

# Biological control of *Icerya purchasi* Maskell (Hemiptera: Margarodidae) with *Rodolia cardinalis* Mulsant (Coleoptera: Coccinellidae) in a Cherry Laurel Orchard

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**Abstract** – This study was conducted in a cherry laurel orchard located in the Black Sea to evaluate the efficacy of *Rodolia cardinalis* Mulsant was released to the site a cherry laurel orchard located in the Black Sea Region of Turkey against *Icerya purchasi* Maskell in May of 2011 at, approximately, 40 days after the implementation. Populations of both *Icerya purchasi* Maskell and *R. cardinalis* were monitored twice a week approximately 40 days after the implementation. In the same way, throughout all the seasons of 2011 and 2013, the populations of both species were continued to be determined. The results showed that, while the population of *I. purchasi* in July of 2011 was 51.9 individuals/tree, this number decreased to 23.9 insects/tree in 2013. These results indicated that, *R. cardinalis* stages have been adapted to the regional climate and other ecological conditions and could be considered as a successful bioagent, able to keep the rate of infestation by *I. purchasi* populations under the economic threshold.

**Keywords** – Cherry Laurel, *Icerya purchasi*, *Rodolia Cardinalis*, Biological Control.

## I. INTRODUCTION

Cherry laurel (*Prunus laurocerasus* L.) is grown widely in warm regions around the world (Bernadovicova and Ivanova, 2011) originated in western Asia, Europe and Southeast Anatolia. In Turkey, it is grown widely in the eastern Black Sea coasts and is an important fruit species in the region. In the Black Sea Region, there are many local varieties of cherry laurel such as black cherry, water, vavul and honey (Islam et al., 2010; Sulusoğlu, 2011; Anonymous, 2014). It is widely consumed as fresh fruit in the region while, it is also used as molasses, jam, marmalade and fruit juice (Celik et al., 2011; 2015; Temiz et al., 2014).

There are no closed cherry laurel groves in a commercial size in Turkey. However, in the eastern Black Sea region, the cherry laurel plants are planted on the edges of houses, tea and hazelnut gardens, inside the forests and in the form of border trees. Therefore, cherry laurel is thought to have a high potential to be an alternative product in the Black Sea region in the coming years. Many mite and insect species have been recorded as pests on cherry laurels around the world (Ülgentürk and Çanakçıoğlu, 2004; Şişman and Ülgentürk, 2010; Dov, 2012). A total of 196 pests have been identified on the various tissues of *Prunus* species (Leather, 1985).

Cottony cushion scale, *Icerya purchasi* Maskell (Hemiptera: Margarodidae) is one of the important pests of *Prunus*

species (Seljak, 2010). In recent years, *I. purchasi* was observed on some cherry laurels in the districts of Black Sea Region of Turkey causing damages on leaves and shoots, especially in the orchards where no pest control is applied. The pest population has been increased year by year. For the biological control of *I. purchasi*, *Rodolia cardinalis* Mulsant (Coleoptera: Coccinellidae) has been widely used (Soares et al., 1999; Causton et al., 2004; Hoddle et al., 2013 and Alvarez et al., 2012). The possibility of intraguild predation between *R. cardinalis* and other scale insect predators should also be considered when assessing the potential impacts of this biological control agent (Causton et al., 2004).

The present study was carried out to evaluate the efficacy of *R. cardinalis* as biological control agent of *I. purchasi*.

## II. MATERIAL AND METHOD

The study was conducted in 2011 and 2013 at the cherry laurel orchard located in the Black Sea Agricultural Research Institute, Samsun, Turkey, infested with the cottony cushion scale, *I. purchasi*. The orchard consisted of 194 cherry laurel trees, 10 years old, There weren't any *R. cardinalis* in the orchard previously and free of *R. cardinalis* pesticides used. Natural enemy was released only in May 2011. In the orchard hasn't been any study in 2012. In the same orchard the populations of pest and natural enemy without release were monitored in 2013.

*R. cardinalis* individuals were collected from citrus orchards in Adana province. On May, 18<sup>th</sup> 2011, 6 (3 male – 3 female) adults and 8 pupae of *R. cardinalis* were released on 3 trees which were naturally infested with *I. purchasi*. In order to monitor the prey-predator population, 10 trees infested with the pest were chosen randomly for samplings.

Counting started in June, 28<sup>th</sup> 2011, 40 days after starting release of and continued until the third week of August (August, 19<sup>th</sup> 2011), and the counting in 2013 started on May, 10<sup>th</sup> 2013 and continued until January, 10<sup>th</sup> 2014. Throughout the counting period, counting was carried out two times every week.

Counting of *I. purchasi* individuals was carried out, periodically, on three different parts (stems, shoots and leaves) of 10 infested trees. *I. purchasi* individuals on shoots and leaves were counted on 20 cm long shoots and 20 leaves, respectively, which were randomly selected. The larvae, pupae and adults of *R. cardinalis* were counted on each of the chosen trees.

### III. RESULTS AND DISCUSSION

The climate data for the years in which the study was carried out are shown in Fig. 3.1. The population changes of *I. purchasi* and its predator *R. cardinalis* are given in

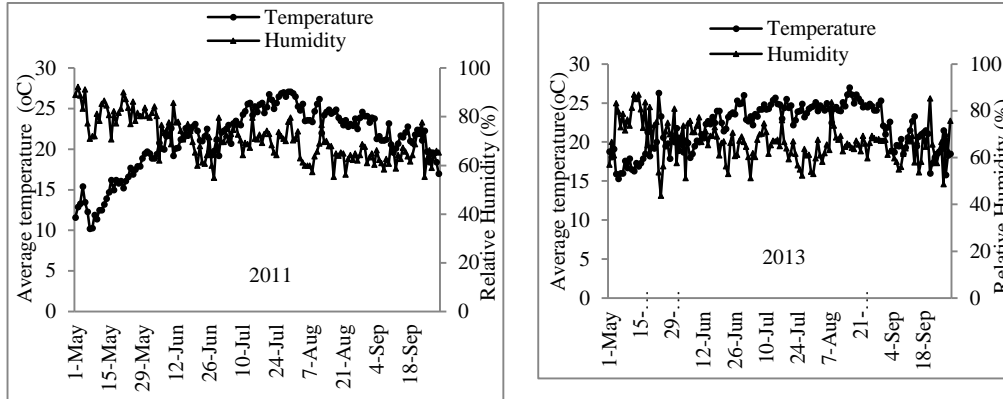


Fig. 3.1. Samsun province climatic data between the years of 2011 and 2013 (Obtained from the Turkish State Meteorological Service, Samsun).

In 2011, a total of 64.2 /tree *I. purchasi* individuals was counted 40 days after the first release of *R. cardinalis*. The total pest population reached the highest level (69.4 individuals/tree) by the end of June and early July. In the

Figs. 3.2, 3.4, and the prey-predator relations are also given in Figs. 3.3, 3.5. The lower developmental temperature threshold of *R. cardinalis* was estimated as 10.8 °C and the degree-day accumulation was calculated as 279 for development from egg to adult (Cardwell *et al.*, 2005).

second half of July, a decline in the population of *I. purchasi* started and around mid-August, the population was 3.6 individuals/tree (Fig. 3.2).

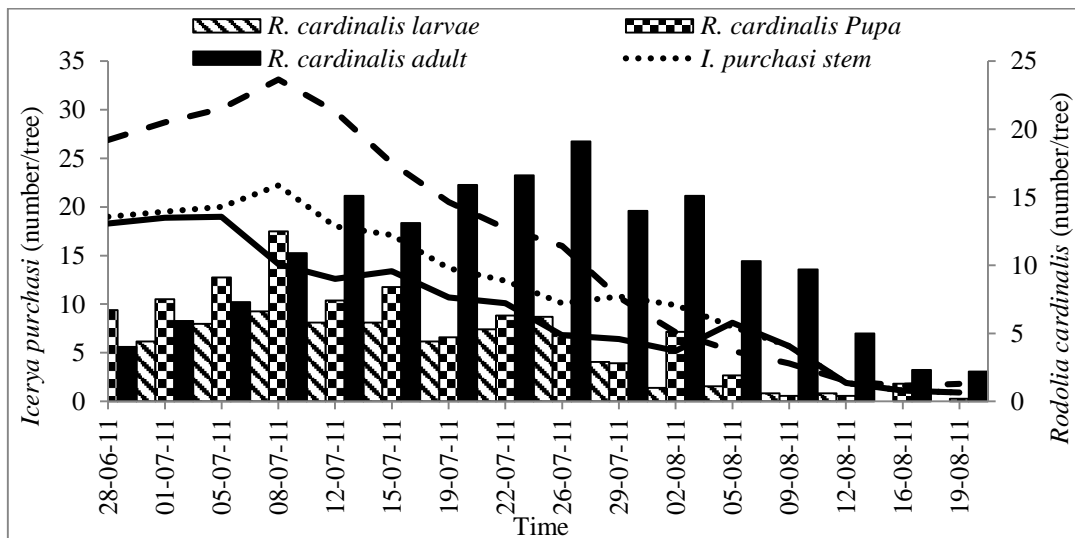


Fig. 3.2. *Icerya purchasi* and *Rodolia cardinalis* population dynamics in the cherry laurel orchard in 2011.

Data of 2011, showed a rapid increase at the beginning, *R. cardinalis* population reaching to the highest level (30 individuals/ tree) on July, 8<sup>th</sup> 2011. The population continued at the same level until the end of July and decreased in August (Fig. 3.2). The population changes of the prey-predator relation that depends on time for the 2011 sampling dates are given in Fig. 3.3.

The population of *I. purchasi* showed its highest infestation rate (99.1 individuals/tree) in mid-May 2013. Until end of the season, a steady decline in the population was observed (Fig. 3.4). In the same year, the *R. cardinalis* naturally population reached 10.3 individuals/tree on May,

10<sup>th</sup> 2013 and by mid-May, the population demonstrated a significant increase.

By the end of May and at the beginning of June, the population has been detected as a total of 32.4 numbers/tree (Fig. 3.4).

The prey-predator relationship in 2013 is given in Fig. 3.5, being similar to that shown in 2011 (Fig. 3.3). While the predator, *R. cardinalis* population increased at the beginning of the season, a decline in the *I. purchasi* population has been observed, and the populations of both insect species have decreased since July (Fig. 3.3).

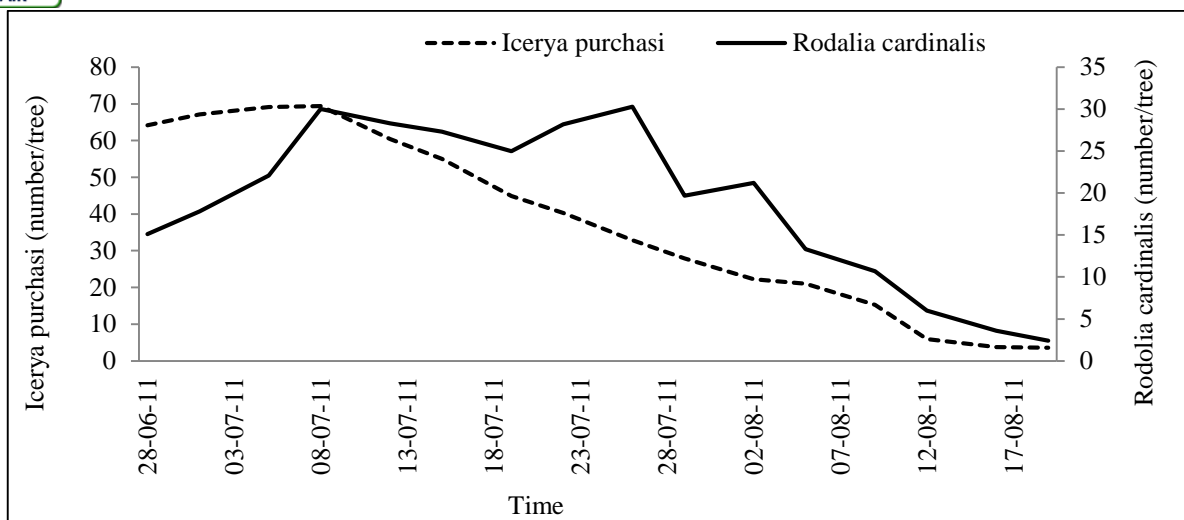


Fig. 3.3. Prey-Predatorrelation in the Cherry Laurel orchard in 2011.

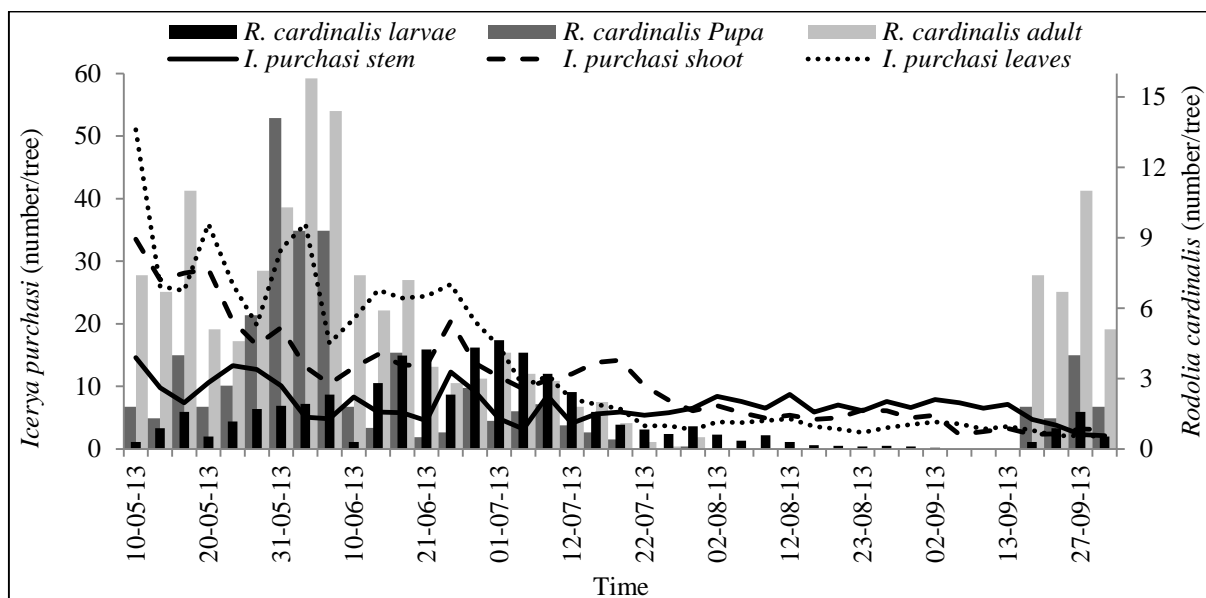


Fig. 3.4. Icerya purchasi and Rodolia cardinalis population dynamics in the cherry laurel orchard in 2013.

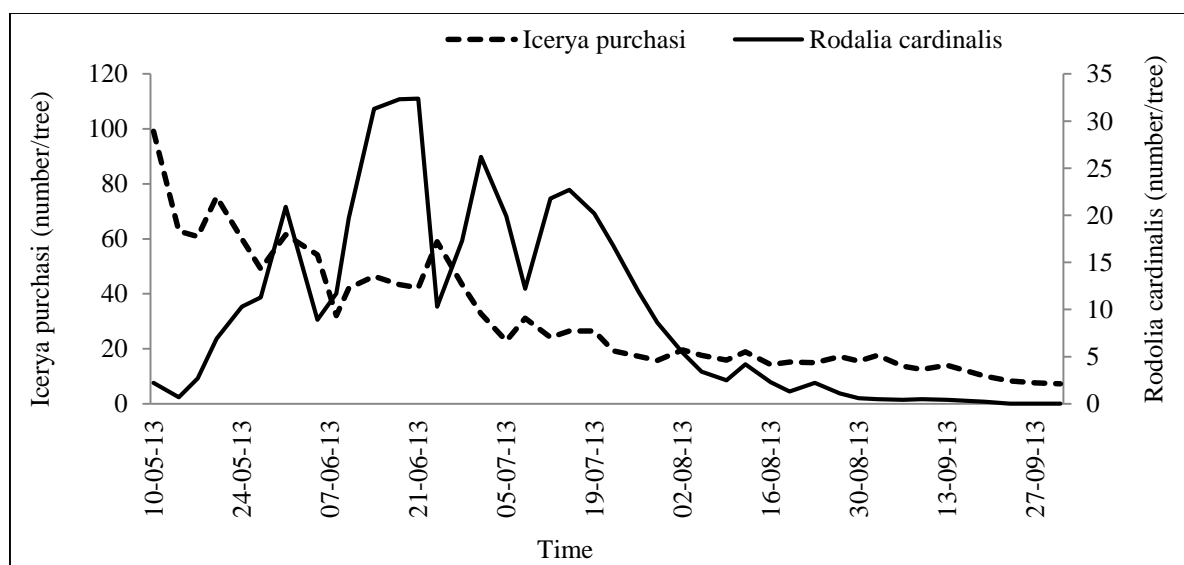


Fig. 3.5. Prey- predator relation in the cherry laurel orchard in 2013.

In the present study, according to the two years data, the population of *I. purchasi* has been averagely 51.9 individuals/tree in July 2011, opposed to 23.9 individuals/tree in 2013. It was determined that a significant decline in the population of *I. purchasi* was recorded in 2013 compared to that of 2011.

In Turkey, *I. purchasi* is one of the major pests of citrus, Turkey. Chemical control is not recommended for this pest in Turkey for a long time. Because the natural enemy, *R. cardinalis* is able to keep the cottony cushion scale population in the citrus orchards of the Mediterranean region under pressure (Uygun et al., 1988, 2010, Uygun, 1991; Karaca et al., 1996; Anonymous, 2008). Even in that in which this pest cause problems, in case of the absence of the predator *R. cardinalis* or if it is not enough in number, the pest population can be reduced rapidly by releasing *R. cardinalis* as the chemical control is not recommended (Anonymous, 2008; Uygun et al., 2010).

#### IV. CONCLUSION

Cherry laurel is a plant which has a high capacity of being an alternative crop to hazelnut and tea in the Black Sea Region of Turkey. But, as it could be detected in the garden where the study was conducted no other important pest except the cottony cushion scale could be found in this region. It has been observed that the population of this pest in the Black Sea Agricultural Research Institute garden significantly increased from year to year. Also, there is no chemical application in this garden. Therefore, we planned to use biological control for the pest and released a promising predator, *R. cardinalis* being successful biological control agent in citrus plantations in Turkey. According to the data obtained in this study, it has been demonstrated that the natural enemy also successfully works in the cherry laurel garden of the Black Sea region. On the other hand, *R. cardinalis* adapted itself to the climatic and other ecological conditions of the region and kept the cottony cushion scale population under pressure during the study. We strongly recommend this biological control agent against the cottony cushion scale.

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