

THE BIOECOLOGICAL CHARACTERISTICS OF *RHINUSA ACIFER* CALDARA (COLEOPTERA: CURCULIONIDAE) ON *VERBASCUM SINUATUM* L.

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ABSTRACT: In this work, the bioecological characteristics of *Rhinusa acifer* Caldara (Coleoptera: Curculionidae) living on the weed *Verbascum sinuatum* L. in Kahramanmaraş province were determined. Galls formation on the plant *Verbascum sinuatum* L. was observed in the field investigations in 2016, and these galls were brought to the laboratory and analyzed. *R. acifer* sp. of Curculionid and parasitoids were obtained from these galls. The feeding, damage and biology of *R. acifer* living on *V. sinuatum* were observed by following up the phenology of *V. sinuatum* periodically starting from the first week of March for the field investigations in 2017. The egg laying of *R. acifer* on *V. sinuatum*, the emergence of egg, larva, pupa, adult and parasitoids of *R. acifer* in the galls resulting from the feeding of the hatched larvae were observed, and their biologies were determined. The parasitoids, *Calosota aestivalis* (Curtis, 1836) and *Entodon mecini* (Dalman, 1820) were identified. *C. aestivalis* of these was the most intense parasitoid, and it was ascertained that this parasitoid was suppressing *R. acifer*. The first egg laying of *R. acifer* was released as April 24, the first emergence of larva on May 2, the first occurrence of pupa and adult on June 24, 2017 and on the same date, the pupas of the parasitoids were obtained.

KEY WORDS: *Verbascum sinuatum*, *Rhinusa acifer*, Curculionidae, galls, bioecology, parasitoid

Verbascum L. is the biggest genus of Scrophulariaceae family which has approximately 2500 species in the world Grieve et al. (1995). It is indicated that there are 360 species belonging to the genus of *Verbascum* L. (Scrophulariaceae) on the earth Heywood (1993). It is specified that in Turkey, there are 243 species belonging to the genus of *Verbascum* and 193 of these species are mostly endemic (80%) (Huber-Morath, 1978; Davis et al., 1988; Vural & Aydoğdu, 1993; Karavelioğulları et al., 2004, 2006, 2009, 2011; Karavelioğulları & Aytac, 2008; Karavelioğulları, 2009; Sutory, 2001, 2004; Özhatay et al., 1996; Kaynak et al., 2006; Parolly & Tan, 2007; Parolly & Eren, 2008; Yılmaz & Dane, 2008; Bani et al., 2010). The first revision of the plant *Verbascum* in Turkey was carried out by Huber Morath for Flora of Turkey Huber-Morath (1978).

The Curculionidae family is considered as one of the richest families of the order Coleoptera in terms of the number of species it contains. The Curculionidae family contains about 60.000 species in the world, and 13.000 species in the Palaearctic Region, which includes Europe, Asia and North Africa Varlı (1998). In Turkey, 89 genera and 382 species of the Curculionidae family are known Lodos et al. (2003). The Curculionidae fauna of Turkey has been examined by many scientists (Bolu & Legalov, 2008; Davidian & Gültekin, 2006; Gültekin, 2006; Gültekin et al., 2008; Keskin, 2005; Lodos, 1960, 1971, 1972; Lodos et al., 1978; 2003; Pehlivan et al., 2005a, b; Avcın & Colonnelli, 2011; Sert, 1995, 2005, 2009; Sert & Çağatay, 1999; Voss, 1962). The Curculionidae (Coleoptera) fauna of Turkey is quite rich because of her different climatic conditions. Both

geographical position and climate variability have some material impacts on the Curculionidae fauna in Lodos et al. (2003). Doğanlar & Üremiş (2014) examined the predator complex of *Verbascum gaillardotii* Boiss. in Hatay, and gave its diagnostic characters, and distribution in Turkey. They designated the predator complex of mullein (*Verbascum gaillardotii*) for the first time in Hatay, and indicated *Rhinusa tenuirostris* (Stierlin, 1888) and *Rhinusa tetra* (Fabricius, 1792) (Coleoptera: Curculionidae) species as predators of *Verbascum gaillardotii*.

The genus of *Rhinusa* Stephens is composed of approximately 40 species with 1829 members of Tribe Mecinini (Curculionidae, Curculioninae) and its Palaearctic distribution (Reitter, 1908; Caldara, 2001). All *Rhinusa* species, on a limited basis, live on Scrophulariaceae or Plantaginaceae which are included in the angiosperm family (Olmstead et al., 2001; Albach et al., 2005). The genus which was introduced to North America as potential biological agents of some toadflax species (*Linaria* Miller spp.) due to the fact that it subjected to a number of detailed ecological surveys (Smith, 1959; Groppe, 1992; Jordan, 1994; Gassmann & Paetel, 1998; Toševski & Gassmann, 2004), and since then has become invader (Saner et al., 1995; Vujnovic & Wein, 1997) has gained importance recently. An identification key was given for 5 species in the group of *R. tetra* species feeding various species of *Rhinusa* spp. *Verbascum* Caldara et al. (2012).

It is indicated that *Rhinusa* species usually spend the winter in adult form and with the arrival of spring, the adults begin to damage when insect activity begins. It is stated that the female insects generally lay an egg in the holes which they opened with their rostrum, and the hatched larvae begin to feed where they are Richard & Davies (1977). The larvae grow in the buds, stem and roots of the plant, and sometimes by producing galls (Hoffmann, 1958; Caldara, 2001). It is specified that its most damaging stage is the larval stage and the adult emerging after it pupated on the same plant or soil continues damaging Richard & Davies (1977). However, there is no exact information about the biology of *Rhinusa acifer* (Coleoptera: Curculionidae) in general. In this work, the bioecology of *Rhinusa acifer* (Coleoptera: Curculionidae) which is the predator of *Verbascum sinuatum* L. (Lamiales: Scrophulariaceae) in Kahramanmaraş province was designated and parasitoids were determined.

MATERIAL AND METHODS

In this work, conducted in Kahramanmaraş province between the years 2016-2017, the biology of *Rhinusa acifer* which is one of the species from Curculionidae family of the order Coleoptera, and feeds on *Verbascum sinuatum* L. was followed up. So, its eggs, larvae, pupa adults and parasitoids were identified and its ecological information was given.

The field investigations started in the first week of March, and to follow up the plant phenology, they were continued periodically per week (Fig. 2). Starting from the early stages of the plant *V. sinuatum*, during the field investigations, the galls which were caused by *R. acifer* were cut from the tiller and stem of the plant with pruning shears and wrapped up in papers. Then they were put into polyethylene bags and brought to the laboratory. In the samples brought to the laboratory, the dates when egg, larva, pupa and adults of *R. acifer* emerged were determined. In addition, the adults that fed on the plant were collected with aspirator tube and brought to the laboratory. The adult individuals were pinned with insect pins, and their label information was written, and then they were sent to the relevant persons for diagnosis (Fig. 1).

In order to follow up the emergence of parasitoid, the galls, brought to the laboratory, were put into plastic jerry cans which were in different sizes and could let air in with the help of gauzes on both sides. To prepare for diagnosis, the parasitoids emerging from the galls were taken with the help of aspirator tube, and transferred into eppendorf tubes containing a fine brush and 70% ethyl alcohol.

RESULTS

With this work, the bioecological characteristics, and parasitoids of *R. acifer* were determined by following up its biology on *Verbascum sinuatum* L. in Kahramanmaraş province.

As a result of this work, it was observed that *R. acifer* spent winter as an adult in galls on dried *V. sinuatum* and reproduced once in a year. The copulating adult individuals lay their eggs on the stem of *V. sinuatum*. The hatched larvae cause gall formation on the stem of *V. sinuatum* by beginning to feed on the stem. Individuals spending pupal stage in the galls continue to damage in the same way after being adult. *Calosota aestivalis* (Curtis, 1836) from Eupelmidae family of the order Hymenoptera and *Entodon mecini* (Dalman, 1820) from Eulophidae family were detected as the parasitoids of *R. acifer*. It was detected that *C. aestivalis* was an intense parasitoid and suppressed *R. acifer* (Fig. 7). In addition, it was also determined that *R. tetra* fed on the tiller of *V. sinuatum*.

DISCUSSION

It is known that *Rhinusa* species usually spend the winter in adult form and with the arrival of spring, the adults begin to damage when insect activity begins (Richard & Davies, 1977). However, it is detected that in general, there is no exact information about the bioecology of *Rhinusa acifer* (Coleoptera: Curculionidae) in our country and in the world. With this work, some new information has been revealed.

The adult females of *R. acifer* that copulate with the beginning of warm air laid their first egg in the stem of *V. sinuatum* on April 24, 2017 (Fig. 4a). The first larval emergence started on May 2, depending on temperature and humidity (Fig. 4b). It was observed that the hatched larvae began to feed on the stem of *V. sinuatum*. As a result of feeding, a small gall formation was observed. It was detected that as the larval stage progressed, galls grew as a result of intense feeding on the stem (Fig. 3). On June 24, it was detected that the larva, pupa and adult of *R. acifer* and pupas of parasitoids were in the galls. Adults continued to feed in the same way in gal, too. In addition, it was observed that also *R. tetra* (Fabricius, 1792) fed on the tiller of *V. sinuatum*.

It was determined that the parasitoids of *R. acifer* were *Calosota aestivalis* (Curtis, 1836) from Eupelmidae family of the order Hymenoptera and *Entodon mecini* (Dalman, 1820) from Eulophidae (Figs. 5, 6). Eupelmidae (Hymenoptera) is a small family of chalcid wasp with its 900 described species. Its larvae, primary and secondary parasitoids, also parasitize generally other groups of arthropods other than the preimaginal stages of insects Noyes (2003). *Entodon* Dalman (Eulophidae, Entedoninae) genus consists of approximately 170 described species. However, a critical revision for this group is required. *Entodon* Dalman (Eulophidae, Entedoninae) species are endoparasitoids of eggs or larvae of various insects. Their most reliable host records, harmful insects are

Curculionidae (Brentidae) and Chrysomelidae (Bruchinae) (mostly in the Afrotropical region: Rasplus (1990), Gumovsky (2008)).

In 2016, the emergences of parasitoids were checked periodically every two days and the numbers of adult individuals were recorded. The first emergence of parasitoid was obtained on February 25. While *Entodan mecini* reached the tip on March 3, *Calosota aestivalis*, on the other hand, reached the tip on March 31 (Fig. 7). It was determined that *C. aestivalis* was the most intense parasitoid and suppressed *R. acifer*.

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Figure 1. *Rhinusa acifer* Caldara (Coleoptera: Curculionidae) adult.

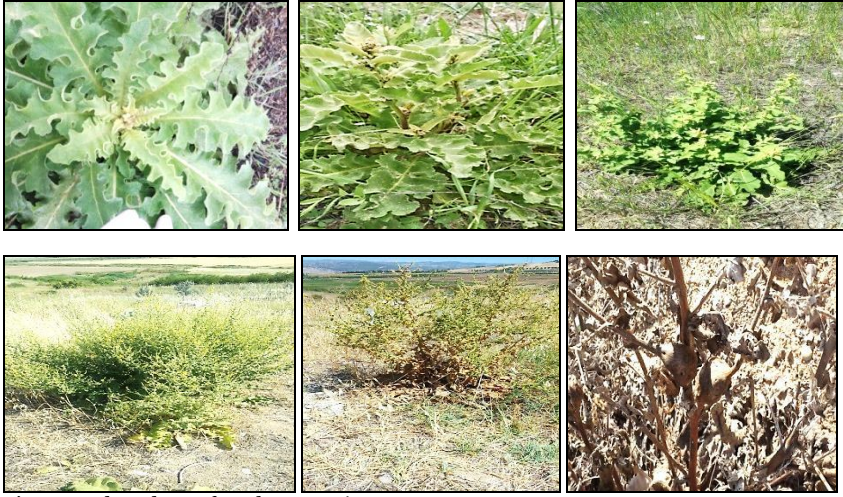


Figure 2. Phenology of *Verbascum sinuatum* L.



Figure 3. Occurrence gall formed in *Verbascum sinuatum* L.





Figure 4. *Rhinusa acifer* (Coleoptera: Curculionidae) a) eggs b) larvae c) pupa d) adult.



Figure 5. *Calosota aestivalis* (Curtis, 1836) adult.



Figure 6. *Entodon mecini* (Dalman, 1820) adult.

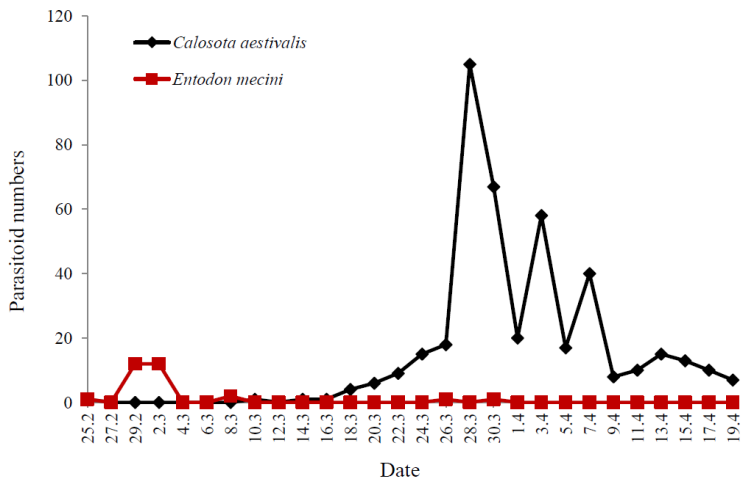


Figure 7. Adult number of parasitoids collected from galls via *V. sinuatum*, 2016.