

THE OCCURRENCE OF *CHORISTONEURA MURINANA* IN *ABIES CILICICA* FORESTS IN ASIA MINOR

Oğuzhan Sarıkaya* and Mustafa Avcı*

* Süleyman Demirel University, Forestry Faculty, Forest Engineering Department, 32260 Isparta, TURKEY, e-mail: oguzhan@orman.sdu.edu.tr

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ABSTRACT: Although widespread in European fir forests, *Choristoneura murinana* (Hübner) was not known in Asia Minor until 2000. Owing to the serious damage caused by this budworm in the Lakes District to stands of *Abies cilicica* Carr., this study was launched on its distribution, morphology, biology and injury.

Forewings of the *C. murinana* adults are yellowish-beige colored. The mean wingspan between forewings was 22.8±1.7 mm (mean ± standard deviation) in female and 18.5±1.6 mm (mean±SD) in male adults. The main flying period of *C. murinana* lasts from the mid of June to the end of July. The moth is univoltine and overwinters in larval stage. *C. murinana* has a total of 6 larval instars, with greyish-light green mature larvae. Pupation takes place among the last needles they feed on. *C. murinana* causes serious damage to fresh shoots, buds and needles, especially when the larvae molt to third stage in the second half of April. Spring feeding of the larvae causes more damage than summer and autumn feeding.

Key words: *Choristoneura murinana*, fir forest, the Lakes District, budworm, Turkey

The European fir budworm (=EFB) *Choristoneura murinana* (Hübner) (Lep.: Tortricidae) feeds on the needles, buds and shoots of fir trees (Du Merle & Géraud, 1988). It was recorded for the first time in Asia Minor in 2000, in *Abies cilicica* Carr. stands in Yenişarbademli, county of Isparta, Turkey (Sarıkaya & Avcı, 2002). EFB is a pest of the fir, and after heavy defoliation the tree weakens and is attacked by bark beetles (especially *Pityokteines curvidens* Germ. and *Cryphalus piceae* Ratz.) which may cause the death of the tree.

EFB is widespread in the northern hemisphere especially in Central and Eastern Europe. Damage caused by *C. murinana* was first recorded in 1805 in Thüringerwald forests in Germany (Bucher, 1953). Outbreaks of the insect in different regions of Germany were recorded by Schimitschek (1936) and Franz (1940). Outbreaks of EFB were reported from Central and Eastern Europe (Patočka, 1960; Birova, 1966; Du Merle et al., 1992; Géraud, 1988; Du Merle & Brunet, 1991; Du Merle et al., 1990; Markalas & Bogenschütz, 1995). Beside these studies, the moth was recorded in central Russia and Siberia (Ivliev et al., 1970; Galkin, 1980).

Du Merle et al. (1992) and Bogenschütz (1997) stated that EFB caused serious damage throughout *A. alba* regions in Europe. Their studies showed that *C. murinana*, which was first known as monophagus on *A. alba*, caused damage on other species of trees in various regions of Europe and Siberia also. The occurrence of the moth in Yenişarbademli fir forests suggests that Asia Minor is included in the range of EFB and *A. cilicica* is a new host plant (Sarıkaya & Avcı, 2002). The study on the

biology and ecology of the moth was launched owing to the severe damages inflicted to the local fir stands.

MATERIALS & METHODS

Field studies were conducted between 2001 and 2003 in May-August in a mixed forest in Yenişarbademli (Fig. 1). The stand includes mainly *A. cilicica*, a few *Pinus nigra* Arnold and *Juniperus excelsa* Bieb. The morphology and biology of EFB was studied on laboratory reared individuals. Larvae were removed from the damaged fir trees at different altitudes (between 1060 and 1400 m) of the study area. A survey was conducted by Delta pheromone traps in neighbor fir stands. The larvae were put into plastic jars (25x25x30 cm) and fed with fresh fir shoots. In addition to the laboratory reared pupae, additional pupae were taken from the forest and put into jars. The development was monitored until adult emergence. Measurements of the wingspan of 30 ♂ and 30 ♀ were taken. The sex ratio and the life span of moths were assessed. The mating took place in reproduction jars. The eggs were collected from the shoots and maintained in the laboratory at 21-24 °C.

RESULTS

Distribution

After the finding of the budworm in *A. cilicica* forests of Yenişarbademli, a county of Isparta, in 2000, investigations were conducted also in *A. cilicica* forests of Lakes District, southwest Turkey. However, EFB was found only in Yenişarbademli Taurus fir (*A. cilicica*) forests.

Biometrics

The wings of adult are yellowish-beige colored with light stripes and brown patterns. Forewings bear had light stripes and brown patterns. Hind wings are brownish grey (Fig.2). Male are smaller than female moths, and the mean wingspan was 22.8 ± 1.7 mm (18-24 mm) in female and 18.5 ± 1.6 mm (16-21 mm) in male moths.

The eggs are laid in two rows and attached on the needles. The eggs are oval, the upper surface is convex and lower surface is disc-shaped, with a width of 0.8-1 mm (0.9 ± 0.06 mm). Mean number of eggs in an egg mass was 26 ± 3.4 (12-42) (n=76).

The newly hatched larvae are greenish-yellow, with reddish-brown head capsules. The first instar larvae are 2 mm long on average. The mature larvae are grayish-light green with blackish-brown head capsules. Abdomen segments are black and clearly visible. The thoracic legs are black. The mean length of mature larvae is 1.6 ± 0.25 cm (1.2-2.1 cm) (Fig. 3). The mean width of the head capsules of last (sixth) instar larvae is 1.60 ± 0.32 mm (1.43-1.80 mm, n=32).

The prepupa is greyish green like last instar larvae. 1-2 days after pupating, the pupae turn to brown (Fig. 4). The pupa mean length is 9.8 ± 1.3 mm (8-12 mm, n=75). Its mean width is 3.6 ± 0.22 mm (3-4 mm,

n=75). Male pupae were smaller (0.33 ± 0.0035 g) and lighter than female pupae (0.48 ± 0.012 g).

Feeding and damage symptoms

The larvae feed on young shoots, buds and needles. They seem to prefer the current year needles. The heavily defoliation is caused by the advance instar larvae (3-6) soon after hibernation. They move between shoots by spinning webs, surrounding two or more neighbouring needles used for shelter. Larvae caused heavy damage on the shoots (Fig. 5).

Basic Biology

C. murinana is a univoltine species. The main flight period lasts from the mid of June to the end of July. Lifespan of adults was 6 days in laboratory. The ratio of male/female was determined as 1/1.

Fresh egg masses are green; they turn to light green in 2nd day and to yellow-green 4-5 days after deposition. Incubation lasted 7-9 days in the laboratory. Hatching began on June 17 in 2002 and on June 15 in 2003. In the forest hatching occurred one week later.

The larvae terminated hibernation in the second half of April. It was observed that larvae were carried by the wind between shoots and trees. The 6th instar larvae were observed at the end of May.

Pupation takes place inside webs surrounded by half consumed needles. In laboratory (21-24 °C) pupation occurred on June 3 and adult emergence occurred on June 12. Hence, pupa stage lasted about 9 days. In the forest the pupation extended for about 12-14 days.

DISCUSSION

The first record of *C. murinana* in Turkey was in 2000 in the *Abies cilicica* stands in Yenişarbademli district. Similar to other species of *Abies*, *A. cilicica* is also a suitable host for EFB. In Europe, Priesner et al. (1980), Du Merle & Cornic (1991), Du Merle et al. (1992) and Bogenschütz (1997) described the biology and the damage caused by the budworm on *A. alba*. Kailidis & Georgevits (1971) found the budworm on *A. cephalonica* and *A. borisi regis*. In addition to these results, other hosts were identified by Du Merle et al. (1992) (*A. grandis*), Du Merle & Cornic (1989; 1991) (*Cedrus atlantica* Endl.) and Du Merle et al. (1990) (*Picea abies* L.).

Du Merle & Cornic (1991) conducted research in three different regions of France (Combe Noire, Mont-Ventoux and Luberon) and reported the wingspan between forewings of mature males and females. In their research in Combe Noire in 1985, they determined the wingspan between forewings of mature males to be between 13.0-21.2 mm and 18 mm on average. In the study in Mont-Ventoux, they observed that this distance in mature males is between 12.0-20.6 mm and is 17.6 mm on average. In the same study in Luberon region in 1988, they reported that the wingspan between forewings of male matures was between 14.2-18.6 mm and 16.6 mm on average whereas in female matures this distance was between 14.8-21.8 mm and 18.8 on average. Du Merle et al. (1992) found

the wingspan between forewings of matures to be 22.6 mm in females and 18.2 mm in males. It can be seen that the results of these investigations and our measures do not have great difference, except the fact that the values that are found in Luberon region are smaller than what we have found.

Du Merle & Brunet (1991) counted the number of *C. murinana* eggs in *A. alba* forests in Combre-Noire region of France and they determined the average number of eggs in an egg packet as 17.6. Du Merle et al. (1992) determined the average number of eggs as 23.3 in their research in Massif Central region of France. Our results are similar to the ones that were reported for the Massif Central region, whereas they were different from the results obtained from Combre Noire forests.

Du Merle & Brunet (1991) reported that eggs changed yellow green in color about 5-6 days after laying and larvae hatched in 10-12 days. We determined that hatching occurred 10-12 days after depositing.

Bogenschütz (1991) reported that the lengths of mature larvae were usually between 1.2-1.8 cm and this value may be as high as 2.2 cm. In our study this value was determined to be between 1.2 and 2.1 cm (average 1.6 ± 0.25 cm). It can be seen that values about the length of mature larva do not have any significant difference.

Du Merle et al. (1992) determined the width of pupa to be between 2.5-3.4 mm in their study which was conducted in France. Also in same study they published that the average weight of male pupa was 0.035 gr whereas in female, it was 0.052 gr. Bogenschütz (1991) reported that the average weight of male pupa was 0.040 gr in female it was 0.052 gr. and the length of pupae were between 8-14 mm. When our work is compared with the two works mentioned above it can be seen that our results are similar to those of Du Merle et al. (1992).

Bogenschütz (1991) reported that the flight period of the moth is from the end of June until the end of July. Du Merle & Brunet (1991) determined this period to be from the beginning of July until the beginning of August in natural *A. alba* forest and afforestation field which is constituted by *C. atlantica* trees in France. Markalas & Bogenschütz (1995) reported the flying period to continue from mid June until mid July. When our work is compared with the other papers, it can be seen that our results are similar to the results of Markalas & Bogenschütz (1995) in Greece. According to the results of Du Merle & Brunet (1991)'s study, which was conducted in France, the flying period starts later than in Greece and in Turkey.

It was observed that the females deposit their eggs in a double row on the needles in the middle and upper crowns of fir trees. Also Géraud et al. (1987), Du Merle & Brunet (1991) and Bucher (1953) reported that females lay their eggs on the upper shoots of trees.

In our study the larvae started to hatch on June 17 in 2002 and on June 15 in 2003 in laboratory conditions. Bogenschütz (1997) reported that the hatching of larvae began at the end of June. When our results are compared with the results of Bogenschütz (1997), it is obvious that larvae

hatched earlier in Yenişarbademli. Pupa duration was between 12-14 days in our study. Also Bogenschütz (1997) reported this period to continue for about 14 days. In both studies the results concerning pupa duration are similar.

In conclusion, it appears that the outbreak of *C. murinana* on *Abies cilicica* forests in Turkey is similar to other outbreaks observed in Europe. Further work is needed in order to better characterize this apparently isolated population of the moth.

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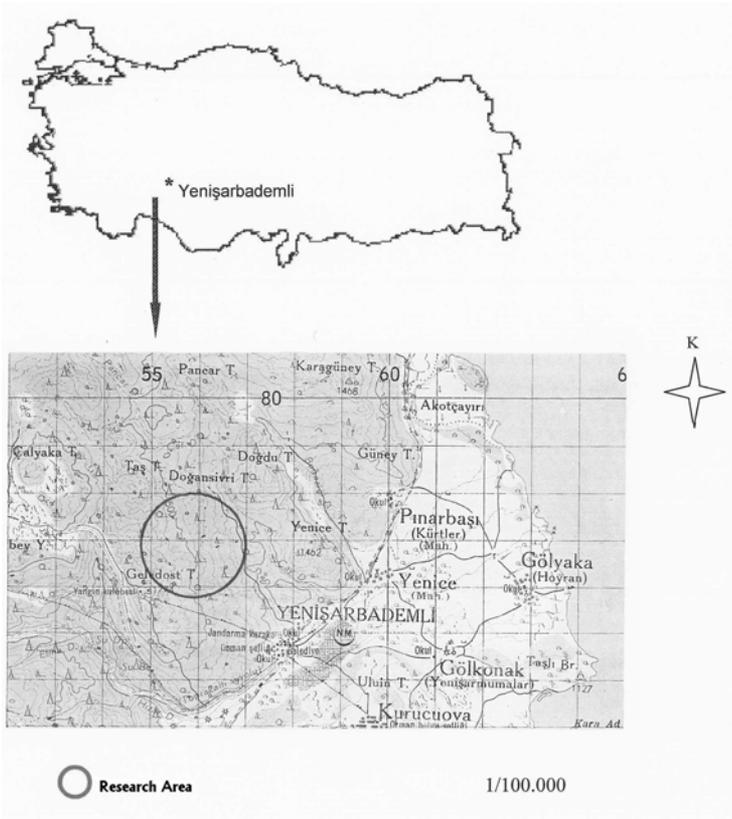


Fig. 1. Research area

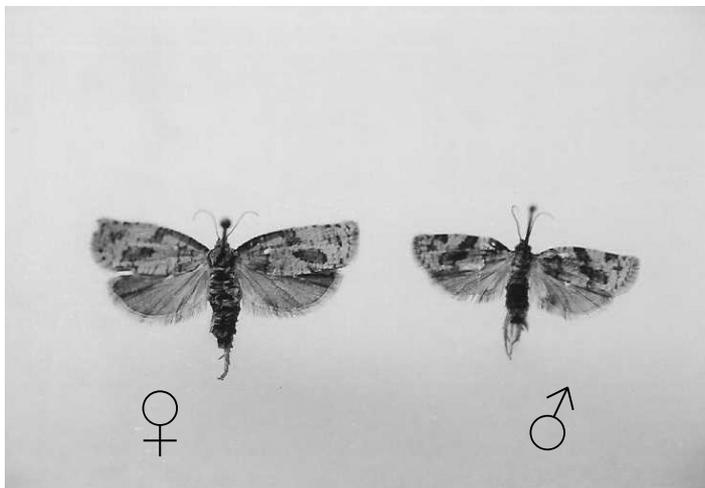


Fig. 2. The female and male moth of *C. murinana*



Fig. 3. The mature larva of *C. murinana*



Fig. 4. The pupa of *C. murinana*

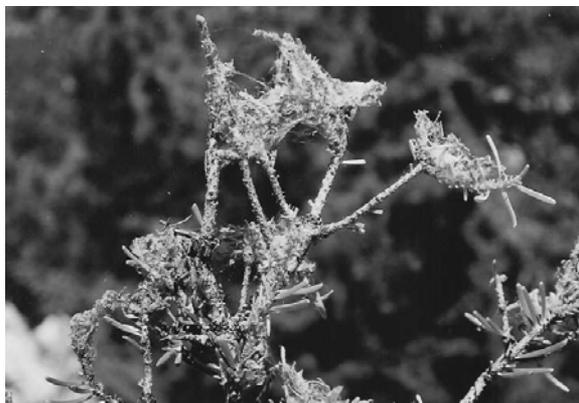


Fig. 5. Heavy damage of larvae of *C. murinana*