

ÜLGENTÜRK, S.; TOROS, S.

University of Ankara, Faculty of Agriculture, Department of Plant Protection, Diskapi 06110,
Ankara, Turkey

STUDIES ON THE BIOLOGY OF *EULECANIUM CILIATUM* (DOUGLAS) (HEMIPTERA: COCCIDAE) IN ANKARA, TURKEY.

ABSTRACT

STUDIES ON THE BIOLOGY OF *EULECANIUM CILIATUM* (DOUGLAS) (HEMIPTERA: COCCIDAE) IN ANKARA, TURKEY.

Eulecanium ciliatum Douglas is a common pest species on Aceraceae and Rosaceae in Ankara province, Turkey. Its biology was investigated on *Acer campestre*, *A. pseudoplatanus*, *Crataegus monogyna* and *C. oxyacantha* in 1995-1996. *E. ciliatum* had one generation a year and overwintered as the 2nd-instar nymph. The number of eggs laid per female depended on the host, with the greatest number of eggs being laid on *A. pseudoplatanus*, on which it had the densest populations. The 1st-instar nymphs were found on both leaf surfaces but they preferred the upper surface. The 2nd-instar nymphs preferred sites on branches on the north-east side of the host trees. The sex ratio varied between 1.5 and 3.8♂:1♀.

Key words: Palaearctic, life cycle, ecology, host plants, settling sites, migration, *Formica cunicularia*, *Camponatus aethiops*, *Plagiolepis vindobonensis*, *Anthribus fasciatus*, urban entomology, Brunton compass, predator.

INTRODUCTION

Eulecanium ciliatum (Douglas) (Coccidae) is a widespread species in the Palaearctic region (Ben-Dov, 1993) and was recorded in Ankara by Bodenheimer (1953). There is only limited information on the biology of *E. ciliatum* in the literature, although Newstead (1903), Borchsenius (1957) and Kosztarab & Kozár (1988) give some data on its distribution and host plants.

During surveys of the Coccoidea in Ankara carried out between 1992-1994, *E. ciliatum* had been found to be harmful to some species of Aceraceae and Rosaceae common in parks and gardens. Following heavy infestations, the tips of the branches dried up and sometimes the whole tree died. Its biology in Turkey is poorly known and the aim of this study was to rectify this.

MATERIALS AND METHODS

The life cycle, growth patterns and population changes of *E. ciliatum* were studied between 1994 and 1996 on three of each of the following host plants: *Acer campestre* and *A. pseudoplatanus* (Aceraceae) and *Crataegus monogyna* and *C. oxyacantha* (Rosaceae). Samples were collected once a month

between November and April, and once a week or once a fortnight between April and October. From each host tree, four 10cm long, one year old or older shoots were collected from the four sides of each tree, giving a total of 48 samples (4 replicates x 3 trees x 4 sides). The number of 1st- and 2nd-instar nymphs, prepupae, pupae, empty tests and adult female (young without eggs or with eggs) stages were counted for each twig. The time of the appearance of each stage, its duration, the sex ratio, changes in the populations and the overwintering stage were determined under natural conditions. For confirmation of particular instars, individuals were transferred to 70% alcohol and mounted as described by Wilkey (1962). The number of eggs per female was determined by counting the number of eggs beneath 150 adult females on each host species in the last quarter of May.

The number of crawlers hatching each day was determined by counting the number emerging from beneath 20 females from each host tree. For this, twig samples from the four hosts, each with a single adult female, were maintained in closed vials in the laboratory and observed daily; all emerged crawlers were removed. The preferred settling sites for the 1st-instar nymphs was determined by counting the number of crawlers on both leaf surfaces of 48 leaves collected from 10cm long shoots off each of the four host plants. The preferences of the adult females were determined by measuring the compass direction of the infected branches on each of the four host species, using a Brunton compass. A total of 30 measurements were made for *A. campestre* and *C. monogyna* and 32 measurements were made for *A. pseudoplatanus* and *C. oxycantha*.

RESULTS AND DISCUSSION

In both years, the first eggs were observed on *A. campestre* in the last week of April, followed by *A. pseudoplatanus*, while they appeared in the first week of May on the two *Crataegus* sp.; in Germany, Schmutterer (1952) found that *E. ciliatum* started oviposition in the second week of May and that it was complete within 15 days. The eggs were deposited within a brood chamber beneath the abdomen of the adult females and were elliptic in shape, pink when fresh but turning brownish-pink as the embryo developed.

The number of eggs laid per female varied greatly between host plants (Table 1), with significantly more eggs being laid on *A. pseudoplatanus* than on the other three host plants. The first crawlers appeared 39 days after first oviposition in 1995 and 31 days in 1996. However, under laboratory

conditions ($25\pm 2^{\circ}\text{C}$, $60\pm 5\%$ relative humidity), maximum crawler hatch occurred after only 5-8 days and hatching lasted 15-20 days (Fig. 1).

Table 1. Mean no. (\pm s.e.) and range of eggs laid by *Eulecanium ciliatum* on four host plants in Ankara province, Turkey in 1995 and 1996.

Plant host	1995	1996
<i>Acer campestre</i>	918 \pm 14 (556-682) ^{bA}	924 \pm 13 (565-1268) ^{bA}
<i>A. pseudoplatanus</i>	1093 \pm 28 (486-2003) ^{aA}	1323 \pm 32 (459-2349) ^{aB}
<i>Crataegus monogyna</i>	598 \pm 22 (205-1397) ^{dA}	458 \pm 8 (216-794) ^{dA}
<i>C. oxyacantha</i>	741 \pm 14 (412-1486) ^{cA}	675 \pm 12 (394-1023) ^{cA}

where: capital letters indicate differences between years and small letters differences between hosts within years; and where data sharing the same letter do not differ statistically ($P < 0.01$).

Table 2. Mean no. (\pm s.e.) and range of 1st-instar nymphs of *Eulecanium ciliatum* which had settled on the lower and upper leaf surfaces of leaves of four host species in Ankara province (data/leaf).

Plant hosts	Upper leaf surface	Lower leaf surface
<i>Acer campestre</i>	213 \pm 31 (57-385) ^{aA}	32 \pm 6 (10-86) ^{aB}
<i>A. pseudoplatanus</i>	263 \pm 36 (97-473) ^{aA}	47 \pm 13 (2-146) ^{aB}
<i>Crataegus monogyna</i>	46 \pm 8 (14-104) ^{bA}	12 \pm 2 (2-23) ^{bB}
<i>C. oxyacantha</i>	40 \pm 4 (11-61) ^{bA}	15 \pm 2 (9-23) ^{bB}

where: capital letters indicate differences between surfaces and small letters differences between host plants; and where data sharing the same letter do not differ statistically ($P < 0.01$).

The crawlers remained under the parental abdomen for some time before dispersing to the young shoots and leaves, where they settled on the midrib and veins of both leaf surfaces. This behaviour is influenced by innate behaviour patterns, availability of acceptable settling sites and ambient environmental conditions (Beardsley & Gonzáles, 1975). Schmutterer (1952) reported that the larvae colonised the lower surface but, in our study, they showed a strong preference for the upper surface (Table 2).

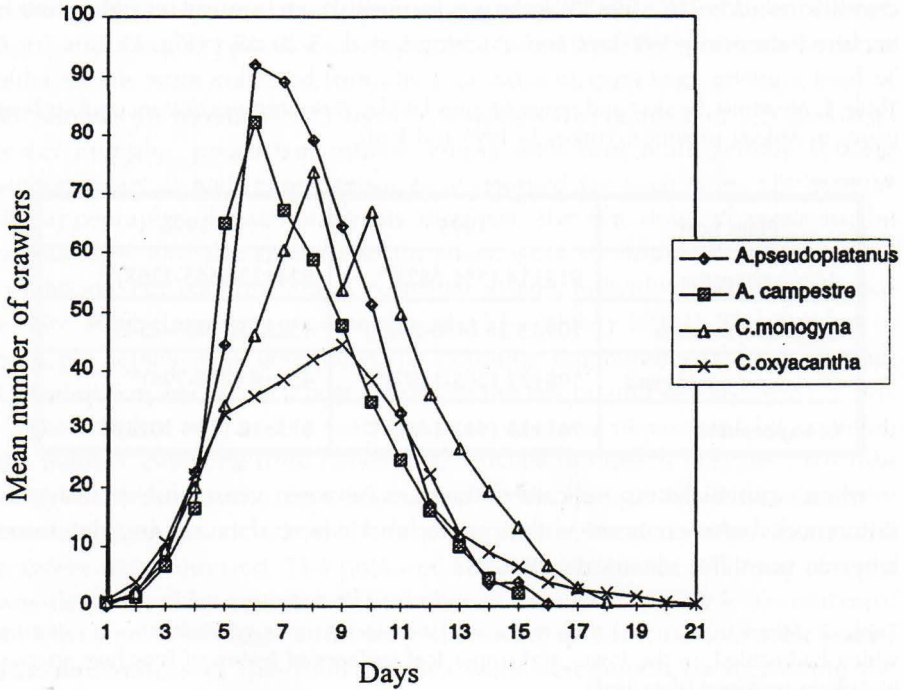


Figure 1. The number of crawlers of *E. ciliatum* emerging each day once hatching had started on the twigs of four host species under laboratory conditions ($25 \pm 2^\circ\text{C}$; $60 \pm 5\%$ RH).

The greatest populations of 1st-instar nymphs were found in July. These nymphs grew slowly until mid-September, when they started to moult. Thus, the 1st instar lasted 93-103 days. Newstead (1903) noted the appearance of the first crawlers of *E. ciliatum* at the end of July and found that they moulted before overwintering, while, on the other hand, Schmutterer (1952) found that the first moult occurred between the end of August and mid-September in Germany.

The first 2nd-instar nymphs were found on the leaves on the 8th Sept. in 1995 and on the 15th September in 1996. There was then a rapid increase in the number of 2nd-instar nymphs until the leaves started to senesce and the mean temperature to fall, when the nymphs migrated to the branches and stems, where they settled beneath the branches or on the more sunny sides of the trees. During this migration, it is believed that many nymphs die due to unfavourable environmental conditions, such as high winds and heavy rain.

of the trees. During this migration, it is believed that many nymphs die due to unfavourable environmental conditions, such as high winds and heavy rain. This migration was complete by the beginning of November and the numbers settling on the four host plants were different, with the largest populations on *A. pseudoplatanus* with 221 nymphs per branch. This migration from the leaves to the branches or stems to overwinter is a common behaviour for scale insects which feed on the leaves of perennial host plants (Hamon & Williams, 1984). This migration of *E. ciliatum* nymphs was also noted by Schmutterer (1952). *E. ciliatum*, therefore, overwinter as the 2nd-instar nymph and this stage lasted about 118-226 days. Little parasitisation of nymphs was noted at this stage.

Schmutterer (1952) reported the first prepupae of *E. ciliatum* at the end of April in Germany, the pupae at the beginning of May and the appearance and flight of the adult males in the second week of May. In the present study, the first prepupal + pupal stages were noted in the second week of April, when the majority of males were at this stage under their glassy, translucent test. The density of the prepupal + pupal populations varied depending on the hosts and the year, with the greatest populations on *A. pseudoplatanus* (means: 94.5 ± 5.5 (range 61-124) in 1995; 122.5 ± 5.3 (range 102-136) in 1996). The first empty pupal test was found in the first week of May on *A. campestre*. The prepupal + pupal stages lasted 36-46 days.

Adult females have a very thin, smooth skin immediately after moulting and, at this stage, were observed to secrete large amounts of honeydew. This was visited by several species of ants (Hymenoptera; Formicidae): *Formica cunicularia* Latreille, *Camponatus aethiops* (Latreille) and *Plagiolepis vindobonensis* Lomnicki. Later, the dorsum of these females became rather convex and sclerotised. Honeydew secretion by the females decreased gradually as they became convex and sclerotised, finally ceasing when this process was complete. The population densities of the adult females (both pre- and post-oviposition) was different on the various hosts, with the largest numbers on *A. pseudoplatanus* in 1996 (30.0 ± 1.2 (range 22-37) per branch). The first eggs were found on *A. campestre* and *A. pseudoplatanus* in the first week in May. The adult females survived for 28-38 days in 1995 and 27-46 days in 1996 respectively. The size of the adult females varied depending on the host species, the largest individuals being on *A. pseudoplatanus* and the smallest on *C. monogyna*.

It was noted that the adult females did not appear to be randomly distributed on the trees but appeared to favour the more N and NE-SW-facing parts of the trees. The position of *E. ciliatum* on the four host plants was therefore evaluated. This showed a strong preference for the north-eastern

and south-western parts of trees. Schmutterer (1952) reported that *E. ciliatum* preferred to settle on trees in the sunshine in the warmer parts of parks.

During the adult stage, there was a significant amount of parasitisation and predation, the latter particularly by *Anthribus fasciatus* (Förster) (Coleoptera: Anthribidae), which was rather effective.

E. ciliatum has 1 generation a year in Ankara, similar to that in Central Europe (Kosztarab & Kozár, 1988). The sex ratio varied according to the host plant but ranged from 1.5 to 3.8♂:1♀.

ACKNOWLEDGEMENTS

The author is very grateful to Dr S. Maden and Dr Y. Kusu for their help in the preparation of the manuscript; and to Dr N. Aktas for the identification of the ant species. This work was supported by Ankara University, Research Foundation, Paper No. 95250011.

REFERENCES

- BEARDSLEY, J.W., GONZÁLES R.H., 1975 - The biology and ecology of armored scales. *Annual Review of Entomology*, 20: 47-73.
- BEN-DOV, Y., 1993 - A Systematic Catalogue of the Soft Scale Insects of the World (Hom.: Coccoidea: Coccidae), with Data on Geographical Distribution, Host Plants, Biology and Economic Importance. Flora and Fauna Handbook No.9, Sandhill Crane Press, Florida. 536pp.
- BODENHEIMER, F.S., 1953 - The Coccoidea of Turkey III. *Istanbul University Faculty Sciences Review, Series B*, 18: 91-167.
- BORCHSENIUS, H.C., 1957 - Fauna of USSR, Homoptera, Coccidae. *Zoologicheskago Instituta Akademii Nauk SSSR (n.s. 66)*, 9: 1-493. (In Russian).
- HAMON, A.B., WILLIAMS, M.L., 1984 - The Soft Scale Insects of Florida (Hom.: Coccoidea: Coccidae). Arthropods of Florida and Neighboring Land Areas, 11. Agriculture and Consumer Services Division of Plant Industry, Contribution No. 600, Florida. 176pp.
- KARAMAN, M.E., 1996 - Yapısal Jeoloji ve Uygulamaları, Ankara. 335pp.
- KOSZTARAB, M., KOZÁR, F., 1988 - Scale Insects of Central Europe. Dr. W. Junk Publishers, Budapest. 456pp.
- NEWSTEAD, R., 1903 - Monograph of the Coccidae of the British Isles. Vol.II. Ray Society, London. 270pp.
- RAGAN, D.M., 1968 - Structural Geology, an introduction to geometrical techniques, John Wiley and Sons. 169pp.
- SCHMUTTERER, H., 1952 - Die Ökologie der Cocciden (Hom.: Coccoidea) Frankens. (2.-3. Abschnitt). *Zeitschrift für Angewandte Entomologie*, Bd. 341, 5-100; 544-584.
- WILKEY, R.F., 1962 - A simplified technique for clearing, staining and permanently mounting small arthropods. *Annals of the Entomological Society of America*, 55: 606.