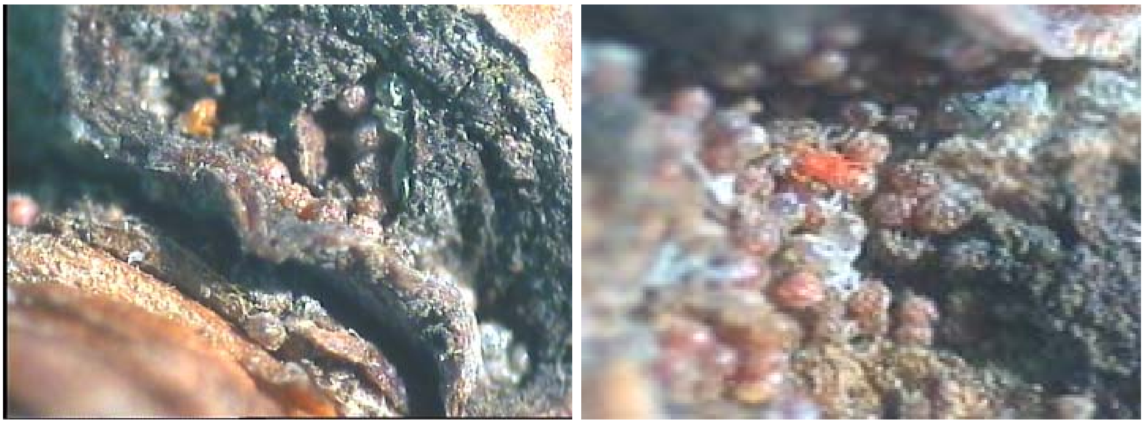

Figure 1. The egg of *B. rubrioculus* near tree buds (40X).

Table 1. Abundance of egg number of *Bryobia rubrioculus* on four host species.

Host	Sweet cherry	Sour cherry	Plum	Apple
Mean (SD)	286.52 (2.93) a	18.93 (2.24) b	11.40 (1.89) c	12.28 (1.88) c

Means with the letter are not significantly different (df= 81, F_{value}= 93.85, P < 0.0001).

Table 2. Comparative abundance of egg number for *B. rubrioculus* on different diameter groups (dg) of four host species.

Host	Mean (SD) (dg1)	Mean (SD) (dg2)	Mean (SD) (dg3)	Mean (SD) (dg4)	Mean (SD) (dg5)
Apple	16.98(1.99)c	19.05(1.62)bc	11.48(1.95)bc	7.59(1.91)c	6.31(1.94)c
Plum	22.91(1.66)bc	14.79(1.78)c	7.08(1.91)c	7.94(2.09)c	4.27(2.04)c
Sour cherry	13.49(1.95)c	16.22(2.04)c	17.38(2.75)b	14.45(2.39)b	33.11(2.04)b
Sweet cherry	77.62(3.39)a	123.03(3.63)a	398.11(2.09)a	309.03(3.24)a	524.81(2.29)a

Means with the letter are not significantly different in each column
(df= 294, F_{value}= 17.13, P < 0.0001), (1= 0.3-0.4; 2= 0.5; 3= 0.6-0.7; 4= 0.8-1; 5= 1.1-1.5) cm

Table 3. Comparative abundance of egg population of *Bryobia rubrioculus* on four host species in tree*diameter group effect slice by tree.

Host	Sweet cherry	Sour cherry	Plum	Apple
df	4	4	4	4
MS	1.60	0.36	1.52	0.54
F_{value}	<.0001	0.0544	<.0001	0.0089

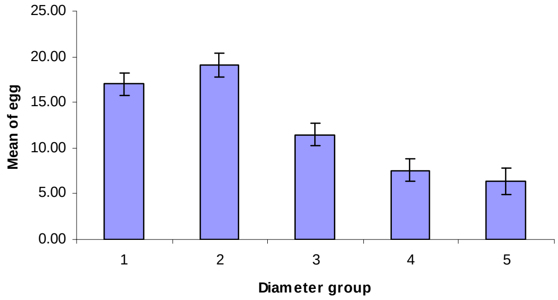

Figure 2. Abundance of egg population for *Bryobia rubrioculus* on apple diameter groups.

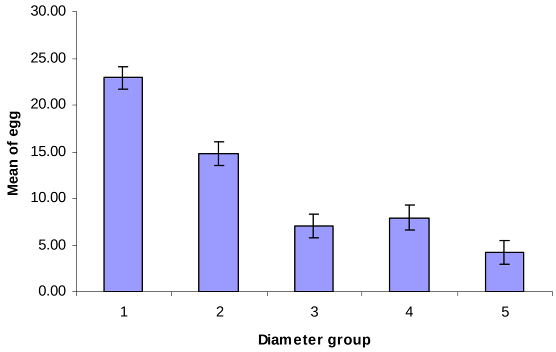

Figure 3. Abundance of egg population of *Bryobia rubrioculus* on plum diameter groups.

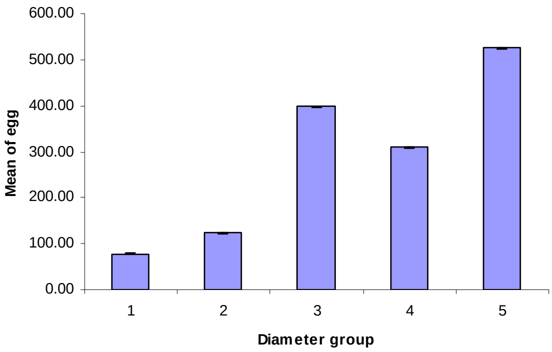

Figure 4. Abundance of egg population of *Bryobia rubrioculus* on sweet cherry diameter groups.

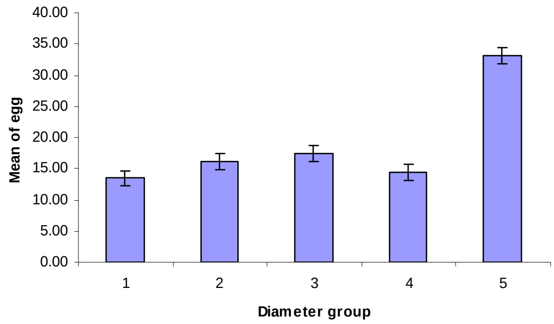

Figure 5. Abundance of egg population of *Bryobia rubrioculus* on sour cherry diameter groups.

Table 4. The Regression procedure for egg population as a dependent variable, on four hosts, different (d) group, recorded areas (s) of the branch for every host.

Host	Sweet cherry	Sour cherry	Plum	Apple
F_{value}	156.39	93.85	102.96	36.81
df	82	81	80	76
R^2	0.85	0.78	0.79	0.59
CV	8.39	10.93	16.13	26.63
Reg. Equation	y= -1.60+0.5d + 0.004s	y= 0.55 + 0.002s	y= 0.28d – 0.03s	Y=0.43 + 0.004s

the area (s) had been positive correlated for all of the equations except on plum and also, only sweet cherry and plum had positive correlation for diameter group (dg). The following Table 4 shows the information of the regression procedure model on four species of hosts.

Discussion

The population of the brown mite increases in May and reaches the peak in June in Amasya province in Turkey (Incekulak & Ecevit 2002) and also, in California, USA the overwintering eggs begin to hatch in late February and continue throughout the blooming season (Hoy 1985). Overwintering eggs of *B. rubrioculus* deposited on the bark of apple trunks began to hatch at mid-May. *B. rubrioculus* population reached a maximum from mid-June to early July (Kasap & Çobanoğlu 2006). Our results showed this pest over wintered as egg on fruit trees shoots and the larvae of first generation appeared in early April. Therefore, appearance of larvae or hatching egg in our study was later than California and earlier than Amasya and seems that environmental temperature has the main role in eggs' hatching. The results showed that egg production increases as the diameter group increases on sweet cherry and sour cherry whereas on plum and apple it decreases; apparently the brown mite prefers to lay the winter eggs on sweet cherry especially on branches of high diameter. It seems that the branch area had considerable effect on egg reduction, thus this egg population can be related to different something on host and/ or natural conditions. In this relation, it is reported that population of *B. rubrioculus* depends on the ecological and biological conditions such as temperature, host plants and natural enemies occurrence (Sabelis 1986, Duzgunes 1977). Hence, sweet cherry may be the best suitable host to feeding and activity of the mite against sour cherry, apple and plum in this area, therefore this can be caused by plant proportionate tissue and mineral elements and probably these conditions had been better for *B. rubrioculus* compared with natural enemies. Osakabe et al. (2000) reported that the population density of *B. rubrioculus* on the pear variety Pharping was higher than the others apparently because of the variation in their seasonal flowering and foliation patterns. According to Kasap & Çobanoğlu (2006) *B. rubrioculus* populations were higher on Starking apples than on golden delicious most probably because of the structure of the leave surfaces of the two cultivars. Cuthbertson & Murchie (2004) found that *Panonychus ulmi* causes severe economic damage to a wide host range of fruit trees like: apple, plum, pear, peach, prune and cherry as, summer eggs were laid on the leaves and the winter eggs deposited predominantly on the bark, with apple and pear being more severely affected. Incekulak & Ecevit (2002) reported that *B. rubrioculus* was suppressed by predators in unsprayed orchards in Amasya. According to Rotem & Agrawal (2003) plant size and quality can influence mite dynamics. Crooker (1985) reported that the chemical constitution of the leaf may influence developmental time of the immature stages of spider mites, especially the host plant's nitrogen content. Tomczyk & Kropczynska (1986) concluded that the feeding time and population density of spider mites depend on the length of their stylets and the leaf characteristics of the host plant. Yano et al. (1998) confirmed the influence of the leaf characteristics of the host plants in the defense against *Tetranychus urticae.* Vrie et al. (1972) emphasized that different plant species or cultivars affect the increase potential of tetranychid mites, and these differences may be associated with the nutritional value of the host plant. According to these results, our findings can play a role in strategic pest management, to control *B. rubrioculus* in the study area and other orchards with similar environmental conditions. Therefore, because sweet cherry is a susceptible host of *B. rubrioculus*, in the Hamedan Province, regular spot checks for the presence of *B. rubrioculus* in these orchards must be carried out and control on the spot. This will prevent them from distributing to other orchards. As *B. rubrioculus* occurs on specific parts of the trees, pruning at the right time can also play a role in controlling the mites.

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