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Effects of Mating Disruption Method on Predators *Chrysoperla carnea* (Stephens, 1836) (Neuroptera:Chrysopidae) and *Coccinella septempunctata* (L., 1758) (Coleoptera:Coccinellidae) in Vineyards

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ABSTRACT

The mating disruption method (MD), which is biotechnical against *Lobesia botrana* Den. et Schiff., a significant pest of vineyards, has been applied in vineyards; and the area exposed to this application and the control trial area (CA) were compared in terms of predators. Sampling was started on 07.04.2013 and 31.03.2014 in 2013 and 2014 at the mating disruption applied area and the control trial area upon formation of the vine leaves. The result of the sampling indicated that the most frequently seen predators were *Chrysoperla carnea* (Stephens, 1836) (Neuroptera:Chrysopidae) and *Coccinella septempunctata* (L., 1758) (Coleoptera:Coccinellidae). When the infestation rate on the bunches in the vineyard, where mating disruption was applied, exceeded 5%, that is the economic loss threshold, *Bacillus thuringiensis* ssp. *kurstaki* was applied twice against the 1st and 3rd generations in 2013; and for 3 times against the 1st, 2nd and 3rd generations in order to decrease the intensity of the population. Insecticide was applied against *L. botrana* on the control trial area very frequently and unconsciously; namely for 7 times until harvest in 2013, and for 8 times until harvest in 2014. In the vineyard, where mating disruption was applied, fungicides were applied for 5 times in 2013 against diseases such as *Uncinula necator, Botrytis cinerea* and *Plasmopara viticola,* however fungicides were applied in the control trial area for 8 times in the same year; in 2014 fungicides were applied against the above-mentioned diseases on the mating disruption applied area for 4 times, however fungicides were applied for 7 times on the control trial area in the same year.

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Bağ Alanlarında Çiftleşmeyi Bozma Tekniğinin Chrysoperla carnea (Stephens, 1836) (Neuroptera: Chrysopidae) and Coccinella septempunctata (L., 1758) (Coleoptera:Coccinellidae) Predatörleri Üzerine Etkileri

ÖZET

Bu çalışma da bağlarda önemli bir zararlı olan *Lobesia botrana* Den. et Schiff. (Salkım Güvesi)'ya karşı biyoteknik bir mücadele olan çiftlesmeyi engelleme metodu uygulanmıştır. Çiftleşmeyi engelleme (ÇE) metodu uygulanan alan ile kontrol alanı (KA) predatörler bakımından karşılaştırılmıştır. 2013 ve 2014 yıllarında ÇE ve KA bağlarında 07.04.2013 ve 31.03.2014 tarihlerinde bağ yapraklarının oluşması ile birlikte örneklemeler başlamıştır. Örneklemeler sonucu en fazla bulunan *Chrysoperla carnea* (Stephens, 1836) (Neuroptera: Chrysopidae) ve *Coccinella septempunctata* (L., 1758) (Coleoptera: Coccinellidae) olmuştur. ÇE bağındaki salkımlarda bulaşma oranı ekonomik zarar eşiği olan % 5'i aştığında popülasyonu düşürmek amacıyla 2013 yılında 1. ve 3. döllerine karşı 2, 2014 yılında ise 1., 2., ve 3. döllerine karşı olmak üzere 3 defa, bakteriyel bir preparat

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olan *Bacillus thuringiensis* ssp. *kurstaki* kullanılmıştır. 2013 yılında KA bağında ise sık aralıklarla *L. botrana*'ya karşı hasada kadar 7 insektisit, 2014 yılında ise hasada kadar bilinçsizce 8 kez insektisit uygulanmıştır. ÇE bağında 2013 yılında bağ küllemesi, bağ kurşuni küf ve bağ mildiyösü hastalıklarına karşı 5, KA bağında ise 8 kez fungusit uygulaması, 2014 yılında ise aynı hastalıklara karşı ÇE bağında 4 fungusit, kontrol bağ alanında ise 7 fungusit uygulaması yapılmıştır.

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INTRODUCTION

Taking place on the most favorable climate zone of the world for viticulture, Turkey is among the top five countries of the world in terms of its vineyards and production values (Çelik at al., 1998). According to the data of TUIK (Turkish Statistical Institute) for the year 2015, Kahramanmaraş province has an important place in its region in terms of viticulture with its vineyards at an area of 333.290 decares (33.329 hectares) and grape production of 271.777 tons.

The most significant pest of the vineyards in Turkey is *Lobesia botrana* (Denis and Schiffermüller, 1775). Chemicals are used unconsciously against *L. botrana*. About 7-9 pesticides are applied against this pest on the vineyards of Bertiz location of Kahramanmaraş province. *L. botrana*, which is one of the most important pests of the vineyards of our country as in Europe, causes damage on the grapes during flowering, unripe and sweetening periods; and also causes great damages as it creates available environment for development of diseases directly and indirectly (Fermaund and Le Menn, 1992; Kovancı et al., 2005; Akyol and Aslan, 2010; Oztürk and Acıöz, 2010; Mamay and Cakır, 2014). In addition, biological control is rather lacking and studies in this field date back to distant past. It is also known that studies regarding the predators and parasitoids living at the vineyards of our country are limited. Use of broad spectrum pesticides on agricultural areas influences the predators and parasitoids, which are biological control agents, directly or indirectly (Blümel et al., 1999).

Above-mentioned reasons revealed the need to study on usage possibilities of the biotechnical methods in control against *L. botrana*. Audemard (1987) stated that successful results were taken against *Cydia pomenella*, *Cydia molesta*, *Anarsia lineatella, Synanthedon myopatforrnis*, *Adorophyes erana*, *Archips podana*, *Pandemis heparana*, *Eupoecilia amhigucila*, *Lobesia botrana*, *Zeuzera pyrina* and many other lepidopter species and that mating disruption method, which is a biotechnical method, against *L. botrana*. Use of mating disruption method has been increasing in Europe recently, and this method is currently used in many countries in wider areas.

Currently, not only the well-known control methods but also the methods, which protect the vineyards as a whole ecosystem, have become essential. Kahramanmaraş has a very important position in Turkey in terms of both its ecological conditions and its agricultural history. In this study, populations of predators *Chrysoperla carnea* (Stephens, 1836) (Neuroptera:Chrysopidae) and *Coccinella septempunctata* (L., 1758) (Coleoptera: Coccinellidae) were followed up both on the area, where mating disruption method was used against *L. botrana*, a pest in vineyards in Kahramanmaraş, and also on the area, where conventional agricultural methods were used, in order to determine the effect of mating disruption method on predators as an alternative to chemical control.

MATERIAL and METHOD

Four pheromone type traps, namely 2 on the mating disruption vineyard and 2 on the control vineyard, were placed when daily maximum total temperature reached to 100 ^{0}C as of 1st of January of the year. The traps were controlled weekly during the adult pest occurance periods; and upon catching the first adult pest, 1 trap of Isonet-L dispensers was placed on mating disruption vineyard in every 20 m^2; namely 6 m intervals on each row and 2 m intervals at the borders, corresponding to 500 traps/ha as suggested by Charmillot et al (1995) on 7th April in 2013 and on 21st March in 2014. The dispensers were used once during the season as the producer company Shin-Etsu informed that the effect period of the dispensers would be 150 to 160 days. The climatic and meteorological data (temperature, relative humidity) were provided from the Meteorology Directorate of Kahramanmaraş.

When the infestation rate on the grapes of the mating disruption vineyard exceeds 5%, which is the economic loss threshold, a bacterial formulation called *Bacillus thuringiensis* ssp. *kurstaki* was used twice against the 1st and 3rd offsprings in 2013 and

three times against 1st, 2nd and 3rd offsprings in 2014. On the other hand, 7 insecticides were unconsciously used against *L. botrana* frequently until harvest on the control vineyard in 2013; and 8 insecticides were used for the same purpose in 2014. Five insecticides were used on the mating disruption vineyard in 2013 against diseases such as *Uncinula necator*, *Botrytis cinerea* and *Plasmopara viticola* and 8 fungicides were applied on the control vineyard in the same year. In 2014, 4 fungicides were applied on the mating disruption vineyard and 7 fungicides were applied on the control vineyard against the same diseases. Bordeaux mixture was used for protection purposes once on each of the mating disruption vineyard and on the control vineyard on 25.03.2014.

In 2013 and 2014, the predators *Chrysoperla carnea* and *Coccinella septempunctata* on the mating disruption and control vineyards were collected for a period of 15 minutes at each time with CDC-Backpack insect aspirator upon burst of the flower buds; and these were counted separated in the laboratory.

RESEARCH FINDINGS and DISCUSSION

Lobesia botrana adults were caught on 2 Pherocon type traps on 07.04.2013 and Isonet-L dispensers were placed on the above-mentioned date, when the adults were caught. In 2014, Pherocon type traps were placed at an earlier date compared to the year 2013. The number of adults was 0 on the mating disruption upon placement of the Isonet-L dispensers. However, the number of the *L. botrana* adults, which were caught on pherocon type traps, continued increasing until harvest on the control vineyard.

Sampling was started on the mating disruption and control vineyards on 07.04.2013 and 31.03.2014 upon formation of the vine leaves. The highest numbers of predators, which were found, were for *C. carnea* and *C. septempunctata*. Although Chrysopid species are known as the predators of aphids, they feed on many insect groups such as acarinas, thrips, pre-adult stages of white flies and leaf bugs; and they are widely seen all around the world (McMurtry et al., 1970; Stark and Whitford, 1987).

Chrysopid species are also widely seen in our country as in the world and many researchers have studied on them due to their biological properties (Sengonca, 1980; Karut and Kazak, 1999). They are among the most preferred groups for biological control, due to the fact that most of the Coccinellid species are predators and may live in different habitats, that the adults and larvae of them feed on pests. Also they have high consumption capacities, can move very fast and feed on many pests (Bolu, 2004; Uygun and Karabüyük 2015). Most of the Coccinellid species are carnivorous predators of aphids and other pests (Chinery, 1993).

It was observed in 2013 that the population of *C. carnea* and *C. septempunctata*, among the natural enemies, increased in the first week of May in the mating disruption vineyard in 2013; then while the population of *C. septempunctata* started to decrease on the last week of May, population of *C. carnea* increased and such increase started to go down on the first week of July (Figure 1). In 2014, population of *C. carnea* and *C. septempunctata* started to increase in the mating disruption vineyard on the first week of April.

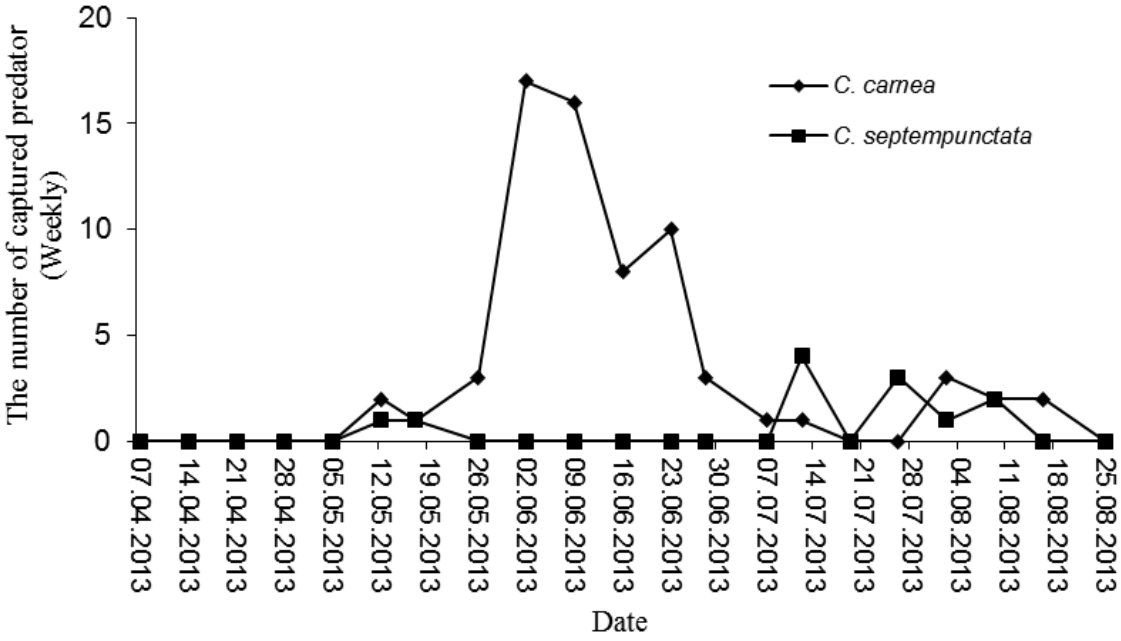

Figure 1- Population fluctuation of the natural enemies collected with CDC-Backpack insect aspirator on the Mating Disruption Vineyard in Kahramanmaraş/Bertiz in 2013

While the population of *C. septempunctata* started to decrease on the last week of May, *C. carnea* population started to go down towards the last week of June. While population of *C. septempunctata* started to increase again on 2nd week of June, population of *C. carnea* started to increase towards the end of June and both predators were continued to be observed until harvest (Figure 2).

The same application was made on the control vineyard where the *C. carnea* and *C. septempunctata* were collected. In 2013, the population of *C. carnea* and *C. septempunctata* started to increase after 3rd week of May. The high number of natural enemies due to high amount of pesticide application on the control vineyard is correlated with the large number of herb population on the control vineyard (Figure 3). In 2014, it was observed that the population of the natural enemies were low; that the population of *C. septempunctata* was high on 07.04.2014 but started to decrease as of the 2nd week of the pesticide application in 2014. However, *C. carnea* population increased during the flowering period of the vineyard. *C. carnea* and *C. septempunctata* started to decrease in 3rd week of May and were not observed until harvest (Figure 4).

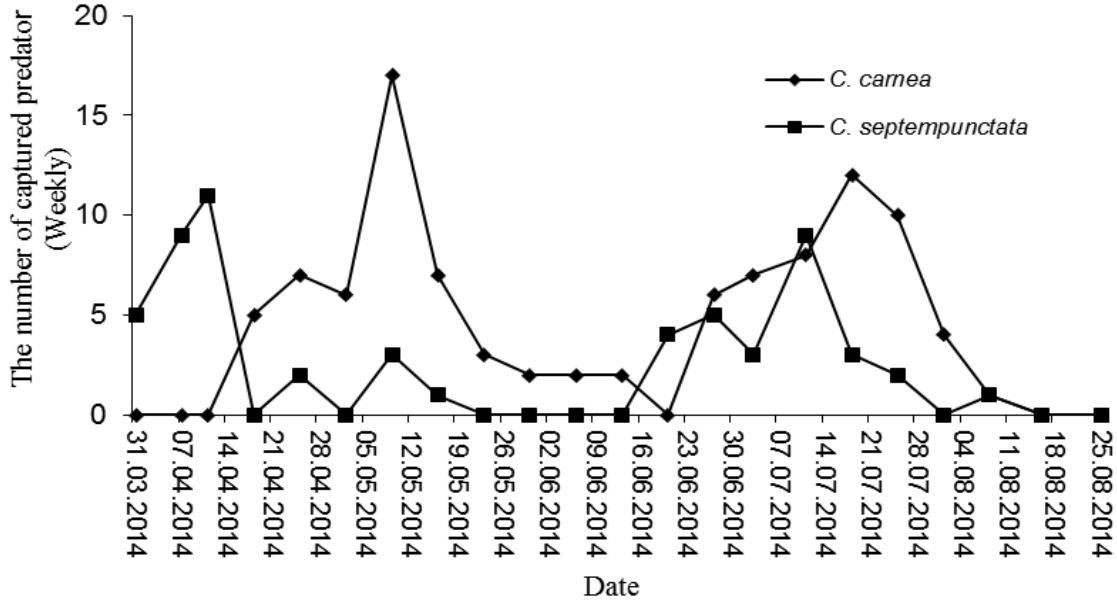

Figure 2 - Population fluctuation of the natural enemies collected with CDC-Backpack insect aspirator on the Mating Disruption Vineyard in Kahramanmaraş/Bertiz in 2014.

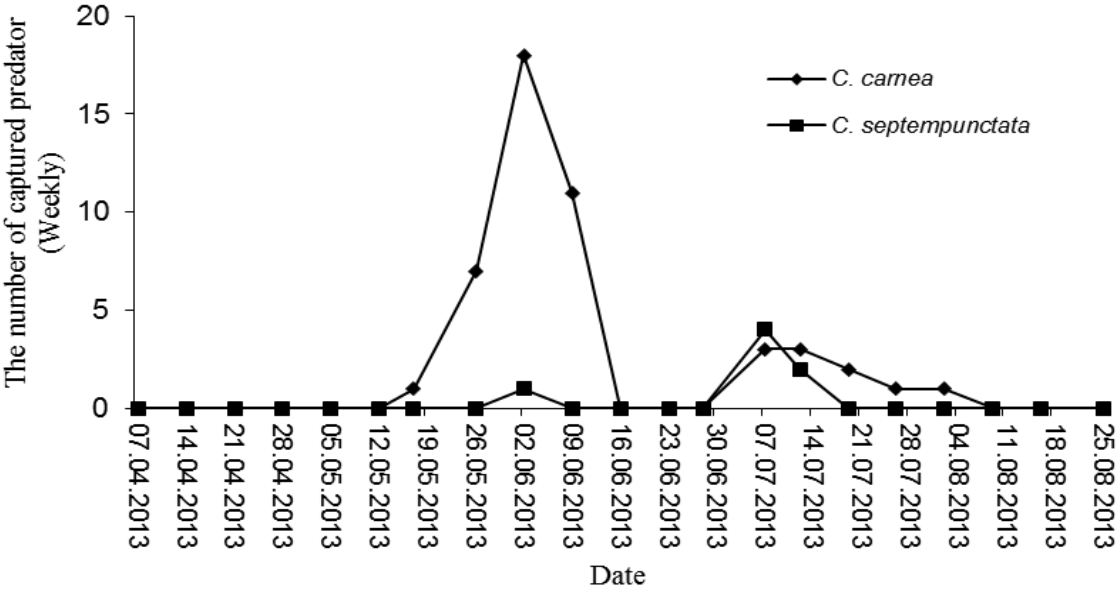

Figure 3- Population fluctuation of the natural enemies collected with CDC-Backpack insect aspirator on the Control Vineyard in Kahramanmaraş/Bertiz in 2013

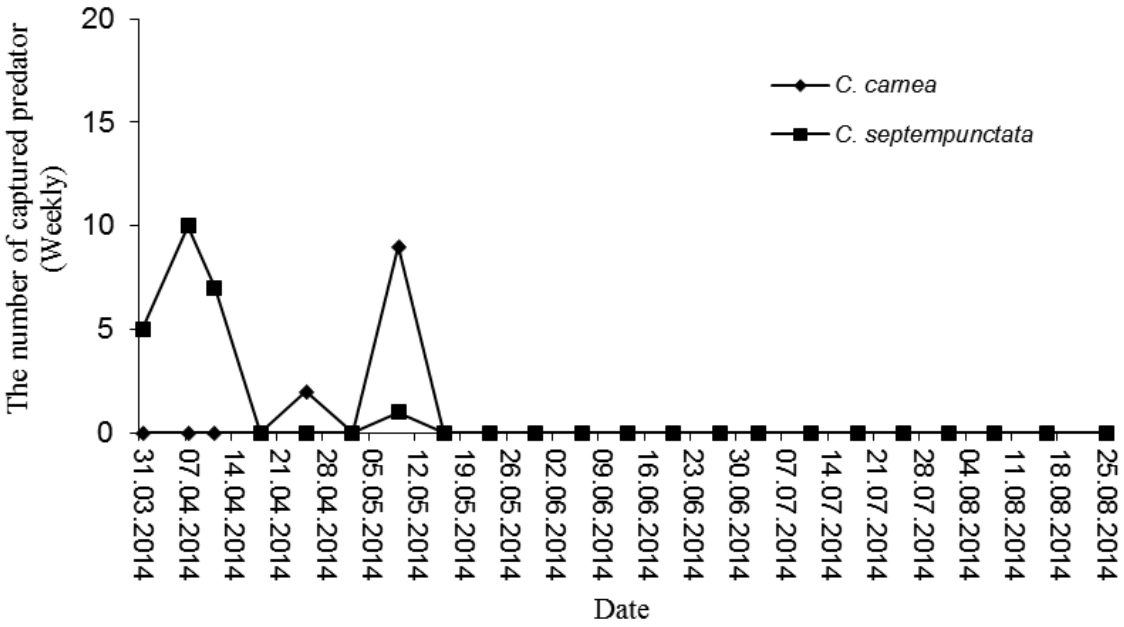

Figure 4- Population fluctuation of the natural enemies collected with CDC-Backpack insect aspirator on the Control Vineyard in Kahramanmaraş/Bertiz in 2014

When these predators, which were obtained from the Mating Disruption Vineyard in 2013 and 2014, are compared in terms of emergence period of *L. botrana*, it was seen that the natural enemies continued their presence in a very dense manner starting from the mid-April until the last week of July in 2014; and 1st, 2nd and 3rd offsprings of *L. botrana* were seen during this period (Figure 5). Due to intense pesticide application during this period, the predator population was rather low on the control vineyard in 2014.

It was determined as a result of this study that the population of natural enemies on the vineyard, where mating disruption technique was applied, was higher that the natural enemy population of the control vineyard and that the applications used in 2013 supported the natural enemies and hence the population of the natural enemies on mating disruption vineyard was rich in number in 2014. Natural enemies play an important role in agricultural ecosystems.

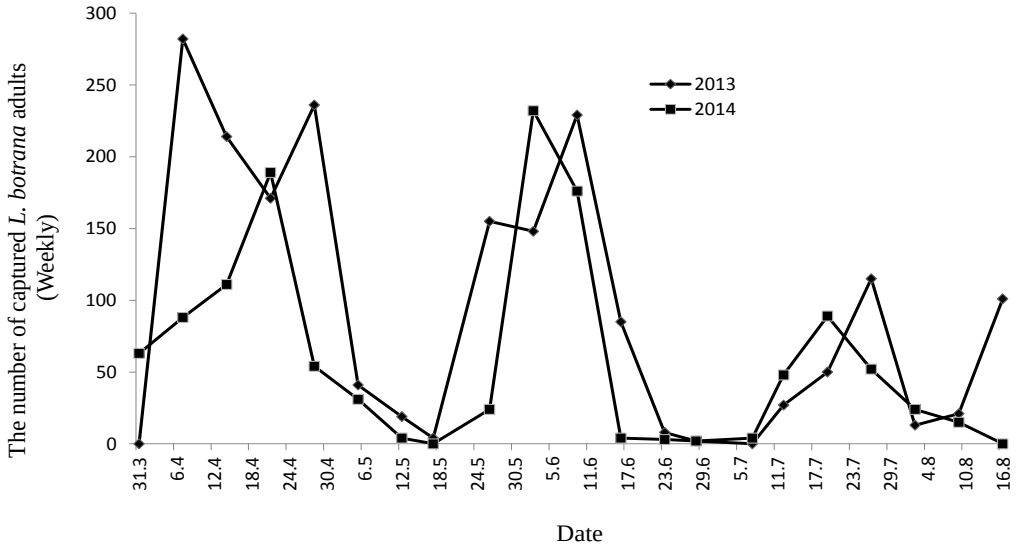

Figure 5 – Population fluctuation of *Lobesia botrana* collected on control vineyard in Kahramanmaraş/Bertiz

They not only play an alternative role but also are important for integration with the struggling methods (Salerno et al., 2002). They underline the effects of herbicides, acaricides and insecticides on population of the useful insects and their survival (Chang and Plapp, 1983; Young et al., 2003).

C. carnea is a significant predator on agricultural lands; it is important not only in terms of being a predator in biological control but also due to the fact that it spreads on a large area and has a large hunting range, and that its 3rd offsprings have multidimensional feeding capability, they feed as much as their body mass daily (McEven et al., 2001). However, natural population of many *Coccinellid* species goes down as their habitat disturbed due to improper pesticide applications (Majerus and Kearns, 1989). In addition, use of wide spectrum pesticides have direct and indirect negative effects on the predators and parasitoids used for biological control. The direct effect is seen in the decrease in population of the predators and parasitoids as well as the effect on their prey. On the other hand, predators and parasitoids cannot find nutrients because of the decrease in the population of the material and hence it indirectly leads to a decrease in the rate of the efficiency of the predators and the parasitoids (Blümel et al., 1999).

The effects of the insecticides with certain lasting toxicity have also been studied against natural enemies (Roger et al., 1994; Cho et al., 1997). In addition, the effects of certain insecticides have been studied on the behaviors of the predators and the parasitoids (Borgemeister et al., 1993; Longley & Jepson 1996). The studies revealed that application of wide spectrum pesticides for long years disrupts the natural balance of predators forcing to migrate not only because of the biotic and abiotic factors but also due to the excessive odors arising from the intensity of the pesticides.

For all the above-mentioned reasons, it is determined that mating disruption method supports *C. carnea* and *C. septempunctata* populations in struggling with *L. botrana*; and use of a bacterial preparation called *Bacillus thuringiensis* ssp. *kurstaki*, which has no harmful effects on the human and environmental health, protects the natural balance and increases the success of the mating disruption method. Mating disruption method must be developed and applied on vineyards, because unconscious chemical pesticide application gives serious damage to human and environmental health as the farmers are unconscious and they fail to determine the offspring period of the insects.

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