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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

The population fluctuation of European grapevine moth, *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera: Tortricidae) in a vineyard in Antalya

Antalya ilinde bağda Salkım güvesi (*Lobesia botrana* Denis & Schiffermüller)'nin popülasyon değişimi

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ABSTRACT

European grapevine moth, *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera: Tortricidae) is the most serious pest of vineyards on a worldwide scale. The study aimed to determine the adult and larval population fluctuations and the generation number for the control of the *L. botrana*. The present study was conducted in a 1 ha vineyard in Serik district of Antalya province during 2014 and 2015. After the first adult in traps, adult and larval population of pest monitored, weekly. The study findings revealed that *L. botrana* adults were initially observed in nature in mid-March and remain active for almost eight months in both years. The second peak in the adult count was observed on June 2 and June 12, in 2014 and 2015, respectively. The highest adult density was observed on July 7, 2014 (72.5 adults trap^{-1}) and July 14, 2015 (54 adults trap^{-1})) during the third peak. The highest larval count was determined on July 14, 2014 (1.72 larva bunch^{-1}) and on July 22, 2015 (1.45 larva bunch^{-1}). The data obtained show that *L. botrana* gives four full generations in Antalya province conditions. Based on the data, it could be suggested that pest population could partially generate a fifth generation in September. It is recommended to consider the determined second and third peak dates in the pest control strategy in Antalya province.

ÖZET

Salkım güvesi [*Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera: Tortricidae)] tüm dünyada bağın en önemli zararlısıdır. Çalışmada, *L. botrana*'nın mücadelesine yönelik olarak, ergin ve larva popülasyonunun değişimi ve döl sayısının belirlenmesi amaçlanmıştır. Bu çalışma, 2014 ve 2015 yıllarında Antalya ili Serik ilçesinde bulunan 1 ha'lık bağda yürütülmüştür. Tuzaklarda ilk ergin yakalandıktan sonra larva ve ergin popülasyonu haftalık olarak izlenmiştir. Çalışma sonucunda, her iki yılda da *L. botrana* erginlerinin Mart ayı ortalarında ilk kez doğada görüldüğü ve doğada yaklaşık 8 ay boyunca aktif kaldığı belirlenmiştir. Ergin sayısında 2014 ve 2015 yıllarında sırasıyla ikinci tepe noktası sırasıyla 2 Haziran ve 12 Haziran tarihlerinde görülmüştür. En yüksek ergin yoğunluğu ise, üçüncü tepe noktasının oluştuğu döneme 72.5 ergin tuzak^{-1} ile 7 Temmuz 2014 ve 54 ergin tuzak^{-1} ile 14 Temmuz 2015 tarihlerinde görülmüştür. En yüksek larva sayısı ise 1.72 larva salkım^{-1} ile 14 Temmuz 2014 ve 1.45 larva salkım^{-1} ile 22 Temmuz 2015 tarihinde saptanmıştır. Elde edilen veriler, *L. botrana*'nın Antalya ili koşullarında dört tam nesil verdiğini göstermektedir. Bununla birlikte zararlı popülasyonunun bir bölümünün eylül ayı içerisinde beşinci nesil oluşturabilme potansiyelinin olabileceği düşünülmektedir. Antalya'da zararlı ile mücadele stratejisinde, belirlenen ikinci ve üçüncü pik tarihlerinin dikkate alınması önerilmektedir.

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INTRODUCTION

Grape is one of the common cultivated plants in the world and in Turkey because it is not very selective in terms of climate and soil. Viticulture plays a key role in Turkish economy (Semerci et al., 2015). Turkey ranks fifth after Spain, Italy, France and China with a surface area of 472 545 ha dedicated to viticulture, and ranks sixth after China, Italy, USA, France and Spain with 4.3 million tons of grape production (FAO, 2020). Turkey ranks first in the world in raisin production (about 400 000 tons; 75% seedless, 25% seeded) and ranks second after the USA in seedless raisin production and first in exports (TMO, 2020).

Similar to many cultivated plants, there are biotic and abiotic factors that could lead to yield and quality loss in grapes. *Arboridia vitisuga* (Dlabola) and *Arboridia adanae* (Dlabola) (Hemiptera: Cicadellidae), *Empoasca vitis* (Gothe) (Hemiptera: Cicadellidae), *Daktulosphaira* (*Viteus*) *vitifoliae* (Fitch) (Hemiptera: Phylloxeridae) (Hemiptera: Phylloxercisteridae); *Planococcus citri* (Risso) (Hemiptera; Pseudococcidae), *Rubiothrips vitis* (Priesner), *Drepanothrips reuteri* Uzel (Thysanoptera: Thripidae), *Otiorhynchus* spp. (Coleoptera: Curculionidae), *Lobesia botrana* (Den. & Schiff.) (Lepidoptera: Tortricidae), *Cryptoblabes gnidiella* Mill. (Lepidoptera: Pyralidae), *Colomerus* (*Eriophyes*) *vitis* (Pagenstecher) (Prostigmata: Eriophyidae) are among the important pests that could limit the production and cause economic losses in grape cultivation (TAGEM, 2008; Sertkaya et al., 2008; Turanlı, 2017; Satar et al., 2020; Keçeci, 2021).

The European grapevine moth [*Lobesia botrana* Denis & Schiffermüller (Lepidoptera: Tortricidae)] is the most significant pest in grape cultivation (Öztürk & Acıöz, 2010; Mamay & Çakır, 2014; TAGEM, 2017; Gutierrez et al., 2018; Kaplan, 2020). The pest overwinters as pupa under the bark or in other protected places. Adults emerge when air temperatures durinh sunset exceed a threshold of 10°C (TAGEM, 2008). Females lay their eggs on flower buds and flower stems before blossom period. The first generation *L. botrana* larvae feed on the blossom and young fruit. The second-generation larvae feed inside berries. Most of the damage is caused by the third-generation larvae by webbing and feeding inside berries in the ripening stage, which lead to berries rottenness due to the saprophytic fungi that grow on the fruit fluids (Fermaud & Le Menn, 1992; TAGEM, 2008).

Environmental conditions directly affect the *L. botrana* through changes in emergence time and the number of generations per year. In a study conducted in Southeastern Anatolia, it is reported that the first generation of adults emerge in late April and the pest gives three offspring during the vegetation period (Kaplan et al., 2016). In another study carried out in Çanakkale, it was found that the first adults of *L. botrana* emerge at the end of April and the first half of May, and three peaks were reported during the vegetation period, in mid-May, late June, and mid-August. This study also reported three generations per year, but in some years the 4th generation may occur after the harvest season (Özpınar et al., 2004). Similar results were reported in studies conducted in İzmir and Manisa, and it was stated that *L. botrana* adults begin to emerge in nature in the second half of March, and the pest can give four generations (Altındişli et al., 2002, 2005). Similar results were obtained in the study conducted in Iznik (Bursa) (Kovancı et al., 2005).

For effective pest control, biological criteria such as the first adult emergence in nature, population peaks and generation number should be determined. There was no study conducted on the *L. botrana* population dynamics in Antalya. The current study aimed to determine the changes in the adult and larval population of *L. botrana* in a vineyard in Serik district located in Antalya province, Turkey.

MATERIALS AND METHODS

The changes in European grapevine moth adult and larval populations were observed in an about 1 ha vineyard, where mostly Trakya İlkeren variety grape are cultivated, and which is located in Antalya province, Serik district, Kocayatak neighborhood between 2014 and 2015.

Delta type traps and pheromones (E-7, Z-9- Dodecadien-1-yl-acetate) were employed to monitor *L. botrana* adult population. Two traps were hung on the vine at a height of 1.5–2 m from the ground on March 1. Traps were checked once a week and catched moth count was recorded separately. The pheromone capsules in the traps were changed after 4-5 weeks based on the manufacturer instructions. The adhesive card was replaced when it was dirty. To monitor the larval stage of *L. botrana* population, 50 grape clusters, 2 of which were collected from each plant, were examined by a hand-held magnifier after the pest adult were seen in traps. In both years, the counts were conducted on 20 small late-period clusters after the end of July, after the harvest. Counts were conducted once a week and the larval count was recorded.

During the study, the air temperature and air relative humidity were recorded in the vineyard with a data logger (Extech). These figures are presented in Figure 1 for first year (2014) and Figure 2 for second year (2015).

RESULTS and DISCUSSIONS

The trapped moth count in the pheromone traps was used to monitor the change in *L. botrana* adult population in 2014 and 2015.

During the first year of the study, the first adults were observed on March 10. The second peak was observed on June 2 (31.5 adults trap^{-1}). The adult population of the pest reached the highest density (72.5 adults trap^{-1}) during the third peak on July 7. The pest count peaked again on August 4 and 26 (45-56 adults trap^{-1}). Although the adult count decreased after August 26, it increased again on September 23 and then rapidly declined. The larval pest population was initially quite low. The larval population then tended to increase on June 9, and reached the highest density (1.72 larvae cluster^{-1}) on July 14, during the grape harvest. Then, it started to decline (Figure 3).

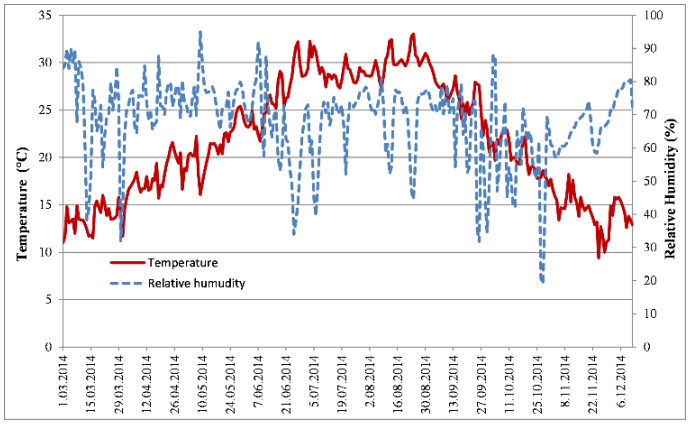

Figure 1. Mean air temperature (°C) and air relative humidity (%) recorded in first year

Şekil 1. İlk yılda kaydedilen ortalama hava sıcaklığı (°C) ve hava nispi nemi (%)

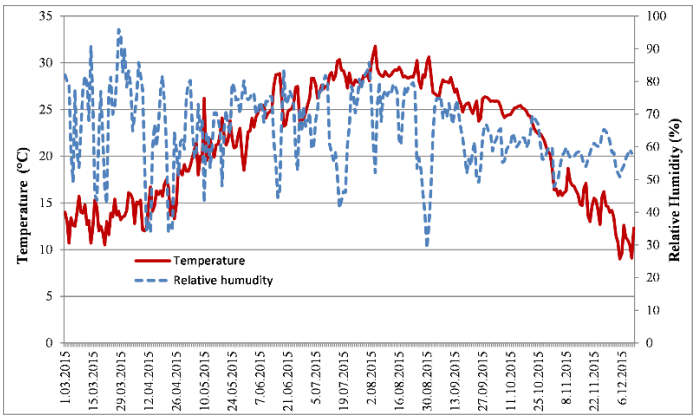

Figure 2. Mean air temperature (°C) and air relative humidity (%) recorded in second year

Şelil 2. İkinci yılda kaydedilen ortalama hava sıcaklığı (°C) ve hava nispi nemi (%)

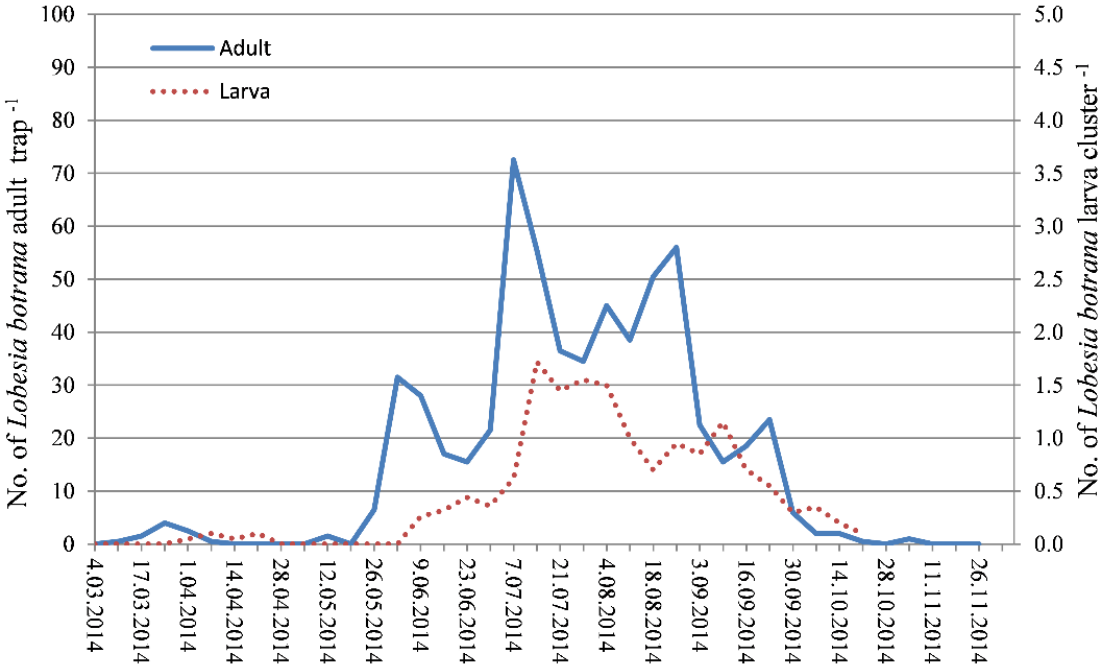

Figure 3. Population fluctuations of larval and adult *Lobesia botrana* in the vineyard in 2014

Şekil 3. 2014 yılında bağda Lobesia botrana larva ve ergininin popülasyon değişimi

In the second year, 2015, the pest was observed for the first time on March 18. The second peak was observed on June 12 (7 adults trap^{-1}), the pest population peaked for the third time during the vegetation period (54 adults trap^{-1}). The pest population increased again in August and it was 45.5-51 adults trap^{-1} on August 5-20. Similar to the first-year findings, the pest population increased again in late September and then started to decline. The larval population was quite low in April but started to increase on June 19. Larval population was 0.68-1.45 larva cluster^{-1} between July 8 and 22 when the grape was ready for harvest.

In the study, generation number was calculated based on the climatic data and the development threshold of *L. botrana*, and the findings were compared with the adults count in the traps in the field. The minimum growth threshold for *L. botrana* was reported as 12°C (TAGEM, 2017). Based on the March 10 - November 4, 2014 and March 18 - November 10, 2015 temperature data, the period when the pest was observed in nature, the total effective temperatures were determined as 2722.0 and 2671.2 day-degrees, respectively. It was reported that one *L. botrana* generation could be generated between 482 day-degrees and 577 day-degrees (Zalom et al., 2009).

These data demonstrated that the pest could produce 4 full generations per year (4.7 generations in 2014 and 4.6 in 2015) under the study conditions, and a part of the population could produce a fifth generation. Calculated generation number and adult population peak counts were consistent for two years.

The study area is located on the Mediterranean coast. It has a warmer climate when compared to other grape cultivation regions in Turkey. In both years of the study, the pest was observed in March and during the flowering period. The pest population generated 3 clear peaks. The second-generation adults reached the highest population on June 2 in 2014 and June 12 in 2015. The third-generation adults reached the highest population on July 7 (72.5 adults trap^{-1}) and July 14 (54 adults trap^{-1}) in 2014 and 2015, respectively. The pest population then peaked in August. However, the adult population did not decrease continuously in September, and increased once more. This suggested that a part of the pest population could have produced a fifth generation. Larval pest density peak was 1.72 larva cluster^{-1} during the study. There are no studies in the literature that reported larval count. However, it was observed that a single larva in a cluster could lead to significant damages in that cluster (Figıre 4).

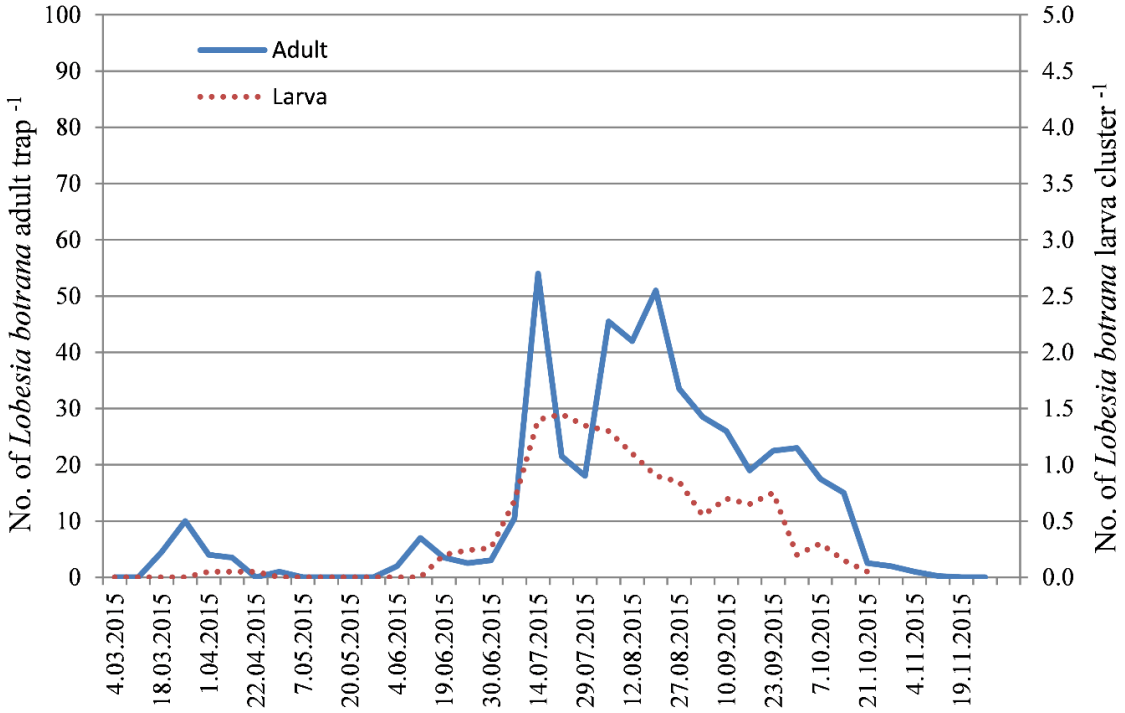

Figure 4. Population fluctuations of larval and adult *Lobesia botrana* in the vineyard in 2015

Şekil 4. 2015 yılında bağda Lobesia botrana larva ve ergininin popülasyon değişimi

It is known that the first *L. botrana* adults emerge at different times in grape cultivation regions with different climatic conditions. Furthermore, the offspring number is a biological parameter affected by the climate. *Lobesia botrana* generates two generations and the second generation leads to economic damages in Northern Europe. It was also reported that the pest could produce four generations in warm geographies such as Spain, Greece, Jordan, Egypt and Iran (Zalom et al., 2009; Gallardo et al., 2009; Saeidi & Kavoosi, 2011). Similar results were reported in studies conducted in Turkey. Kaplan et al. (2016) reported that the pest produced three generations in a study conducted in Mazıdağı district in Mardin Province. In a study conducted in the Çermik district in Diyarbakır province, it was reported that the pest produced three generations (Kaplan, 2020). In Hatay province vineyards, it was determined that *L. botrana* produced three generations every year, in April, June and July (Şekerden Çağlar, 2009). However, it was also reported that the pest could produce four generations in warmer climates. In a study conducted in Tarsus in Mersin province, it was reported that although the last two peaks that were observed after

the harvest were not prominent, the pest population peaked four times (Öztürk & Acıöz, 2010). Similar results were reported in a study conducted in Çanakkale vineyards. It was determined that the pest population peaked three times, but in certain years, fourth generation was observed after the harvest (Özpınar et al., 2004). A similar finding was reported in studies conducted in Manisa, Gaziantep and Şanlıurfa vineyards that the fourth generation was observed (Altındişli et al., 2005; Öztürk & Şahin, 2013; Mamay & Çakır, 2014; Güleç & Ünlü, 2018).

In conclusion, it was observed that there was a correlation between the pheromone traps that were employed to monitor the adult and the larval populations determined in the vineyard. In regions without early warning for pest control, pheromone traps could be employed to decide the application time. Control was not recommended due to low population density during the first generation, which does not lead to economic damages. However, since the second and especially the third generations feed directly on the grape and lead to economic damages, the populations should be monitored and densities can be assessed to determine proper application time. During the harvest, leaving the clusters of no economic significance in the vineyard would lead to infestation in the next year, which would generate a higher population; thus, these clusters should be removed and discarded during the harvest.

Especially during the construction of new vineyards in coastal areas, the presence of various plants such as blackberry, blackcurrant, cherry, plum, persimmon, kiwi, pomegranate and clove, which are pest hosts, and the pest density on these hosts should be considered.

STATEMENT OF CONFLICT OF INTEREST

The author has declared no conflict of interest. This study presented in Vth International Eurasian Agriculture and Natural Sciences Congress (October 23, 2021) and published as summary in the proceedings book.

AUTHOR'S CONTRIBUTIONS

The planning, field observations, evaluation of study and writing of the manuscript was done by author.

STATEMENT OF ETHICS CONSENT

Ethical approval is not required as there are no studies with human or animal subjects in this article.

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