



Walnut sunscald and sunburn injuries on walnut fruits harvested from the Trakya region of Turkey

Ahmet ÇITIR,^{1*} Havva ILBAGI¹

¹Department of Plant Protection, Faculty of Agriculture, Tekirdağ Namık Kemal University, 59030, Tekirdağ, Turkey

Research Article

Keywords:

Walnut
Sunscald
Sunburn
Trakya

Received: 06.04.2022

Accepted: 28.04.2022

Published: 31.05.2022

DOI: 10.55848/jbst.2022.8

ABSTRACT

Walnut (*Juglans regia* L.) is one of the most important fruit species grown in the world. Turkey has positioned the fourth producer country in the world through its 120 000 tones yield harvested from 10 million trees. The production amount of 2118 Kg /ha does not represent the potential of Turkey's high walnut tree numbers attained in recent years. The causes of this outcome could be explained as the lack of cultivar purity of walnut trees and low yield production. In addition to imported walnut fruit in the markets, most of the walnut yields are a mixture of local and breed varieties in the region's Edirne, Kırklareli, and Tekirdağ provinces. Alongside mixtures of local uncertified walnut fruit trees, the certified Turkish cultivars of Bilecik, Şebın, Kaman, Yalova, and the American Chandler nurses are being planted as individual trees and establishment of small walnut orchards and groves in the Trakya region. Obtaining 2448 walnuts harvested in the season of the 2021 year from their shelled fruits were examined for sunscald and sunburn typically symptoms. As a result of this study, a total of 118 out of 2448 walnuts at the rate of 4.82 % of walnut samples exhibited sunscald and sunburn injuries. The least rate of sunscald injuries was found at 3.44 % among the mixture of Tekirdağ local cultivars. However, Edirne local cultivars were found to be the most susceptible at the rate of 11.43 %. Results of this study point out that besides selecting the best accurate walnut cultivars, ecological factors to allocate locations for establishing walnut orchards and groves are important environmental and horticultural practices that should be more or less in valleys shaded by hills and mountains as in Anatolia. To provide certified walnut nurses for growers, public and private nurseries have recently been active in nine provinces.

1. Introduction

Walnut (*Juglans regia* L.) is called as Persian walnut, Anatolian walnut, or English walnut. These are an important shelled fruit classified into the family of Juglandaceae and 21 other walnut species, including many cultivars. Walnut is generally produced in the USA, Europe, and Asia. FAO statistics showed that China leads production with 420,000 t, followed by the USA (322,000 t), Iran (150,000 t), and Turkey (133,000 t) [1]. Turkey is located at the germplasm and center of origin of walnut. As reported by [2] that it is extended to a wide region from the Carpathian Mountains across Turkey, Iraq, Iran, Afghanistan, and southern Russia to northern Indiana. At least 21 local and 14 foreign cultivars of walnut and their pomological characteristics were described by [3] and 28 worldwide cultivars were also led to know by [4]. Walnut production in Turkey had been dependent on individually grown trees from planted seeds by coincidence at the sides of water streams, creeks, and rivers in deep valleys all over the country. Some of those monumental walnut trees had been served as shade trees in parks, picnic areas, and other recreational areas in villages and small towns with their valuable fruits until the last quarter of the twentieth century. Scientific investigations and studies have been initiated

concerning walnut breeding in the Yalova Atatürk Horticultural Research Institute by [5] and followed by [6]. In another part of the country, [7] also initiated walnut breeding projects in Eastern Anatolia at Atatürk University. The studies and investigations on walnut had continued at Samsun 19 Mayıs University [8] and Van Yüzüncü Yıl University [9]. Akça et al. [10] has led sustained walnut research in Van and later followed at Tokat Gaziosmanpaşa University. Thus, almost all 81 provinces of Turkey and some districts were surveyed, evaluated, and selected for horticultural practices of the best fruitful walnut trees. For private forests with almond and walnuts nurses in Edirne, Kırklareli, and Tekirdağ provinces of the Trakya Region, Şebın or Kaman cultivars were suggested to be the main walnut production cultivars. However, Bilecik is the pollinator one both of them. Akça et al. [10] indicated that the productive walnut orchards and groves in the Trakya region of Turkey might establish these cultivar combinations suitable in accordance with the region's climate. More than 65 % of arable land is flat and plain allocated for annual field crops in the Trakya region. Some farmers and eager landowners have established walnut orchards in irrigatable areas in the parcels by Yalova cultivars. Because of the average 22 cm deep planting

* Corresponding author: ¹Department of Plant Protection, Faculty of Agriculture, Tekirdağ Namık Kemal University, 59030, Tekirdağ
Present address: Değirmenaltı Mah. Bahçeköy sit., B2/5, Süleymanpaşa, Tekirdağ/Turkey
E-mail address: acitir140@gmail.com

malpractice in the walnut nurseries, most of those planted nurseries were dried and dead, as reported by [11] and [12]. It was a great disappointment for those eager landowners in this region. Compared to Anatolia, there are no prevailing pest and pathogenic diseases in walnut trees in Trakya. Depending on our observations since 1998, only walnut anthracnose caused by *Gnomonia leptostyla* (Fr.) et de not. that occurs on some individual walnut trees causing black spots on leaves and fruits, which is a significant disease on the local walnut cultivars in Central Anatolian as Yalova 1, Yalova 3 and Yalova 4 varieties were found tolerant to this disease [13]. Codling moth (*Cydia pomonella*) is an important pest of walnuts. Moreover, walnut leaf gall mite (*Eriophyes tristriatus*) infestation cause galls on walnut leaves in Anatolia and occurs in the Trakya region as well. It is worth investigating walnut diseases caused by fungi, prokaryotic pathogens, virus diseases, nematodes, and improper agricultural practices, as suggested by [3]. At least two out of six virus diseases in walnut trees were reported in Bulgaria [14]. Prevailing global climatic changes have increased atmospheric temperatures also solar stresses since at the end of last century. This event has caused local sunscald symptoms on greenhouse plants and complete sunburn injuries with yield and quality losses on fruits like walnuts in orchards [15, 19]. To control sunscald and sunburn damages and yield losses, a reflectance containing calcium carbonate spray was formulated by Novasource Firm in Phoenix, Arizona, USA. Either ground and aerial spraying with measured doses on Chandler walnut trees reduced sunscald and sunburn damages from 17.5 % to 3 %. Three times spraying with 3-4% wettable kaolin solution prevented sunburn damage and improved the yield and fruit quality of Balady Mandarin [16]. It is necessary to investigate kaolin application tests that may prevent sunscald and sunburn injuries and damage in walnut fruit orchards too.

This study aims to determine the effect of sunscald and sunburn injuries in walnut fruits from different cultivars harvested in the 2021 season in the Trakya region of Turkey and suggest meaningful control strategies and management programs.

2. Materials and Methods

Walnut fruits were collected from the walnut orchards and groves between October 1, 2021, to March 18, 2022. After noting the cultivar's name, fruit samples were entirely taken by coincidence from surveyed areas without any selection. The samples included every shape and size of walnut fruits. By comparing original measurements of dimensions and shapes, three cultivars were identified, and the other two groups were named as the mixture of local cultivars. Obtaining shelled nuts were also examined for pest damages, disease symptoms, sunscald injuries, shrivels, and color changes. Color pictures were taken of both unbroken walnuts and shelled nuts. The percentage rate of sunscald injuries and sunburn damage belonging to walnut cultivars was calculated.

3. Results and Discussion

Characteristic features of collected walnut samples, harvested from different orchards and groves as well as individual walnut trees located in Edirne and Tekirdağ provinces are exhibited in Fig. 1. It is observed that cultivar names and production locations are unknown by sellers of

walnut fruits in market as well as lack of standard features and measurement in sizes and shapes. At least five varieties of walnut fruits were separated in the mixtures of cultivars and varieties obtained from the orchards and groves. Depending on their original shapes and measurements of dimensions, three groups of samples were identified as Chandler, Yalova 1, and Bilecik. The other two walnut groups were named a local mixture of Tekirdağ and a local mixture of Edirne. Thus, the shapes and dimensions of five different walnut fruit samples were exhibited in Fig. 1. Besides rare symptoms of pathogenic diseases of walnut anthracnose caused by *Gnomonia leptostyla* (*Marsonina juglandis*), bacterial blight caused by *Xanthomonas arboricola* pv. *Juglandis* and fruit damages caused by codling moth of (*Cydia pomonella*) were determined in this study as reported in and on walnut fruits in the other parts of Turkey [4,17]. Similarly, Akça and Aydın [3] stated to codling moth and walnut leaf gall mite infestation cause galls on walnut leaves in Anatolia and Trakya region. Apart from these studies, there is constricted studies investigated up to now in Turkey. Prokaryotic pathogens and virus diseases are also affected dramatically the walnut trees which should be focused on further such investigations in Turkey, especially in the prevailing production areas. No detailed studies on those biotic and abiotic stress factors in Turkey where it is required to better understand the damages of those factors. The principal point of this study indicated that the yield loss of sunscald and sunburn of shelled walnut kernels are exhibited in Fig. 2. In contrast to healthy white walnut kernels, sunscald and sunburn-damaged fruits displayed with their dark brown, black color, puckered, crumpled, and shriveled appearances. Evaluating phenological features of six domestic and six foreign walnut cultivars adaptations in 14 different locations in Bursa province, [18] selected susceptible cultivars to sunburn injuries. According to their findings, Maraş and Şen 1 cultivars were found to be the most susceptible cultivars to sunscald and sunburn injuries. Compared to healthy shelled walnut kernels, partial and total sunscald injuries and complete sunburn of scorching black-colored fruits are exhibited in Fig. 3. Therefore, before establishing of walnut orchards, they suggested studying ecological features and selecting suitable cultivars. Walnut fruit yield losses of sunscald injuries and sunburn damages and the rate of fruit losses are exhibited in Table 1. Our investigation revealed that Tekirdağ local mixture was found the most resistant to sunscald and sunburn injuries at the rate of 3.44 %, Chandler 5.24 %, Bilecik 5.93 %, and Yalova 17.00 %. Edirne local mixture was found the most susceptible one to sunscald and sunburn damages at the rate of 11.43%.

Table 1. Sunscald injuries and burns of walnut fruit harvested in 2021 season in Trakya Region of Turkey.

Name of walnut	Number of walnut	Number of Sunscald	Rate of injured
Cultivars	samples	shown samples	walnut (%)
Tekirdağ local mixture	1107	38	3.44
Chandler	1011	53	5.24
Yalova 1	100	7	7.00
Edirne Local mixture	105	12	11.43
Bilecik	135	8	5.93
Total	2448	118	4.82

4. Conclusion

With the effect of the global climatic changes, solar stress upon all fruit trees, including walnut trees, has increased recently. Sunscald and sunburn incidences are increasingly rising more injurious to fruits and other plants in countries in all



Fig. 1 Walnut fruit cultivars of Trakya Region in Turkey harvested in 2021. Bilecik (A), Chandler (B), Yalova 1 (C), Tekirdağ local mixture (D), Edirne local mixture (E).

temperate regions. In order to reduce sunscald and sunburn yield and quality losses on walnut, its production should be in orchards and groves established for productive walnut cultivars. Productive certified walnut cultivars suitable to every microclimatic ecology and area have been determined and bred in Turkey.

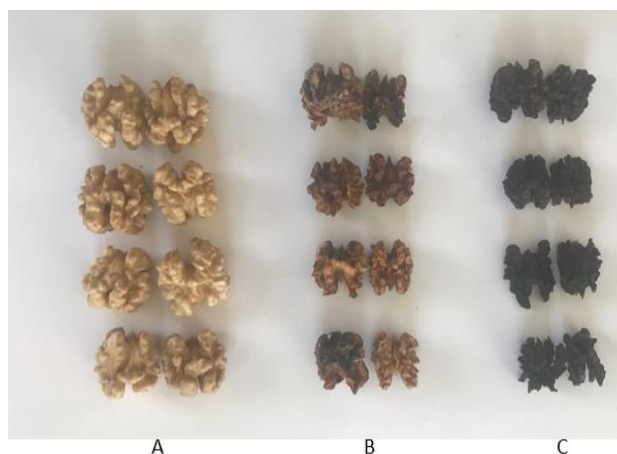


Fig. 2 Shelled walnut fruit lines (B) exhibited sunscald injuries (C) exhibited and indicated sunburn damages, as line (A) being healthy walnut fruits.

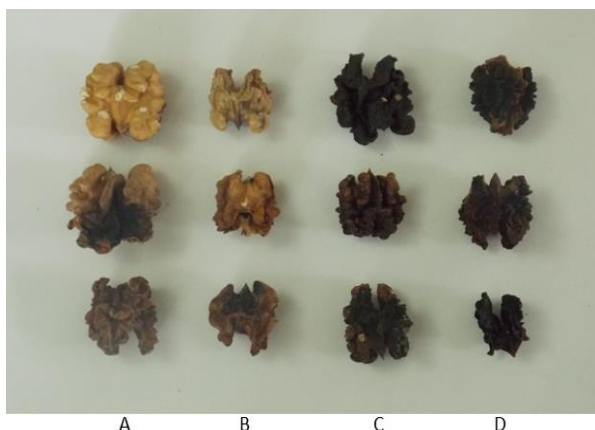


Fig. 3 Local and complete sunscald damages of shelled walnuts with healthy control (A), color changes caused by sunscald injuries (B), sunburn injuries (C), completely burned and scorched shelled walnuts (D).

Public and private fruit tree nurseries, including walnut, are active and located in at least nine provinces, actively following provinces such as Van, Giresun, Tokat, Samsun, Kırşehir, Düzce, Bilecik, Bursa, and Yalova. For Trakya region Sebin, Kaman, and Chandler cultivars were recommended for chief walnut producers such as Bilecik is for the pollinator one. Walnut nurses should be planted technically suitable to avoid deep planting. By pruning walnut tree trained to a modified central leader canopy shape up. Trunks of walnut trees should be painted with white color plastic paint. After shaping up walnut fruits, 3 % kaolin solution should be sprayed after fruit formations in June in order to achieve fruitful production. Such applications might be suggested as control strategies.

Declaration

Author Contribution: Conceive-A.Ç., H.I.; Design- A.Ç., H.I.; Supervision- A.Ç., H.I.; Experimental Performance, Data

Collection and/or Processing A.Ç., H.I.; Analysis and/or Interpretation A.Ç., H.I.; Literature Review- A.Ç., H.I.; Writer- A.Ç., H.I.; Critical Reviews - A.Ç., H.I.

Acknowledgment: This study was conducted in the laboratory of Molecular phytopathology and virology at Department Plant Protection of Faculty of Agriculture in Tekirdağ Namık Kemal University (Tekirdağ/Turkey).

Conflict of Interest: There is no any conflicts of interest for all authors.

Orcid-ID

Ahmet Çıtır  [0000-0002-0453-5112](https://orcid.org/0000-0002-0453-5112)

Havva Ilbagı  [0000-0002-0016-190X](https://orcid.org/0000-0002-0016-190X)

References

- [1]. FAO (2005) <http://www.fao.org/Statistical Databases>
- [2]. H.I. Forde, 'Walnuts,' in *Advances in Fruit Breeding*, J. Janick and J.N. Moore, Eds. Purdue University Press, West Lafayette, Indiana, 1975, pp.439-455.
- [3]. Y. Akça, and M. Aydın, "Assessment of the performance of some walnut cultivars under Tokat-Niksar ecological conditions", *Bahçe* vol.34, pp.49-56, 2005.
- [4]. S.M. Şen, *Walnut, Cultivation, Nutrient Value, Folklore*, Ankara; ÜÇM Yayıncılık, 2011.
- [5]. H. Ölez, "Marmara region walnuts (*Juglans regia* L.) breeding by selection methods" Unpublished Ph.D.Thesis. Atatürk Horticultural Research Institute, Yalova, 1971.
- [6]. G. Çelebioglu, G. Ferhatoglu, and M. Burak, "Selection and plantation of walnut in Turkey", *International*

- Conference on Walnuts, 09, 1988, Yalova, Turkey, pp.83-87.
- [7]. S.M. Şen, “Studies on the selection of walnut (*Juglans regia* L.) in North-Eastern Black Sea region and Eastern Black Sea region”, Thesis of Assoc. Professor, University of Atatürk, Erzurum, Turkey, 1980.
- [8]. S.M. Şen, Walnut Growing, Samsun, Turkey, Eser Press, 1986.
- [9]. S.M. Şen, “The past, present and future of walnut in Turkey”, *Bahçe*, vol. 34, pp.15-27, 2005.
- [10]. Y. Akça, L. Baş, and A. Çıtır, “Conference Series on Basic Farmer Education of Walnut Cultivation in Edirne Province”, Republic of Turkey, Edirne Governor’s Office, 2008.
- [11]. Ş.Y. Gören, “Abiotic Fruit Diseases and Their Control on Newly Established Orchards in Tekirdağ Province,” MS Thesis, Namık Kemal University, Tekirdağ, Turkey, 2009.
- [12]. E.A. Borer, “The perils of planting trees too deeply. Ohio State Government, Department of Natural Resources”, Columbus, Ohio, USA, 2009.
- [13]. H. Coşkun, “Observations on sensibility degrees of important walnut varieties against walnut antracnose *Gnomonia leptostyla* (F r.) Ces et de Not.) in Central Anatolia Region,” International Conference on Walnuts, 1998, pp.47-51.
- [14]. M.A. Yılmaz, and H.M. Sipahioğlu, Nut Viruses. “Advanced Course: Production and Economics of Nut Crops”, Organized by CIHEAM and University of Çukurova ; FAO, with the contribution of Commission of The European Union. 09, 1998. Adana, Turkey, 15 p,
- [15]. G.N. Agrios, Plant Pathology, New York, USA, Elsevier Academic Press, 2005.
- [16]. H.A. Ennab, S.A. El-Sayed, and M.M.S. Abo El-Enin, “Effect of Kaolin Applications on Fruit Sunburn yield and Fruit quality of Balady Mandarin”, *Menoufia J. Plant Prod* , vol. 2, pp.129-138, 2017.
- [17]. Republic of Turkey, Ministry of Agricultural and Rural Affairs, Plant Protection Technical Instructions Pome and Stone Fruit Diseases, TAGEM, Ankara, Başak Matbaası, vol.5, 301 p, 2008.
- [18]. U. Ertürk, C. Mert, A. Soylu, Y. Akça, and Y. Okay, “Evaluation of some domestic and foreign walnut cultivars in the conditions of Bursa, Turkey”, *Acta Hort*, pp.123-130, 2014.
- [19]. M.C. Ophardt, and R.L. Hummel, “Environmental Injury: sunscauld and sunburn on trees. Home Garden series, Washington State University Extension Service, 2016.