

Özcan 46: A New Walnut Variety with High Nut and Kernel Percentage

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Walnuts are one of the most important food sources for all living things on earth (Woodroof 1967). As reported by Germain (1998), walnut trees are classified as wind pollinated, monoecious, and highly dichogamous. As a result of their dichogamy, walnut trees have a very limited self-pollination ability. Therefore, walnut orchards generally require a sufficient number of pollinator genotypes (Bernard et al. 2018). Cross-pollination affects not only nut set, but also the genetic diversity of walnuts (Kumar et al. 2024). The primary objectives of walnut breeding programs are to produce varieties that are productive (high lateral bud flowering), have high nut quality, and are resistant to biotic and abiotic stress conditions. One of the most significant problems encountered in walnut cultivation is the frequent and severe occurrence of late-Spring frost damage (Fallah et al. 2022). This phenomenon leads to significant yield losses in early-leafing walnut varieties, primarily as a result of the freezing of emergent flowers and young leaves. Given the high cost of external frost prevention measures, selecting late-leafing varieties represents the most effective strategy to mitigate these risks. Moreover, late-leafing varieties typically exhibit increased resistance to common diseases such as anthracnose and walnut bacterial blight. Consequently, the adoption of late-leafing walnut varieties can simultaneously prevent yield losses and reduce disease susceptibility, thereby fostering more sustainable walnut cultivation. However, it is important to note that certain late-leafing varieties with extended growing periods (e.g., Chandler) may remain vulnerable to early-autumn frosts resulting from delayed defoliation. For this reason, breeders are focusing on developing walnut varieties that exhibit late leafing, early harvesting, early defoliation, and high lateral bud flowering rates (Vahdati et al. 2019). The development of these varieties enables more productive and economical walnut cultivation. The development of walnut varieties exhibiting superior nut weight, high kernel percentage, and

adaptability to diverse environmental conditions is of importance.

Origin and Development

Kahramanmaraş, located in southern Turkey (lat. 37°35'27"N, long. 37°03'28"E), is situated at an elevation of 930 m above sea level and is characterized by a temperate climate. Annual precipitation is 727 mm and the average temperature is 16.9°C. Our study was conducted in walnut breeding plots at the Kahramanmaraş Sütçü İmam University Nuts Research and Application Center. In 2005, M.S. obtained numerous F₁ populations in breeding programs using different parental combinations (Özcan et al. 2025; Sütyemez et al. 2018). Within the scope of these studies, 'Özcan 46' is a hybrid walnut variety obtained from a cross between 'Chandler' (Pedro × UC 56-224) and 'Sütyemez 1' (selection breeding) (Fig. 1). 'Chandler' is late leafing, has a very light kernel color, and is a productive walnut variety of American origin. 'Sütyemez 1' is a patented variety selected from Kahramanmaraş, a region of Turkey with a rich walnut population grown from seed. 'Sütyemez 1' is recognized as the largest known walnut variety in the world (Sütyemez 2016). The purpose of choosing this parental combination was to obtain a variety that is late leafing, with high lateral bud flowering, a large nut, and a high kernel percentage. As part of the breeding program, pollen from 'Sütyemez 1' (♂) was crossbred with 'Chandler' (♀) at the beginning of the 2007 growing season. From this parental combination, 1250 F₁ seeds were obtained. After stratification, 1017 of these seeds germinated. The germinated seeds were transferred to the breeding plot. Phenological observations were conducted on the F₁ plants in this plot for 3 consecutive years. Of a total 1017 genotypes, 13 late-leafing and early-yield genotypes were selected. Grafting material was then collected from these 13 selected genotypes for propagation. In 2012, an orchard was established with 10 trees of each selected genotype. Five trees from each parent variety were also planted in this orchard to serve as controls. In this plot, yield, phenological observations, and pomological measurements were recorded annually. An application was submitted to the Republic of Turkey Ministry of Agriculture and Forestry Variety Registration and Seed Certification

Center with the data obtained when the plants reached 7 years of age (2019). 'Özcan 46' was patented in 2023 by this institution (Akide and Mehmet 2023).

Description and Performance

This study was conducted on 'Özcan 46', 'Sütyemez 1', and 'Chandler' varieties between 2019 and 2022. Phenological observations were carried out on 10 grafted trees of 'Özcan 46'. For pomological analyses, 150 nuts were used, with 50 nuts sampled from each variety ('Chandler', 'Sütyemez 1', and 'Özcan 46'). The average of the data obtained in our study is presented in Table 1. International Plant Genetic Resources Institute (1994) and Union Internationale Pour le Protection des Obtentions Vegetales (2014) criteria were used to determine plant characteristics in our study.

'Özcan 46' is characterized by a semierect growth habit and protandrous flowering. Its high proportion of lateral bud flowering (85%) leads to a notable nut yield. Leafing occurs 5 d before 'Chandler', with a harvest date that occurs 18 d before 'Chandler'. The nut of 'Özcan 46' is light in color and has a smooth shell texture. The average nut weight, kernel weight, and kernel percentage of the variety are 16.93 g, 8.7 g, and 51.4%, respectively. The variety has a large nut size, whereas the kernel color is light and there is no veining. 'Sütyemez 1' had a nut weight, kernel weight, and kernel percentage of 26.30 g, 13.35 g, and 50.80%, respectively. The nut size and weight of 'Özcan 46' are observed to be above standard as a result of the influence of the 'Sütyemez 1' variety. Ideal walnut nut weight should be between 12 and 18 g (Cosmulescu and Botu 2012), with an optimal kernel weight of 6.00 to 10.00 g, or at least 50.00% of total nut weight (Khadi-Khub et al. 2015; Korac et al. 1997). In walnut breeding programs, a highly desirable kernel percentage should be greater than 50.00% (Korac et al. 1997).

Breeders have successfully combined the positive traits of the parents—specifically, late leafing, high lateral flowering, light kernel color, early harvest, large nut size, heavy nut weight, and high kernel percentage—in the 'Özcan 46' variety. The most important factors that limit and reduce yields in walnut cultivation include late-Spring frosts, unstable weather conditions, and inadequate pollination (Mazinani et al. 2023; Soveili and Khadi 2023). Climate change is increasing the frequency and severity of extreme weather events, despite rising average global temperatures. This poses a risk of late-Spring frosts and early-autumn frosts, particularly for temperate fruit species such as walnut. These events can cause significant yield losses and quality declines in walnut cultivation. Against these reported risks, 'Özcan 46' is a significant new variety for efficient cultivation because of its characteristics.

Availability

'Özcan 46' saplings or scions for grafting can be obtained by appointment from the

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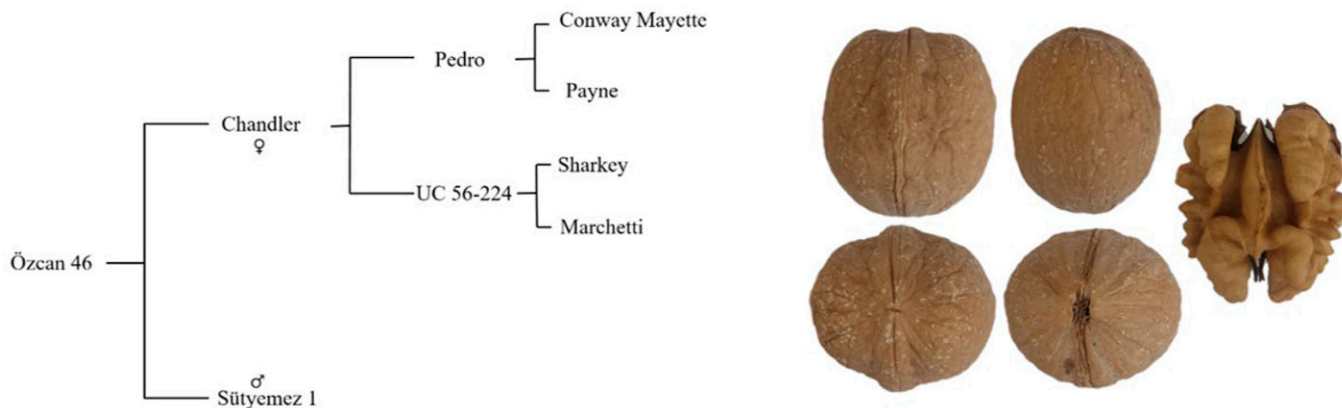


Fig 1. 'Özcan 46' pedigree and nut characteristics.

Table 1. Tree and nut characteristics of 'Özcan 46', 'Chandler', and 'Sütyemez 1'.

Characteristic	Özcan 46	Chandler	Sütyemez 1
Growth habit	Semierect	Semierect	Semierect
Date of budbreak (day)	-5	0	-12 Apr
Flowering trait	Protandrous	Protandrous	Protogynous
Estimated yield	Intermediate	High	Intermediate
Lateral bud flowering (%)	85	96	75
Harvest date (day)	-18	0	-21
Defoliation date (day)	-22	0	-25
Nut weight (g)	16.93	12.85	26.30
Nut size	Large	Medium	Very large
Shell texture	Smooth	Medium	Smooth
Shell color	Very light	Light	Very light
Kernel weight (g)	8.7	6.3	13.35
Kernel percentage (%)	51.4	49.02	50.8
Kernel color	Light	Light	Light
Kernel veins (%)	Smooth	Smooth	Smooth

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References Cited

Akide Ö, Mehmet S (inventors). 2023. Walnut plant named 'Özcan 46' University of Kahramanmaraş Sütcü İmam (assignee). Türkiye Patent (registered) 1627. (Filed 2021, granted 27 Mar 2023).

Bernard A, Lheureux F, Dirlwanger E. 2018. Walnut: Past and future of genetic improvement. *Tree Genet Genomes*. 14(1). <https://doi.org/10.1007/s11295-017-1214-0>.

Cosmulescu S, Botu M. 2012. Walnut biodiversity in southwestern Romania resource for perspective cultivars. *Pak J Bot*. 44:307–311.

Fallah M, Rasouli M, Hassani D, Lawson SS, Sarikhani S, Vahdati K. 2022. Tracing superior late-leaving genotypes of Persian walnut for managing late-spring frost in walnut orchards. *Horticulturae*. 8(11):1003. <https://doi.org/10.3390/horticulturae8111003>.

Germain E. 1998. Genetic improvement of the Persian walnut (*Juglans regia* L.). *Acta Hort*. 442:21–32. <https://doi.org/10.17660/ActaHortic.1997.442.2>.

International Plant Genetic Resources Institute. 1994. Descriptors for walnut (*Juglans* spp.). International Plant Genetic Resources Institute, Rome, Italy.

Khadivi-Khub A, Ebrahimi A, Mohammadi A, Kari A. 2015. Characterization and selection of walnut (*Juglans regia* L.) genotypes from seedling origin trees. *Tree Genet Genomes*. 11(3):54.

Korac M, Cerovic S, Golosin B, Miletic R. 1997. Collecting, evaluation and utilization of walnut (*Juglans regia* L.) in Yugoslavia. *Bull Des Ressourc Phytoenet*. 111:72–74.

Kumar A, Dangi G, Kumar P, Sharma DP, Sharma G, Sajwan P, Dogra RK, Gundogdu M. 2024. Exploring pollination mechanisms in walnut: Production and breeding perspectives. *South*

Afr J Bot. 171:673–681. <https://doi.org/10.1016/j.sajb.2024.06.043>.

Mazinani M, Zarafshan P, Dehghani M, Vahdati K, Etezadi H. 2023. Design and analysis of an aerial pollination system for walnut trees. *Biosyst Eng*. 225:83–98. <https://doi.org/10.1016/j.biosystemseng.2022.12.001>.

Özcan A, Bükücü ŞB, Taşçı H, Ayaz İB, Sütyemez M. 2025. Inheritance patterns of pomological traits in walnut hybridization breeding influence of parental varieties on nut traits. *BMC Plant Biol*. 25(1):98. <https://doi.org/10.1186/s12870-025-06124-6>.

Soveili S, Khadivi A. 2023. Selecting the superior late-leaving genotypes of Persian walnut (*Juglans regia* L.) using morphological and pomological evaluations. *BMC Plant Biol*. 23(1):379. <https://doi.org/10.1186/s12870-023-04386-6>.

Sütyemez M. 2016. New walnut cultivars Maras 18, Sütyemez 1, and Kaman 1. *HortScience*. 51(10):1301–1303. <https://doi.org/10.21273/HORTSCI.10972-16>.

Sütyemez M, Özcan A, Bükücü ŞB. 2018. Walnut cultivars through cross-breeding Diriliş and 15 Temmuz. *J Am Pomol Soc*. 72(3):173–180.

Union Internationale Pour le Protection des Obtentions Vegetales. 2014. Draft guidelines for the conduct of tests for distinctness homogeneity and stability walnut (*Juglans regia* L.). Union Internationale Pour le Protection des Obtentions Vegetales, Geneva, Switzerland.

Vahdati K, Arab MM, Sarikhani S, Sadat-Hosseini M, Leslie CA, Brown PJ. 2019. Advances in Persian walnut (*Juglans regia* L.) breeding strategies. In: Al-Khayri J, Jain S, Johnson D (eds). *Advances in plant breeding strategies: Nut and beverage crops*. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-030-23112-5_11/COVER.

Woodroof JG. 1967. *Tree nuts: Production, processing, products*. AVI Publishing Co, USA.