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Biology of the Euonymus scale *Unaspis euonymi* (Hemiptera: Diaspididae) in Urban Areas of Ankara, Turkey*

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Abstract*: Unaspis euonymi* is an important pest of *Euonymus* plants in parks and gardens of Ankara. In this study, the biology of *U. euonymi* was investigated in 2002 and 2003. The euonymus scale overwintered as mated adult females and had two generations per year. Crawlers of the first generation were present from mid-May to mid-June and those of the second generation during July. The maximum number of eggs counted in a female body was 70,8; the greatest number laid in a day was 10,8. Adult females were more abundant on the branches than the leaves. In contrast, adult males were more abundant on leaves than on branches. The number of predator species (Coccinellidae: *Adalia bipunctata* (L.), *Chilocorus bipustulatus* (L.), *Exochomus quadripustulatus* (L.): Nitidulidae: *Cybocephalus* sp.; Neuroptera: *Chrysoperla* sp.) was low and inefficient.

Key Words: Euonymous, *Unaspis euonymi*, Euonymus scale, biology, urban, Ankara

Ankara İli Yeşil Alanlarında Taflan Kabuklubiti *Unaspis euonymi* (Hemiptera:Diaspididae)'nin Biyolojisi

Öz: *Unaspis euonymi* (Comstock) (Taflan kabuklubiti) Ankara parklarında taflanların en önemli zararlısıdır. 2002-2003 yıllarında yapılan bu çalışmada *U. euonymi*'nin biyolojisi araştırılmıştır. Kışı döllenmiş dişi olarak geçirmekte ve yılda iki döl vermektedir. I.dölün hareketli larvaları mayıs ortasından haziran ortasına kadar, ikinci dölün hareketli larvaları ise Temmuz ayı boyunca görülmektedir. Dişilerin dallara, erkeklerin ise yaprak üzerinde daha fazla sayıda yerleştiği gözlenmiştir. Ankara park ve yeşil alanlarında Adalia bipunctata (L.), *Chilocorus bipustulatus* (L.), *Exochomus quadripustulatus* (L.) (Coleoptera: Coccinellidae), *Cybocephalus* sp. (Coleoptera: Nitidulidae) ve *Chrysoperla* sp. (Neuroptera: Chrysopidae) türlerinin az sayıdaki bireylerinin taflan kabuklubiti ile beslendiği ancak ve zararlı populasyonu üzerinde etkisiz oldukları gözlenmiştir.

Anahtar Kelimeler: Taflan, *Unaspis euonymi*, Taflan kabuklubiti, biyoloji, yeşil alan, Ankara

Introduction

Euonymus scale (*Unaspis euonymi* (Comstock)) is an important pest on *Euonymus* and on other ornamental shrubs common in all regions in the World, except in Australia. Davidson and Miller (1990) list this insect as a serious and widespread pest. The presence of the scale on shrubs decreases their aesthetic quality, rendering plants in nurseries unmarketable. The annual economic losses caused by *U. euonymi* were estimated at approximately $355.568 in Massachusetts and approximately $711.135 for the entire southern region of New England (Van Driesche et al., 1998b). In Missouri, *U. euonymi* is a pest both in greenhouses and outdoors, and attacks almost all the above-ground parts of the host (Gill et al. 1982). On the leaves, the scale causes chlorosis, reduces photosynthesis and transpiration, and encourages leaf senescence and abscission, followed by branch dieback (Gill et al., 1982; Cockfield and Potter, 1990). Euonymus scale has one to three generations a year depending on the climate. It tends to be a more serious pest in warmer regions than in cooler climates. It attacks a wide range of plants in addition to *Euonymus* spp., i.e. *Aspidistra, Buxus, Celastrus Citrus, Daphne, Hedera*, *Hibiscus*, *Fraxinus, Ilex, Jasminum, Ligustrum, Lonicera, Olea, Pachistima, Prunus, Pachysandra, Pericheimenum, Syringa, Viscum* (Kozár 1998).

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Euonymus spp. is widely used as ornamental shrub in Turkey. The two common species, *Euonymous fortunei* (Turcz.) and *E. japonicus* Thunb (Celastraceae) are abundant in the parks and gardens of Ankara (Aslan and Çelem, 2001). In Turkey, *U. eounymi* on *Euonymus* sp. is found in Ankara, Bursa, Antalya, Istanbul, Izmir and Rize (Bodenheimer 1949; Çanakcıoğlu 1977, Yaşar 1995, Erler et al. 1996). It has been known to be harmful and widespread in Ankara for a long time (Bodenheimer 1949, Ülgentürk and Toros 1996; Ülgentürk and Dolar 2002). Bodenheimer (1953) suggested that euonymus scale could have two generations a year but its biology was not known in Turkey. Chemical control has been of limited effectiveness because of constraints of coverage and timing (Sadof and Sclar 2000).

The aim of this research was to determine such aspects: biological stages, number of generations, overwintering stage, number of eggs, distribution and natural enemies of *U. euonymi* in Turkey.

Material and Methods

Biological studies were conducted with regular observations and samplings in two parks in Ankara province, during the years 2002-2003. The sampling was done by weekly surveys, with one infested shoot, each 10 cm long, being collected from four directions and in the middle part of the four plants, 20 in total. The leaves and twig samples were examined under a stereomicroscope in the laboratory and the number and growth stage of all *U. euonymi* were recorded and made slide using the methods of Kosztarab and Kozár (1988).

In addition, healthy potted five plants kept on Ankara University campus were infested with *U. euonymi*. Ten cm long stems from each plant were marked and biology of the same aged individuals was observed daily in this marked area. To determine oviposition and egg number, 100 randomly chosen adult females were checked daily, total and average number of the eggs in the body of the females was determined by dissecting them under the microscope in the laboratory.

To determine the distribution of the euonymus scale in Ankara, in total 100 parks and gardens were randomly surveyed in different parts of Ankara twice a week. Randomly selected some branches and leaves of *Euonymus* plants were investigated visually and number of infested plants were recorded. This plants were controlled for the natural enemies of *U. euonymi* too. The predators were collected both by hand and by shaking the euonymus plants over a Steiner funnel. Larvae of predators were reared on the euonymus scale in the laboratory at 28 C, 60 % relative humidity and a photoperiod of 16 h light per day.

For the determination of the parasitoid, infested twigs and leaves were placed in the emergence chambers in the laboratory. The slides of instars, parasitoid and predators of *U. euonymi* were deposited at the department of Plant Protection, Faculty of Agriculture, Ankara University.

Results

The present survey showed that *U. euonymi* is widespread in urban areas of Ankara, being present on *Euonymus* in all the 64 parks and gardens surveyed (Table 1).

In Ankara, *U. euonymi* has two generations a year. In 2001/2002, the scale overwintered as mated, 2^{nd}-generation females, which survived through from the end of September until beginning of June. At the start of oviposition by the 1^{st} generation, there was a mean of 5.45 eggs under each test, with the first crawlers emerging about 24 hours after being oviposited. First generation eggs and crawlers were noted between early May (6^{th}) and June (11^{th}). The maximum number of eggs under each test (10.8) was on the 18^{th} May, decreasing to 0 by the 18^{th} June (Fig. 1). The largest mean number of eggs noted in dissected females was 70.8. Oviposition continued for 35 days; dead post-ovipositing females were present from the second half of June, although eggs were still present in some dead females. 2^{nd} instar nymphs (male and female) (Fig. 2a) were found in the second half of June (17^{th}). Adult males were observed in flight at the beginning of July (7^{th}) (Fig. 2b) and, after mating, the adult female exuded their 3^{rd} scale cover (Fig. 2c). Second generation eggs and crawlers were present at the end of July (22^{nd}) (Fig. 2d) and 2^{nd}-instar nymphs from the middle of August until the end of September (19^{th} Aug. until 8^{th} Sept.). Adult males were then observed for about a week between 17^{th} and 25^{th} Sept. As previously, mated females overwintered but only until the middle of May in 2003. The timing of each stage in 2003 was then similar to that in 2002 (Fig. 1).

Male and female of *U. eounymi* were found to settle on different parts of the host plant. In 2002, only a third of the individuals on the branches were male but they made up more than 90% of the population on the leaves. In 2003, the differences were even more marked, with males making up only about 20% of the population on the branches but more than 85% on the leaves. In addition, the number of males on the lower leaf surface was far greater than on the upper leaf

Table 1. Found localities and host plant of *Unaspis euonymi in Ankara*

Localities	Dates and host plants
Çankaya	III/V/2002, *E. japonicus*
Barış Manço Parkı	III/V/2002*E. japonicus*
Bahçelievler	VI/V/2002, *E. japonicus*
Etimesgut	X/V/2002,*E. japonicus*
Bahçelievler İkebana Çiçekçilik	XX/V/2002*, E. japonicus*
Hoşdere	XXI/V/2002*, E. japonicus*
Keçiören	XXIIV/V/02, *E. japonicus*
Şehitlik Park	XXXI/V/02, *E. japonicus*
Atatürk Orman Çiftliği	XX/VI/02, *E. japonicus*
Sokullu Ahmet Arif Park,	XXVI/V/02, *E. japonicus*
Dikmen	XXVI/V/02, *E. japonicus, E. japonicus aureo-pictus*
Sanatoryum	XV/VII/02, *E. japonicus*
Etlik	II/VIII/02, *E. japonicus aureo-pictus*
Basınevleri	II/VIII/02, *E. japonicus*
Çiğdem Mahallesi	XV/VIII/02, *E. japonicus*
Yüzüncü Yıl	XV/VIII/02, *E. japonicus*
Cumhurbaşkanlığı Köşkü	XXIX/VIII/02, *E. japonicus*
Orman Fidanlığı Serası	XII/IX/02, *E. japonicus*
Gazi Mahallesi	XII/IX/02, *E. japonicus aureo-pictus*
Bahçelievler Anıtpark	XVIII/IX/02, *E. japonicus aureo-pictus*
Batıkent Vedat Dalokay Park	XXV/IX/02, *E. japonicus albamarginatus*
Batıkent	XXV/IX/02, *E. japonicus*
Aydınlıkevler	XXVIII/X/02*, E. japonicus*

Table 1. continued

Keçiören	XVI/V/03, *E. japonicus*
Aşağı Ayrancı	XXX/V/03, *E. japonicus*
Aydınlıkevler	IV/VI/03, *E. japonicus, E. japonicus aureo-pictus*
Subayevleri	IV/VI/03, *E. japonicus*
Türk-iş	IV/VI/03, *E. japonicus*
Yenimahalle	XXV/VIII/02, *E. japonicus, E. japonicus aureo-pictus*
Demetevler Parkı	XIII/VI/03, *E. japonicus*
Nato Yolu	XXVII/VI/03, *E. japonicus*
Akdere	XXVII/VI/03, *E. japonicus aureo-pictus*
Abidinpaşa	XXVII/VI/03, *E. japonicus aureo-pictus*
Seğmenler Parkı	II/VII/03, *E. japonicus*
Çankaya	II/VII/03, *E. japonicus aureo-pictus*
Peyami Safa	II/VII/03, *E. japonicus aureo-pictus*
Bağcılar	II/VII/03, *E. japonicus aureo-pictus*
Sokullu	XI/VII/03, *E. japonicus*
Oran	XI/VII/03, *E. japonicus*
Atatürk Sitesi	XI/VII/03, *E. japonicus*
Ostim Mahallesi	*XXIII/VII/03, E. japonicus, E. japonicus aureo-pictus*
Eryaman	*30/VII/03, E. japonicus, E. japonicus aureo-pictus*
Keçiören	VI/XIII/03, *E. japonicus*
Maltepe	XIII/XIII/03, *E. japonicus*
Hoşdere	XIII/XIII/03, *E. japonicus*
Beysukent	XX/VIII/03, *E. japonicus*
Bilkent	XX/VIII/03, *E. japonicus*

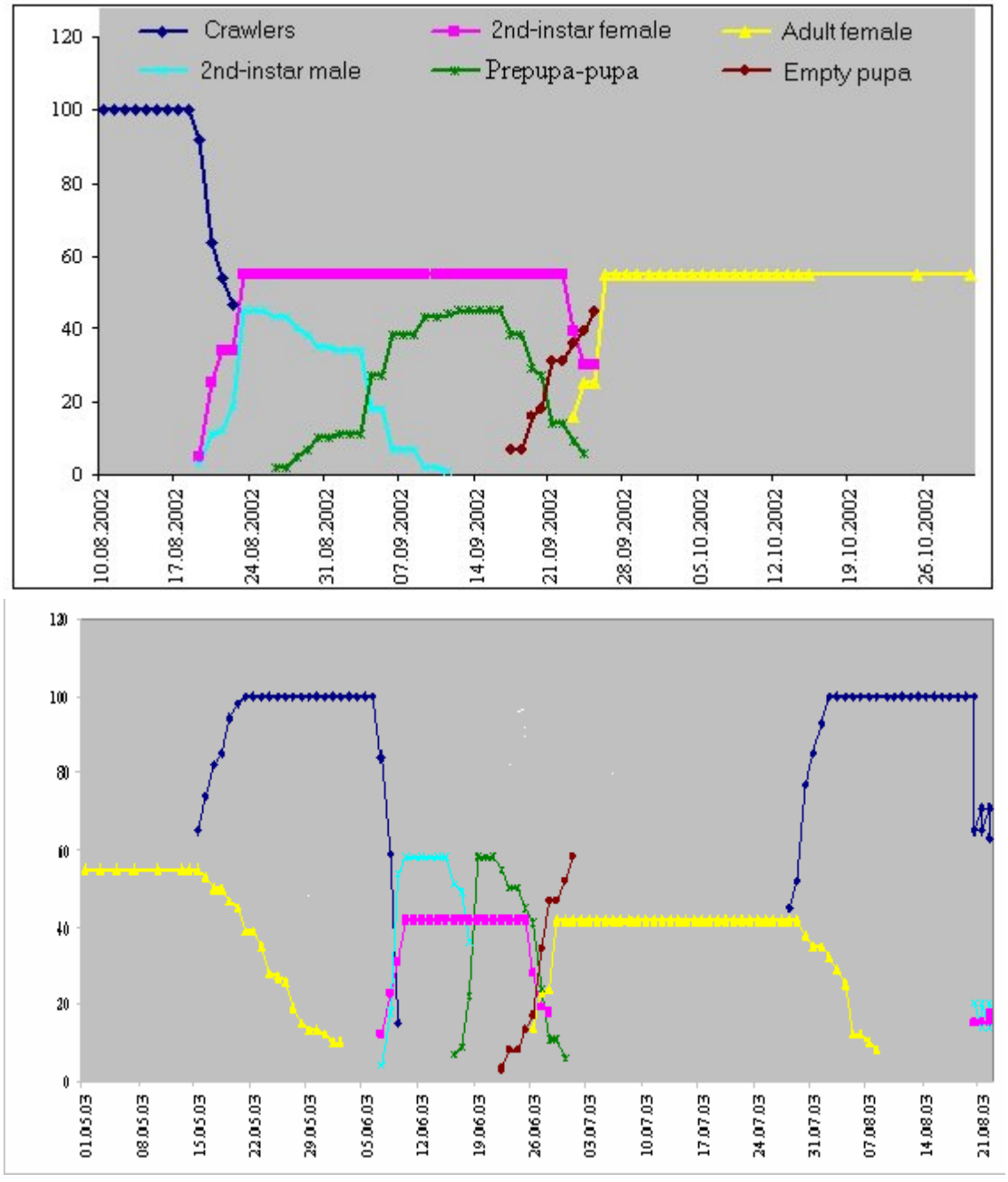

Figure 1. Population of biological stage of *Unaspis euonymi* on *Euonymus japonica* in 2002-2003 years, Ankara

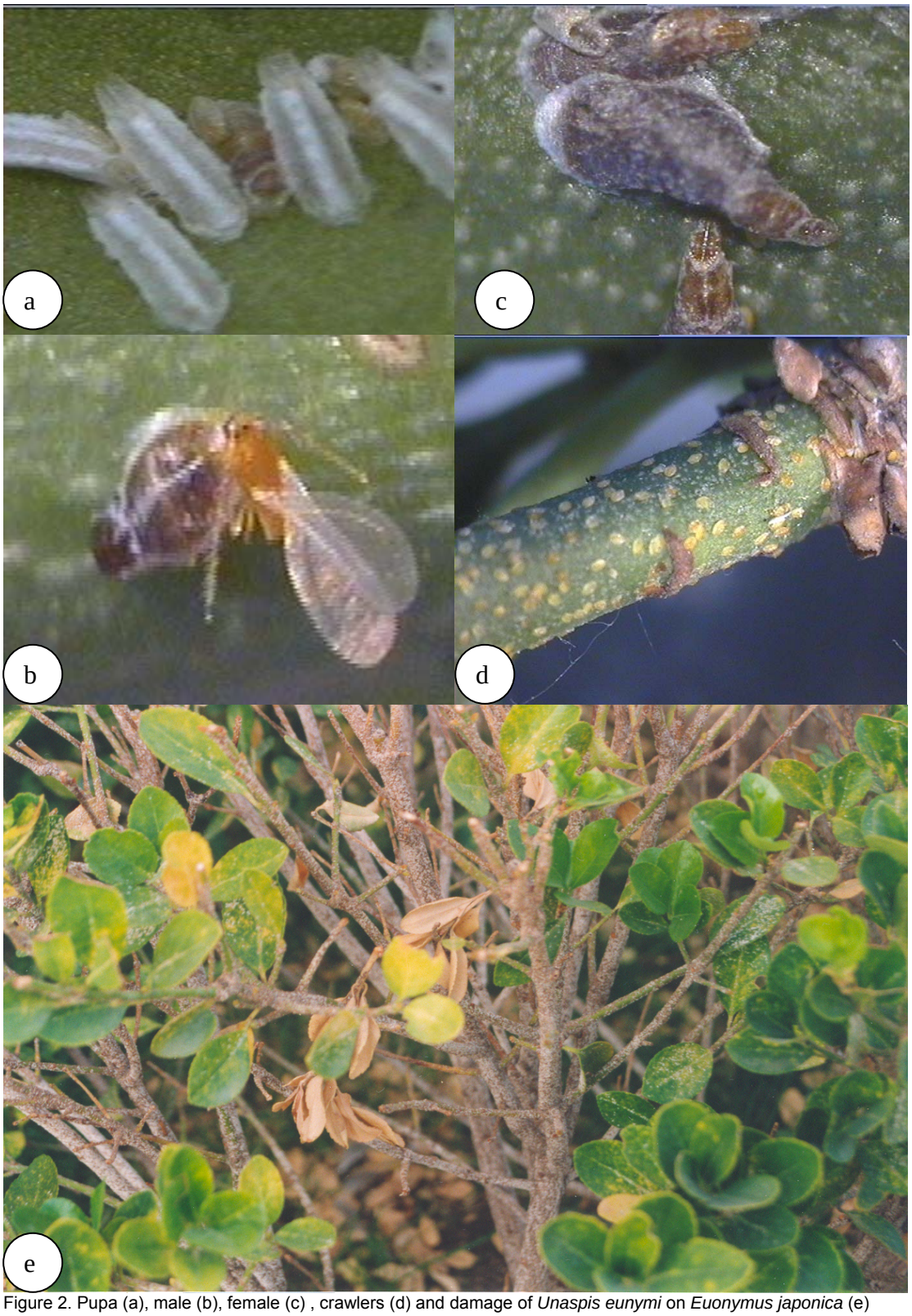

Figure 2. Pupa (a), male (b), female (c) , crawlers (d) and damage of *Unaspis eunymi* on *Euonymus japonica* (e)

surface (22.5♂:1♀ on the lower surface, 3.3♂:1♀ on the upper surface). When the infestation was heavy, stems and leaves were almost entirely covered with scales (Fig. 2e). Yellow spotting on the upper surfaces of leaves was the first symptom, causing early leaf fall when the symptoms were severe. When the population on the branches was heavy, die-back was noted and occasionally evens the death of the entire plant.

The predatory species noted in the study area were: Coccinellidae: *Adalia bipunctata* (L.), *Chilocorus bipustulatus* (L.), *Exochomus quadripustulatus* (L.), Nitulidae: *Cybocephalus* sp.; Neuroptera: *Chrysoperla* sp. and unidentified larvae of an anthocorid and a hemerobiid species. Adult *C. bipustulatus* were seen in the autumn but larvae were only recorded once. *Chrysoperla s*p larvae were found to feed on the prepupa and pupal stages of euonymus scale but had no impact on infestations. In addition, a parasitoid was collected from samples on *E. japonicus albomarginatus,* but it could not be identified.

Discussion

The biology of *U. euonymi* on euonymus in Ankara is similar to the other research results (Stimmel 1979, Gill et al. 1982, Cockfield and Potter 1987, Kosztarab and Kozár 1988; Savopoulou-Soultani 1996, Schmutterer 1998). Euonymus scale undergoes two generations per year and overwinters as mated, second-generation, adult females. Kosztarab and Kozár (1988) reported that the number of yearly generations within its range varied but they found two and a partial third generations in Hungary, where it mainly overwinters as the adult female but also as nymphs. Schmutterer (1998) found that it had one or two generations per year in Germany and overwintered only as the adult female. Mated female overwinter and deposit eggs in early spring. Two generations per year occur in Kentucky (Cockfield and Potter 1987).

Crawlers of first generation were seen from the beginning of May until June; the 2nd stage nymphs from the middle of June and the adults in middle of July. Crawlers of the second generations were detected at the end of July, the 2nd-instar nymphs in middle of August, and the adults from the end of September until the following spring (May) in Ankara. In Greece, Savopoulou-Soultani (1996) found crawlers of the 1st generation at the beginning of May, and those of the 2nd generation in middle of July. In the USA, the timing of the generations varies according to the region but they are generally observed between May and July (Gill et al., 1982). Crawlers of first generation hatch from mid-April to mid-May, and those of second generation begin to hatch in mid-July in Lexington (Cockfield and Potter 1987). *U. euonymi* has 2 generations per year in Pennsylvania. Fertilized adult females overwinter and begin producing eggs as the weather warms, usually around late April. Eggs hatch and crawlers begin to emerge around mid-May, heavy crawler emergence continues for 1-2 weeks. Crawlers settle and soon begin feeding and mature in about 6 weeks. Oviposition ensues and second generation crawlers appear from late July through mid-August. From late August through September, males emerge and fertilize the second generation adult females (Stimmel 1979).

We found a clear difference between the sexes on their preference of where to settle. Males were much more abundant on the leaves while the females were more abundant on the twigs. This was also noted by Gill et al. (1982) but in Greece this was less marked. Savapoulou-Soultani (1996) had sex ratios of 1 male to 45.5 females on branches, and 2.5:1 on the leaves.

In Ankara, natural enemies were clearly ineffective and appeared to have no effect on the Euonymus scale populations. In the USA, Van Driesche et al. (1998a) reported that *Chilocorus kuwanae* Silvestri (Coleoptera: Coccinellidae) had been introduced from China and was common and effective. After these results we introduced this predator from the USA to Turkey and try to control *U. euonymi* in Ankara. The data obtained on the biology of *U. eonymi* which is a serious pest of euonymus in Ankara parks and gardens will help to control the pest effectively at right time.

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