Turkish Journal of Forest Science
Available online at dergipark.gov.tr/turkjforsci

KAHRAMANMARAŞ KENT PEYZAJINDA *Fraxinus angustifolia* Vahl ÜZERİNDE *Zeuzera pyrina* L. (Lepidoptera: Cossidae) ZARARI ÜZERİNE GÖZLEMLER

Bülent LAZ

Kahramanmaras Sutcu Imam University, Faculty of Forestry, Departmen of Forest Engineering, Kahramanmaras

Corresponding author: bulentlaz@ksu.edu.tr

Bülent LAZ: https://orcid.org/0000-0001-9237-1092

Please cite this article as: Laz, B. (2024) Observations on zeuzera pyrina l. (lepidoptera: cossidae) damage on fraxinus angustifolia vahl in urban landscape of Kahramanmaras, *Turkish Journal of Forest Science*, 8(1), 53-62.

ESER BİLGİSİ / ARTICLE INFO
Araştırma Makalesi / Research Article
Geliş 1 Şubat 2024 / Received 1 February 2024
Düzeltmelerin gelişi 13 Mart 2024 / Received in revised form: 13 March 2024
Kabul 18 Mart 2024 / Accepted 18 March 2024
Yayımlanma 30 Nisan 2024 / Published online 30 April 2024

ÖZET: Dünyada ve ülkemizde Dar yapraklı dişbudak olarak bilinen *Fraxinus angustifolia* Vahl hızlı gelişen, değerli odunlara sahip türler kategorisinde yer alan ve dünyadaki en geniş ormanları Türkiye'de bulunan önemli bir ağaç türüdür. Türkiye'nin önemli yapraklı türlerinden olan dar yapraklı dişbudak kavak ve kızılağaçtan sonra en hızlı gelişen türlerden biri olduğundan dikim yoluyla yeni meşçereleri kurulmakta ve endüstriyel plantasyonları yanında Türkiye'nin birçok ilinde şehir içi peyzajında, yol kenarı ağaçlandırmalarında da çok kullanılmaktadır. Çalışmanın yapıldığı Kahramanmaraş kent peyzajında önemli bir yeri olup bulvarlarda, ana caddelerde, park ve yol kenarlarında *Fraxinus angustifolia* türüne rastlanmaktadır. Türe ait yapılan gözlemlerde bazı bireylerin gövde ve dalları üzerinde böcek çıkış delikleri gözlendiği ve bu deliklerden koyu renkli akıntı ile birlikte larvaların deri değişim parçalarının varlığı tespit edilmiştir. Bazı dişbudakların kuruduğu, birçoğunun ise gövde üzerinde bazı dalların kuruması neticesinde şekil bozuklukları meydana geldiği, tohum veriminde çok büyük azalmalar olduğu gözlenmiştir. Türe ait bu zararları belirleyebilmek adına odun örneklerindeki böceklere bakıldı ve *Z pyrina* L.1761 (Lepidoptera; Cossidae) tespit edildi. Aynı zararlının kent içinde park ve bahçelerde bulunan ceviz (*Juglans regia* L.) ağaçlarında da çok yaygın olduğu gözlenmiştir. Kent merkezinde transekt yöntemi kullanılarak yaklaşık 200 ağaç ziyaret edilerek zararlı böceğin bulaş düzeyi belirlenmeye çalışılmıştır. Yapılan gözlemlerde Dar yapraklı dişbudakların %28'inin bu zararlı tarafından bulaşık olduğu ve bu bulgulara dayanarak *F. angustifolia*'nın Kahramanmaraş ilinde en önemli zararlısının bu güve türü olduğu belirlenmiştir. Bu araştırma, Doğu Akdeniz Bölgesinde yer alan Kahramanmaraş il merkezinde 12 Mart-15 Aralık 2022 yılında gerçekleştirilmiş olup hem *F. angustifolia*'nın zararlılarını belirlemek hem de polyfag bir zararlı olan *Z. pyrina*'nın yaygınlık durumunun belirlenmesi amacıyla gerçekleştirilmiştir.

Anahtar kelimeler: *Fraxinus angustifolia*, Kahramanmaraş, Peyzaj, *Zeuzera pyrina*.

OBSERVATIONS ON *Zeuzera pyrina* L. (Lepidoptera: Cossidae) DAMAGE ON *Fraxinus angustifolia* Vahl IN Urban LANDSCAPE OF KAHRAMANMARAS

ABSTRACT: *Fraxinus angustifolia* Vahl has fast-growing, valuable wood and the largest forests in the world are in Turkey. Since it is one of the fastest growing species after poplar and alder, new stands are established by planting and it is widely used in urban landscapes and roadside. It has an important place in the urban landscape of Kahramanmaraş, where the study was conducted, and is found on boulevards, main streets, parks and roadsides. In the observations of the species, insect exit holes were observed on the trunk and branches of some individuals and it was determined that there was dark colored discharge from these holes and the presence of skin change parts of the larvae. It was observed that some of the ash trees dried up, and many of them had deformities as a result of the drying of some branches on the trunk, and there was a great decrease in seed yield. In order to determine these damages of the species, insects were examined in the wood samples and *Z pyrina* L.1761 (Lepidoptera; Cossidae) was identified. The same pest was observed to be very common in walnut (*Juglans regia* L.) trees in parks and gardens in the city. Approximately 200 trees were visited in the city center using the transect method to determine the level of transmission of the pest. The observations showed that 28% of the ash trees were infected by this pest and based on these findings, it was determined that this moth species is the most important pest of F. angustifolia in Kahramanmaraş province. This research was carried out in Kahramanmaraş city center, located in the Eastern Mediterranean Region, between 12 March and 15 December 2022 to determine the pests of F. angustifolia and to determine the prevalence of *Z. pyrina*, a polyphagous pest.

Keywords: *Faraxinus angustifolia*, Kahramanmaras, Landscape, *Zeuzera pyrina.*

INTRODUCTION

Fraxinus angustifolia Vahl, known as narrow-leaved ash in the world and in Türkiye, is an ash species from the Oleaceae family, distributed in Central and Southern Europe, North Africa and Southwest Asia (Yaltırık, 1978). It has valuable wood. It is in the category of fast growing species. It can establish pure forests. It grows on moist and rich soils in low elevations in the bottom lands, and on moist soils with no drainage problems at high elevations. It grows best at low altitudes. It prefers sandy-sludgy soils with good ventilation and low density (Anonymous, 2005; Şahin&Güler, 2015). Narrow-leaved ash grows best in alkaline soils with pH values between 6.0-7.5 but with good drainage. In addition to their good growth in deep and moist soils, they can also adapt well to cold climatic conditions. They are not affected by stagnant water but avoid dry shallow soils, meadows, heavy and clayey soils with poor drainage (Odabaşı et al., 2004).

Fraxinus angustifolia subsp. *oxcarpa* taxon, which forms forests in Türkiye, reaches an annual ring width of 2.5-3 cm, 1.5-2 m breast diameter and 45 m height on good soils in Adapazarı-Süleymaniye forest (Çiçek, 2002). In terms of these characteristics, it is considered as one of the most valuable trees in Türkiye and Europe (Çiçek et al., 2002; Tilki&Çiçek, 2005). The largest *Fraxinus angustifolia* forests in the world are located in Türkiye. Since narrow-leaved ash, which is one of the most important secondary-leaved species in Türkiye, is one of the

fastest growing species after poplar and alder, new stands are established by planting (Çiçek, 2002; Çiçek&Yılmaz, 2002).

In addition to industrial plantations of narrow-leaved ash species, it is also widely used in urban landscaping and roadside afforestation in many provinces of Türkiye. It is widely used in both urban landscaping and roadside afforestation, especially in provinces such as Konya and Ankara, which are located in the Central Anatolia Region, where the annual rainfall is low and a full continental climate prevails. One of the provinces in Türkiye where this species is widely used in urban landscaping is Kahramanmaras, located in the east of the Mediterranean Region. The city center has a Mediterranean climate. The city center is 568 m above sea level. In the province where many different plants are used in the urban landscape, Fraxinus angustifolia, one of the most widely used species among the leafy species, has an important place. There are not many studies in Turkey on the biotic and abiotic pests of this very important species for our country. This study was carried out in order to overcome this deficiency in some way.

Feeding on the wood of trees, *Zeuzera pyrina* larvae open galleries in the trunk and branches. They weaken these parts and cause them to break and dry out. During feeding, the conduction bundles are damaged and the damaged organ or tree may die completely. The most typical feature of the pest is the flow of plant sap through the larval entrance holes (Anonymous 2008; Canıhoş et al. 2014; Ulaşlı & Cengiz, 2016; Öztürk et al. 2016). *Z. pyrina* is mainly found on Acer, Aesculus, Amelanchier, Broussonetia, Carya, Castanea, Celtis, Ceratonia, Cotoneaster, Crataegus, Cydonia, Fagus, Fraxinus, Ilex, Juglans, Ligustrum, Liquidambar, Liriodendron, Lonicera, Malus, Olea, Prunus, Punica, Pyrus, Quercus, Rhododendron, Ribes, Robinia, Rubus, Salix, Syringa, Tilia, Ulmus, Viburnum and 150 plant species in 20 genera (Faostat, 2016; Balachowsky& Mesnil, 1935; Carter, 1984; Castellari, 1986; Gatwick, 1992; Kanat& Sütyemez, 2002; Demirel, 2022).

In the literature review on the pests of *Fraxinus angustifolia*, it was seen that many studies were conducted on the pests of this species. However, *Zeuzera pyrina*, which causes great damage to this species, is not mentioned in these studies. In this study, it was determined that *Z. pyrina* is the most damaging pest of narrow-leaved ash, which is widely used in Kahramanmaras urban landscape in Türkiye.

MATERIALS AND METHOD

Kahramanmaras city center has an urban settlement extending in the east-west direction between Ahır Mountain in the north and Kayseri-Gaziantep ring roads in the south. The sections close to the ring road have a flat ground and the ground water is high in this section. Towards the Ahır Mountain in the city center, the land is both sloping and the ground water is not high.

The material of the study was taken from *Fraxinus angustifolia* individuals with emergence holes on the trunk and branch parts in the city center of Kahramanmaras. The branches and wood pieces were cut together with the Metropolitan Municipality Parks and Gardens Directorate teams on 06.06.2022 and brought to the Forest Entomology Laboratory of KSU Faculty of Forestry (Figure 1). Here, the wood parts were cut in different lengths with a maximum length of 70 cm with a chainsaw and placed in 80x80x80 gauze cages. On

09.06.2022, adult emergence started to be seen. Adult individuals were taken from the net cages and prepared for identification.

In the study, in order to determine the population of *Zeuzera pyrina* and to reveal the damage situation, two elevation steps were determined as lower and upper steps in the north-south direction of Kahramanmaras, and all *F. angustifolia* individuals encountered were observed by using the transect method. The area called the lower step is in the form of bottom land and the ground water is higher than the upper step. The area described as the upper step is 100-150 m higher in altitude than the lower step and the ground water is not high.

Figure 1. Exit Holes of *Zeuzera pyrina* from *Fraxinus angustifolia* Trunk Wood Brought to The Laboratory And Damage to The Wood

The locations of *Fraxinus angustifolia* individuals were determined. *F. angustifolia* individuals were marked as dots on the map. The main population size (N) of *F. angustifolia* in the city center was assumed to be 1000. Based on the population size, the sample size was calculated using the formula below.

$$n = \frac{Z^2.N.P.Q}{N.D^2+P.Q.Z^{2.}}$$ (Serin et al, 2002)

n: Sample size

Z: Confidence coefficient (95% confidence coefficient is 1.96)

N: Main population (accepted as 1000)

P: The probability that the characteristic we want to measure is present in the main mass

Q:1-P

D: Accepted sampling error (taken at 10%)

Sample Size $n = \frac{1.96^2.1000.0.5.0.5}{1000.0,1^2+0.5.0.5.1.96^{2.}} = 87.62$

A total of 200 individuals, 100 individuals at the lower elevation level where the ground water level was high and 100 individuals at the upper elevation level where the ground water level was not high, were randomly checked for Zeuzera pyrina.

RESULTS

Identification of Fraxinus angustifolia individuals damaged by Zeuzera pyrina

In the lower elevation level (500-650 m), 44 out of 100 F. angustifolia individuals visited by transect method were found to be infected by *Zeuzera pyrina*. In the upper elevation level (650-900 m), 12 of the 100 *F. angustifolia* individuals visited by transect method were found to be infected by the pest.

Observations on Fraxinus angustifolia individuals

On 06.06.2022, wood samples taken from ash trees in the city center where the pest had flight holes were placed in 80x80x80 gauze cages in the Forest Entomology Laboratory of KSU Faculty of Forestry. On 09.09.2022, the first adult emergence began to be seen.

There are significant differences between ash trees infected with *Zeuzera pyrina* and those without the pest. The first of these differences is remarkably observed in the amount of seeds on the tree. While there are many seeds in the trees without the pest, there are very few or no seeds in the trees with the pest. On the trunk or branch parts of the beetle damaged trees, the flight holes of the beetle and the black colored discharge spots caused by the beetle are immediately visible as seen in Figure 2.

Figure 2. Damage Caused by *Zeuzera pyrina* on Ash and Walnut Tree Trunks.

The beetle damages especially the branches of the tree and causes drying of the branches or deformation of the trees due to the drying of the branches as seen in Figure 3 and 4. In the galleries opened by the beetle in the wood, rotting occurs as a result of the activities of various fungi.

Figure 3. Damage Caused by *Zeuzera pyrina* on *Fraxinus angustifolia* Branches

Figure 4. Damage Caused by *Zeuzera pyrina* on The Trunk And Branches of *Fraxinus angustifolia.*

As a result of emerging holes in the branches and trunk parts and the activities of the insect, bark cracks are observed in the trunk and branch parts. It has been observed that some insects use these cracks as shelters to spend the winter.

DISCUSSION

In this study conducted in the city center of Kahramanmaraş, it was determined that narrow-leaved ash trees located in the lower elevation level of the province on relatively flat, bottom land were more exposed to Pars wood moth damage. On the other hand, it has been revealed that NLA (Narrow Leaf Ash) located at the upper elevation level is relatively less affected by the Pars wood moth. In this case, it was determined that NLD was more exposed to Pars wood moth damage in the bottom land.

Wood Leopard moth is a polyphagous pest that damages more than 150 plant species belonging to 20 genera, including many fruit trees such as walnut, olive, apple, pear, pomegranate and forest trees such as elm, maple, chestnut and oak (Faostat, 2016; Balachowsky & Mesnil, 1935; Carter, 1984; Castellari, 1986; Gatwick, 1992; Kanat & Sütyemez, 2002; Demirel, 2022). Olive and walnut are valuable species that have very important places in the economy and ecology of Kahramanmaras where is one of the provinces where walnut cultivation is done a lot. In 2021, walnut production in Turkey was realized as 325 thousand tons in 1.5 million decares of land (TÜİK, 2021). In terms of planted walnut production area on the basis of provinces in Turkey, Denizli ranks 1st with 115000 decares, Manisa ranks 2nd with 102,000 decares and Kahramanmaraş ranks 3rd with 97000 decares. In terms of walnut production amount, Mersin ranks first with 23 thousand tons of walnut production in 2021 and Kahramanmaraş ranks second with 19 thousand tons of walnut production (TÜİK, 2023).

Kahramanmaraş accounts for 5.9% of the walnut production in Turkey and 6.3% of the total planted areas. With 24 kg/tree average walnut yield per tree, Kahramanmaras is above the average of Turkey (23.8 kg/tree) (Aytekin et al, 2022). Kahramanmaras, which is a successful and ambitious province in walnut production, is also an ambitious and successful province in olive production. It has an important place with 1537200 fruit-bearing and 1534840 non-fruit-bearing olive trees and 20000 tons of olive yield in the 2022-2023 harvest period. The number of olive trees in Kahramanmaras is constantly increasing with continuous plantings. While there were 1255290 fruit-bearing and 370055 non-fruit-bearing olive trees between 2013-2014, this number reached 1537200 fruit-bearing and 1534840 non-fruit-bearing olive trees in the 2022-2023 season. In other words, the number of olive trees has doubled in about eight years (UZZK report, 2023). Two studies were conducted on the presence of *Z. pyrina* in olive varieties in Hatay region, and in the first of these studies, the infestation rate of the districts was determined as 58%, 58%, 52%, 55%, 55%, 49%, 42%, 41%, 34%, 33% and 28% in Dörtyol, Samandağ, İskenderun, Kırıkhan, Erzin, Reyhanlı, Hassa, Yayladağı, Antakya and Altınözü districts, respectively (Ulaşlı&Cengiz, 2016).

In the other study, it was determined that there was a high level of infection level of 90% in Gemlik type olives in Antakya (Arpahan) village and 40% in Yayladağı district. In the same study, it was reported that this damage was not observed in Ayvalık variety in Belen district and *Zeuzera pyrina* damage was not observed in "Savrani", "Haşebi", "Savrani+Karamani" varieties, which are local varieties, in Altınözü district (Demirel, 2022). If it is known how many of the olive varieties planted in Kahramanmaras province in the last 10 years are "Gemlik" and how many are "Ayvalık" varieties, it is necessary to take some measures against the Wood Leoprd moth.

According to Eppo, 17 organisms that damage *Fraxinus angustifolia* have been identified and the list is given below. Among these 17 organisms, 11 of them are insects. 4 of these insects

are from the cerambycidae family. These species are 1- *Anoplophora chinensis*, 2- *Anoplophora glabripennis* 3- *Trichoferus campestris*, 4- *Trirachys sartus*, 4 of them Scolytinae subfamily 1- *Xylosandrus germanus*, 2- *Euwallacea kuroshio*, 3- *Megaplatypus mutatus*, 4- *Xyleborinus attenuatus*, and insects belonging to both families are among the insects that damage the wood of the tree (Eppo, 2024). The absence of *Z. pryna* in Eppo's list seems to be a deficiency.

Eppo names 17 species as pests of *F. angustifolia*. These harmful organisms are: 1-*Candidatus Phytoplasma fraxini*, 2- *Anoplophora chinensis*, 3- *Anoplophora glabripennis*, 4- *Brevipalpus yothersi*, 5- *Corythucha ciliata*, 6- *Euwallacea fornicatus sensu stricto*, 7-*Xylosandrus germanus*, 8- *Euwallacea kuroshio*, 9- *Hymenoscyphus fraxineus*, 10- *Malacosoma disstria*, 11- *Megaplatypus mutatus*, 12- *Orgyia leucostigma*, 13- *Trichoferus campestris*, 14- *Trirachys sartus*, 15- *Xyleborinus attenuatus*, 16- *Xylella fastidiosa*, 17- *Xylella fastidiosa subsp*. Multiplex.

CONCLUSION AND RECOMMENDATIONS

Zeuzera pyrina is a polyphagous pest that damages the branches and trunk wood of many trees. At the moment, two species have been identified in the urban landscape of Kahramanmaraş, but it should be kept in mind that in the future, the pest may also damage the aforementioned tree species. Before June, which is the flight time of the pest, covering the flight holes in the branches and trunk parts of ash and walnut trees in the urban landscape, which are suspected to be insect-infested, with hard putty, and covering the wound parts, if any, with putty will contribute to the control of this pest, since the pest primarily prefers wound areas such as those in Figure 5 to lay eggs.

Figure 5. *Zeuzera pyrina* Laying Eggs on *Fraxinus angustifolia* Trunk

Care should be taken in the pruning of species susceptible to the damage of the above-mentioned insect, it should be done long before the insect's flight time and the wounds should be well closed with vaccine paste. Drainage works should be given importance in the planting places of new species.

Walnut and olive production areas are increasing every year in the province. It is important to prefer varieties resistant to pars wood moth in new olive and walnut varieties to be planted.

FUNDING STATEMENT

The study received no financial support.

ETHICS COMMITTEE APPROVAL

This study does not require any ethics committee approval.

REFERENCES

Anonim (2005). *Ashspecies in europe: biological characteristics and practical guidelines for sustainable use*. Fraxigen, Oxford Forestry Institute, University of Oxford, UK

Anonim (2008). Zirai mücadele teknik talimatları (Cilt: 4). T.C. Tarım ve Köyişleri Bakanlığı Tarımsal Araştırmalar Genel Müdürlüğü, Ankara, 388 s.

Aytekin, F. Z., Çetinkaya S., & Akbay, C. (2022). Kahramanmaraş ilinde ceviz üreten işletmelerin analizi. *Türk Tarım ve Doğa Bilimleri Dergisi* 9(3), 658–665

Balachowsky, A., & Mesnil, L. (1935). *Les insects nuisibles aux plantes cultivées*. Paul Lechevalier, Paris, 1935, 697 pp

Canıhoş E., Öztürk N., Sütyemez M., Toker D. S., & Hazır A. (2014). Ceviz. Türkiye Bilimsel ve Teknik Araştırma Kurumu (TÜBITAK) Tarım, Ormancılık ve Veterinerlik Araştırma Grubu Yayını, 69 s.

Carter, D.J. Pest (1984). Lepidoptera of Europe with special reference to the British Islands. Series Entomologica. Dr W. Junk Publishers, Dordrecht, 1984, 31, pp. 431.

Castellari, P. L. (1986). Zeuzera pyrina L. (Lep. Cossidae): Biological investigations and field tests on the attractiveness of mixtures of sex pheromone components. Bollettino dell'Istituto di Entomologia 'Guido Grandi' della Università degli Studi di Bologna, 40, 239-270.

Çiçek, E. (2002). Adapazarı-Süleymaniye Subasar Ormanında Meşcere Kuruluşları ve Gerekli Silvikültürel Önlemler (Doktora Tezi). İ.Ü. Fen Bilimleri Enstitüsü, İstanbul, 138 s. (Yayınlanmamış).

Çiçek, E. & Yılmaz, M. (2002). "The Importance of Fraxinus angustifolia subsp. oxyacarpa as a Fast Growing Tree for Turkey", IUFRO Meeting on Management of Fast Growing Plantations, Izmit-Turkey, 192-202.

Çiçek, N., Çiçek, E., & Bilir, N. (2005). Dar yapraklı dişbudak'ta (Fraxinus angustifolia Vahl.) bazı tohum ve fidecik özellikleri, *Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi*, Seri A, No 1, 17-24.

Demirel, N. (2022). Evaluation of the damage rates of leopard moth, Zeuzera pyrina L. (Lepidoptera: Cossidae) on different olive varieties in Turkey. II International Biology Congress, 18-20 May 2022, Bishkek, Kyrgyzstan

EPPO (2024). https://gd.eppo.int/taxon/FRXAN/pests. (Erişim tarihi: 10.01.2024)

Faostat, Production of olives by countries; Browse data, World, 2016.

Gatwick, J. (1992). Crop pests in the UK. p. 126–127. In "Collected Edition of MAFF Leaflets". Chapman & Hall, 1992, London.

Kanat, M., & Sütyemez M. (2002). Kahramanmaraş yöresinde ceviz ağaçlarında Zeuzera pyrina(L.) (Lepidoptera: Cossidae)'nın zararı, biyolojisi üzerine gözlemler ve mücadele yöntemlerinin araştırılması. *KSÜ Fen ve Mühendislik Dergisi*, 5(1), 47- 55.

Odabaşı, T., Çalışkan, A., & Bozkuş, F. (2004). Silvikültür tekniği (Silvikültür II), *İstanbul Üniversitesi Orman Fakültesi Yayınları*, Yayın No. 4459, O.F. Yayın No. 475, İstanbul.

Öztürk, N., Hazır, A., & Bükücü, Ş. B. (2016). Cevizde zararlı ağaç sarıkurdu [Zeuzera pyrina L.(Lepidoptera: Cossidae)]'nun mücadelesinde kitle halinde tuzakla yakalama yöntemi etkinliğinin belirlenmesi, Bitki Koruma Bülteni, 56(2), 165 – 172 ISSN 0406-3597

Serin, H., Akyüz, İ., Hicabi, C., & Akyüz, K. C. (2002). İçel ili küçük ve orta ölçekli orman ürünleri sanayi işletmelerinin yapısı sorunları ve çözüm önerileri. *Gazi Üniversitesi-Kastamonu Orman Fakültesi Dergisi*.

Şahin, H.İ., & Güler, C. (2015). Hızlı gelişen dar yapraklı dişbudak (Fraxinus angustifolia Vahl) odununun orman ürünleri endüstrisinde değerlendirilmesi. *Gazi Üniversitesi Fen Bilimleri Dergisi*, Part:C, Tasarım Ve Teknoloji GU J Sci Part:C 3(1):357-365

Tilki, F., & Çicek, E. (2005). Effects of stratification, temperature and storage on germination in three provenances of *Fraxinus angustifolia* subsp. Oxycarpa seeds, *Turkish Journal of Agriculture and Forestry*, 323-330, 2005

TÜİK, (2021). Türkiye İstatistik Kurumu, https://www.tuik.gov.tr/ (erişim tarihi: 10.01.2024)

TÜİK, (2023). Türkiye İstatistik Kurumu, https://www.tuik.gov.tr/ (erişim tarihi: 19.01.2024)

Ulaşlı, B., & Cengiz, F.C. (2016). Hatay ili zeytin bahçelerinde sarı ağaçkurdu Zeuzera pyrina L. (Lepidoptera: Cossidae)'nın yayılışı ve bulaşıklık oranlarının belirlenmesi *Journal of Agricultural Faculty of Mustafa Kemal University* 21(2):149-156 ISSN:1300-9362

Yaltırık, F. (1978). Türkiye'deki Doğal Oleaceae Taksonlarının Sistematik Revizyonu, İstanbul Üniversitesi Orman Fakültesi Yayın No: 2404.