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DISTRIBUTION, LIFE HISTORY AND BIOLOGY OF ALMOND SAWFLY (*Cimbex quadrimaculata* (Müller, 1766), HYMENOPTERA: CIMBICIDAE)

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Abstract

Cimbex quadrimaculata Müll. is an important pest in fruit-growing areas of Turkey where its hosts include almond, pear, plum, peach, apricot, and cherry. Surveys on C. quadrimaculata in various ecologies have been conducted in the provinces (Adıyaman, Diyarbakır, Elazığ, Mardin) of Southeastern and Eastern Anatolia regions of Turkey between the years 2010-2014. C. quadrimaculata larvae collected from Amygdalus communis L. (Rosacae) in Adıyaman, Diyarbakır, Elazığ, Mardin. There were similarities in the larvae population changes in Adıyaman-Diyarbakır and Elazığ-Mardin. The highest density of the larvae was recorded of Besni location in Adıyaman province. Population density of the larvae was low in Mardin. Occurrence of the larvae generally observed between April and July in the all of province. C. quadrimaculata overwinter as a pre-pupa in a cocoon in the ground or other protected place, pupating in the spring. In early summer, adults lay eggs in or on plant tissue and the larvae feed on the leaves.

Key words: *Cimbex quadrimaculata, Almond pest, Hymenoptera, Cimbicidae.*

INTRODUCTION

The almond (*Amygdalus communis*) is a species of tree native to the Middle East and South Asia. Turkey is a country with high almond production. Almonds are produced mostly in the Aegean, Marmara, Mediterranean, Southeast and Eastern Anatolia regions, and the almond has great economic importance (USDA 2010). Some pests and disease have caused important crop losses affecting almond growth and production all over the world. Studies on the determination of pests and disease in almonds have shown that *Cimbex quadrimaculata* (Hymenoptera: Cimbicidae) is a common pest on almond trees in Turkey and worldwide (Maçan, 1986; Russo et al., 1993; Bolu et al., 2005). Its larvae feed on the leaves of almonds and can occasionally become numerous enough to cause injury to some trees.

The Cimbicidae are a small family of large-bodied, often hairy sawflies, with only 130 species in six genera worldwide. Larvae are solitary herbivores. The family is distinctive in having antennae with prominent apical clubs or knobs. The adults of some species can exceed 3 cm in length, and are among the heaviest of all Hymenoptera.

Cimbex quadrimaculata Müll. (Hymenoptera: Cimbicidae) is a polyphagus pest, with almond, apple, pear, plum, peach, apricot, and cherry among its most important hosts. First instars attack newly opened buds of the host, while older instars feed along the main leaf veins. Damage to fruit was documented by Maçan (1986). Bodenheimer (1958) discussed the importance of this species to fruit trees in Turkey. Bolu et al. (2005) reported it from the southeastern and eastern Anatolia region of Turkey.

Because of its considerable economic importance and given that details of the life history are poorly documented, I studied the biology of this species in the laboratory and in nature. Also the distribution of the pest in the Southeastern Anatolia Region was determined. The results are presented in this paper.

MATERIALS AND METHODS

Cimbex quadrimaculata larvae were captured in the vicinity of Adıyaman, Diyarbakır, Elazığ, Mardin between 2010-2014. The sampling method was based on the techniques usually applied in orchards, namely knocking the larvae out of the trees by the frappage (beating) method. Twenty-five trees at about

the same stage of growth were randomly selected in each biotope and four branches per tree (4 X 25= 100 branches) were sampled. These branches were given three blunt beatings with a stick wrapped in foam rubber and the larvae that fell onto a piece of cloth, 50 X 50 cm were collected. The development of larvae observed daily and shed larval head capsules were collected, measured and preserved in 70% ethyl alcohol. Pupae were harvested daily and transferred to a new cage (40x30 cm) containing a potted host plant. The length larvae and pupae were measured. The colony was maintained under controlled laboratory conditions at 26°C with 16:8 (L: D) photoperiod. All data were subjected to analysis of variance (ANOVA), and means were separated using Fisher's Least Significant Difference (LSD) ($P< 0.05$).

RESULTS ANS DISCUSSIONS

C. quadrimaculata larvae collected from *Amygdalus communis* L. (Rosacae) in Adıyaman, Diyarbakır, Elazığ, Mardin. There were similarities in the larvae population changes in Adıyaman-Diyarbakır and Elazığ-Mardin. The highest density of the larvae was recorded of Besni location in Adıyaman province. Population density of the larvae was low in Mardin. Occurrence of the larvae generally observed between April and July in the all of province. *C. quadrimaculata* overwinter as a pre-pupa in a cocoon in the ground or other protected place, pupating in the spring. In early summer, adults lay eggs in or on plant tissue and the larvae feed on the leaves.

Description of the pest

Adult: The color of the adult varies from dark brown to black, and there are yellow spots on the body. Differs from male and female individuals (Figure 1). Head dark brown, covered with short hairs. The head is large. Clypeus is colored yellow. The antennae are black at the base and yellow-orange at the tip. The antennae end in a club and have seven segments. The last segment took the shape of the club. The antennae are black at the base and yellow-orange at the tip. The thorax is dark brown. Brown scutellum is shaped like a narrow trapezoid. The abdomen is yellowish, with two large dark brown bands. Wings are transparent and are colored yellow. The tip of the front wing is slightly darker. This darkness in the form of a strip extends along the wing. The back wing is lighter than in dark places and not be seen. In the male, the coxa and the femur is very swollen. Coxa, trochanter and femur black. In females, the legs brown, the segments of the tarsus are yellow. Coxa and femur is made thinner. The average length of female individuals 18.40 millimeters (16.57-21.88). The average length of male individuals 14.25 millimeters (12.57-18.10).

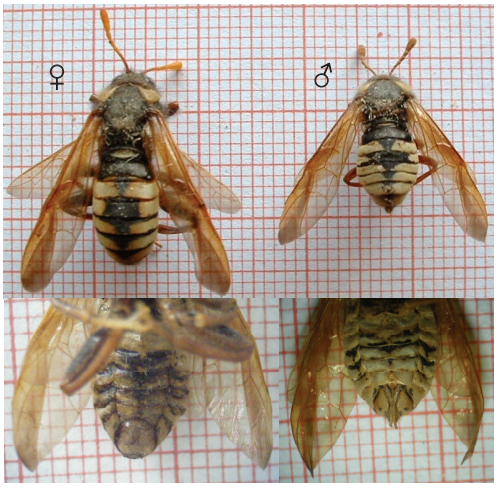

Figure 1. Female and Male adults of *Cimbex quadrimaculata*

There is only one generation per year. Larvae gnaw the leaf margins of the host plants (especially *Amygdalus communis* L., *Crataegus monogyna* Jacq. (Figure 2), *Prunus domestica* L. and *Prunus cerasus* L.). When they reach the maturity they build a strong oval cocoon (Figure 3), in which they change to pupa, within which they overwinter. Cocoons the average length of 16.25 millimeters (14.17-23.00) average width of 10.50 millimeters (10.10-11.00).

Figure 2. Last larval stage of *Cimbex quadrimaculata* on *Crataegus monogyna*

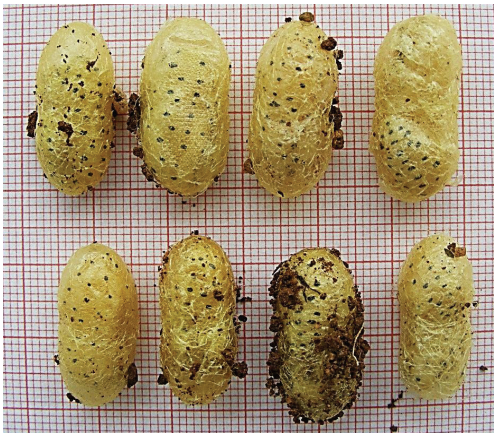

Figure 3. Cocoons of *Cimbex quadrimaculata*

Larvae: Larvae of *Cimbex quadrimaculata* are grayish and black markings. The average length of these larvae can reach about 20 millimeters (0.79 in), with a maximum of about 50 millimeters (1.9 in) in last larval instars. The larvae are big and full-bodied. The larval head capsule is black in the first larval instars. The last larval instar head capsule is white (Figure 4). It stops on the curved leaves during larval feeding. The larvae secrete a yellowish substance tapping by hand.

Damage: Young larvae after eating a portion of the leaf, to leaf through a nearby pass. The larvae are fed up to a month and will grow more voracious. This completely leafless almond trees where they can leave their high population during the period (Figures 5 and 6). Such a formation of almond trees do not fruit next year cannot afford to continue their normal activities; it greatly improves the susceptibility to falls and cold.

Figure 4. The first larval instars and the last larval instars of *Cimbex quadrimaculata*

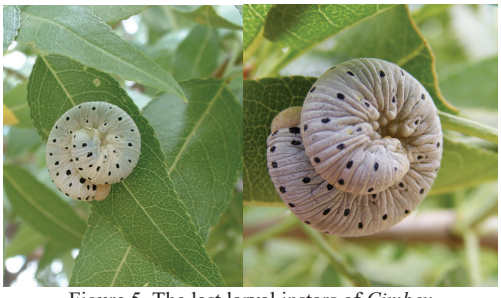

Figure 5. The last larval instars of *Cimbex quadrimaculata*

Biological Control: In Turkey, the presence of 3 parasitoid species of *C. quadrimaculata*, which is an important almond pest, has significant importance in enhancing the potential to control the abundance of *C. quadrimaculata* in almond orchards. Larvae and pupae of *Cimbex quadrimaculata* are parasitized by *Opheltes glaucopterus, Listrognathus mactator* and *Phobetes nigriceps* (Özgen et al., 2010; Özbek, 2014).

Figure 6. The damage on almond tree of larvae *Cimbex quadrimaculata*

Cultural Control: Harmful cocoons found in the soil (Figure 7) in the tree crown projection can be destroyed by cultivation. Simply tilling or plowing a almond orchard before winter may disrupt a pest's life cycle by causing mechanical injury, by increasing exposure to lethal cold temperatures, by intensifying predation by birds or small mammals, or by burying the pests deep beneath the soil surface.

Figure 7. Cocoons in soil of *Cimbex quadrimaculata*

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