Scientific Papers. Series B, Horticulture. Vol. LXX, No. 1, 2026
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

# ANALYSIS OF BIOMETRIC AND ECONOMIC INDICATORS IN TWO PEACH CULTIVARS (*PRUNUS PERSICA* L.) – GLOUGHAVEN AND CRESTHAVEN

**Sashka Savchovska SAVCHOVSKA, Rumena GANDEVA**

Fruit Growing Institut, Ostromila 12, 4004, Plovdiv, Agricultural Academy - Sofia, Bulgaria

Corresponding author email: kirilova.savchovska93@abv.bg

***Abstract***

*The study was conducted during the period 2023-2024 at the Institute of Fruit Growing in Plovdiv. A comparative analysis of the peach varieties 'Gloheaven' and 'Kresthaven' was performed based on biometric and economic indicators. In 2023, the average fruit weight ranged from 0.239 g for the `Glowhaven` cultivar to 0.256 g for the `Cresthaven` cultivar. The yield per decare for ``Glowhaven`` was 1265 kg, followed by ``Cresthaven`` with 1201 kg. The average fruit weight in the second year ranged from 0.159 g for `Glowhaven` to 0.163 g for `Cresthaven`. The Randemana as follows: 2023 - 96% for `Cresthaven` and 95% for `Glowhaven`; 2024 - 95% for both cultivars. The economic analysis shows that the `Glowhaven` cultivar has a higher average annual profitability (233%) compared to `Cresthaven` (62%), which indicates a better ratio between the resources invested and the yield. The results obtained from the yield per decare for both cultivars in 2024 (3624.70 kg for `Glowhaven` and 1768.13 kg for `Cresthaven`), all other conditions being equal, emphasize the need to continue observations and conduct a multifactorial analysis over a long period.*

***Key words****: Prunus persica (L.) Batsch, peach, biometric indicators, yield, market potential.*

## INTRODUCTION

The right choice of peach cultivars is crucial for successful and profitable fruit growing. In the context of changing climatic factors and growing competition in the sector, research into cultivar differences and their impact on productivity is becoming increasingly relevant.

The peach (*Prunus persica* (L.) Batsch) has a wide distribution range and finds favorable conditions for development in Southern Europe, North Africa, Asia, America, and Oceania. According to the latest FAOSTAT data for 2023, peaches and nectarines rank fourth after plums - 57,740 tons (18%), cherries - 46,230 tons (14%), and apples - 34,930 tons (11%), with a yield of 10,800 tons (3%) from fruit plantations in the country. Despite their lower percentage share, peaches occupy an important place in the structure of fruit growing due to the potential of a crop in which Bulgaria has a comparative economic advantage.

Peach production is in line with the OAP's objectives of supporting local cultivars and traditions, with an emphasis on preserving agrobiodiversity and sustainable rural development. The crop is preferred by small and medium-sized producers, while providing income diversification and increasing farm sustainability (European Commission, 2018; Bélanger & Pilling, 2019).

To achieve optimal production results in peach cultivation, it is necessary to have in-depth knowledge of the characteristics of the cultivars and their behavior under specific conditions. In recent years, there has been growing interest in the scientific literature in comparative studies that allow the evaluation of different peach cultivars (Surányi, 2020; Pashova, 2024; Barayschuk et al., 2025) in terms of the sustainability and profitability of fruit farms.

Cipriani et al. (2013) implemented a twenty-year breeding program, within which they comparatively analyzed 535 selections and 125 cultivars of peaches and nectarines. The evaluation of pomological and phenological characteristics using a multi-criteria method allows for the selection of the most promising cultivars in view of market requirements.

Mihaylova et al. (2021) investigated the biological activity and mineral composition of early and mid-season peach cultivars, finding significant differences in the nutrient profile related to the phenological ripening period.

Ondrášek et al. (2022) conducted a comparative analysis of phenological and pomological

indicators of 35 traditional and modern peach cultivars from the national genetic collection in the Czech Republic. The results identified cultivars with the potential to renew the cultivar composition and increase the efficiency of commercial production.

Research in the field demonstrates the influence of a number of factors on the production potential of fruit crops, including genetic predisposition (Tareen et al., 2022; Lesmes-Vesga et al., 2022; Vuković et al., 2025; Altan et al., 2025), climatic conditions (Malyshev, 2020; Alexandrov & Hoogenboom, 2000; Vanalli et al., 2021;), agrotechnical measures (Staneva et al., 2018, 2020; Rankova et al., 2021; Drew and Wang, 2025; Harhash et al., 2025) and others.

Established peach cultivars such as Glowhaven, Cresthaven, Redhaven, Evmolpia, Lascava, etc. are grown for mass production in the country. Although Glowhaven and Cresthaven were created in the last century, these cultivars have proven agronomic and consumer advantages, making them some of the most preferred for cultivation and consumption in Bulgaria.

This study aims to compare the cultivars 'Glowhaven' and 'Cresthaven' in terms of biometric and economic indicators.

The number of paragraphs below is just an example. You can have any number of paragraphs in your paper.

This is the first paragraph from the Introduction that should be replaced with your content. Contains also contains a citation example (Adams et al., 2009; Millogo et al., 2008).

This is the second paragraph from the Introduction that should be replaced with your content. Contains also contains a citation example (Adams et al., 2009; Millogo et al., 2008).

This is the third paragraph from the Introduction that should be replaced with your content. Contains also a citation example (Zahiu et al., 2010).

## MATERIALS AND METHODS

The experimental field is located at the Fruit Growing Institute in Plovdiv. The subject of the study are two peach cultivars: 'Glowhaven' and 'Kresthaven'. The orchard was established in 2018. The study period is 24 calendar months (2023-2024). The trees are in full fruiting and are grafted onto seed peach rootstock. The orchard is planted according to a 5x3 m scheme (67 trees per decare). They are grown according to an identical set of agronomic practices.

Annual phenological observations are carried out, and the individual phases are determined using the BBCH scale from bud swelling to leaf fall. The biometric indicators of height, width, thickness, and weight of the fruits of both cultivars were recorded. Each sample consisted of 25 fruits selected from all parts of the tree. The dimensions of the fruits were measured using a Mitutoyo CD-15DAX digital caliper and electronic scales.

The results obtained were statistically processed using the method of David B. Duncan (Duncan, 1955; Harter, 1960). The software used was "R3.1.3", in combination with "RStudio-0.98" and the installed package "agricolae 1.2-2" (Mendiburu, 2021). The percentage of fruit flesh yield was determined. Yields were calculated using the average method. The average yields from three trees were taken as reference values, on the basis of which the total harvest volume per decare was calculated.

Within the framework of this study, a financial assessment of the profitability of the studied cultivars was carried out. For each of them, the costs associated with cultivation, including planting material, fertilizers, preparations, labor, and others, were calculated. The potential revenues from the sale of the production at current market prices were assessed, taking into account the quantitative indicators of the fruits. The results should help producers make informed decisions when choosing a suitable variety and an investment activity.

## RESULTS AND DISCUSSIONS

One of the most important economic characteristics of fruit crops is fruit size and yield. According to research in the field, these depend on the genetic potential of the cultivar (Petrov & Grigorov, 1981), growing conditions (Iglesias & Echeverria, 2022), nutrient supply (Cai, et al., 2023), disease resistance (Manganaris et al., 2022), accumulation of low positive temperatures during dormancy (chill hours) (Penso et al., 2020), etc.

The results of the two-year study of the two peach cultivars show significant differences in

both the biometric indicators of the fruit and the yields per decare. In 2023, the growing season began on February 27 (BBCH 51) and continued until early November. The duration of the entire growing season was 253 days for Glowhaven and 248 days for Cresthaven (Table 1).

Table 1. Phenological phases and duration of vegetation in days in 2023

| Cultivars | | BBCH 51 | BBCH 62 | BBCH 63-65 | BBCH 67 | BBCH 97 | Continued of vegetation in days |
|---|---|---|---|---|---|---|---|
| Glowhaven | 2023 | 27 Feb | 20 Mar | 22 Mar | 25 Mar | 7 Nov | 253 |
| Cresthaven | | 27 Feb | 21 Mar | 23 Mar | 26 Mar | 2 Nov | 248 |
| Glowhaven | 2024 | 23 Feb | 19 Mar | 21 Mar | 26 Mar | 4 Nov | 256 |
| Cresthaven | | 22 Feb | 19 Mar | 22 Mar | 27 Mar | 10 Nov | 263 |

In 2024, the beginning of phenological development occurred on February 23 (BBCH 51) for both cultivars observed. The beginning of dormancy (BBCH 97) was observed on November 4 for Glowhaven and on November 10 for Cresthaven. The duration of the entire growing season was longer than in the previous year, ranging from 256 to 263 days (Table 1).
According to Ivanova (2015), critical temperatures for flower buds are between -2.7º and -3.5ºC, and during flowering they are between -1.6º and -2.2ºC. In 2023, damage from late spring frosts was observed, and at the beginning of flowering, negative temperatures reaching -2.5ºC were recorded. The negative temperatures measured on March 20, 2023, were sufficient to partially compromise yields (Figure 1).

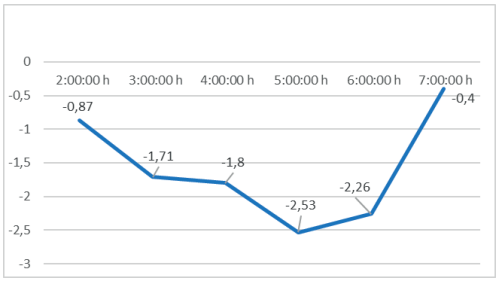


Figure 1 Minimum temperatures recorded in 2023 Source: Author's calculations based on measurements in 2023-2024

An analysis of average monthly temperatures for the period 2023-2024 shows that the winter period provides optimal conditions for accumulating the necessary number of cooling hours (Figure 2).

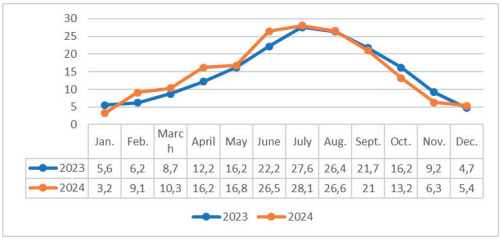


Figure 2. Average monthly temperatures for 2023 and 2024
Source: Author's calculations based on measurements in 2023-2024

In 2023, the average fruit weight ranged from 239.07 g for the Glowhaven cultivar to 256.51 g for the Cresthaven cultivar (Table 2). The study by İkinci and Bolat (2018) on the pomological characteristics of different peach cultivars found that the average fruit weight of the Glowhaven cultivar was 0.115 g. In our study, the values obtained are significantly higher, which is due to the lower load on the trees. The average yields per decare obtained this year range from 1201 kg for Cresthaven to 1265 kg for Glowhaven.
In the second year of the study, the average fruit weight ranged from 159.13 g for the Glowhaven cultivar to 163.38 g for the Cresthaven cultivar. The average fruit weight was lower than in the previous year, as a large number of fruit buds differentiated without competition from the limited number of fruits in the previous season. The highest yield was recorded for the Cresthaven cultivar (96.08%), with both cultivars within the acceptable percentage range.

Table 2. Average annual pomological characteristics of fruits

| Cultivars | Fruit weight (g), 2023 | | Fruit weight (g), 2024 | | Randeman % 2023 | Randeman % 2024 | Weight of stone (g), 2023 | | Weight of stone (g), 2024 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Glowhaven | 239.0 | a | 159.1 | a | 95.7 | 95.0 | 10.0 | a | 7.65 | a |
| Cresthaven | 256.5 | a | 163.3 | a | 96.0 | 95.4 | 9.8 | a | 7.08 | b |

Source: Author's calculations based on measurements in 2023-2024.

The values for fruit thickness in the two cultivars studied are similar (Table 3). In terms of stone size, the Cresthaven cultivar stands out with the highest values for all three measured indicators (Table 4). Similar values were found in the study by Pashova (2024), where the stone weight was 9.79 g, while in our study it ranged from 9.83 g for the Cresthaven cultivar to 10.01 g for the Glowhaven cultivar.

The weight of the stone ranges from 7.06 g for Kresthaven to 7.65 g for Glowhaven. The lower fruit weight of the fruit corresponds to smaller dimensions in height, width, and thickness. This year, the measured average weight is lower, which means that the biometric dimensions of the mesocarp and endocarp are smaller compared to the previous year.

Table 3. Average biometric data for fruits for 2023-2024

| Cultivars | Fruit size | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | hight (mm) 2023 | | hight (mm) 2024 | | width (mm) 2023 | | width (mm) 2024 | | thickness (mm) 2023 | | thickness (mm) 2024 | |
| Glowhaven | 71.96 | a | 64.38 | b | 78.14 | b | 67.50 | a | 77.39 | a | 67.45 | a |
| Cresthaven | 73.15 | a | 67.07 | a | 81.01 | a | 67.41 | a | 76.54 | a | 65.67 | a |

Source: Author's calculations based on measurements in 2023-2024.

Table 4. Average biometric data for stones for 2023-2024

| Cultivars | Stone size | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | hight (mm) 2023 | | hight (mm) 2024 | | width (mm) 2023 | | width (mm) 2024 | | thickness (mm) 2023 | | thickness (mm) 2024 | |
| Glowhaven | 38.24 | a | 37.73 | a | 19.84 | b | 19.13 | a | 27.76 | b | 26.09 | a |
| Cresthaven | 38.92 | a | 37.21 | a | 22.30 | a | 19.24 | a | 29.40 | a | 25.90 | a |

Source: Author's calculations based on measurements in 2023-2024.

In 2024, despite the smaller size of the fruit, the quantity per tree is greater, with a significant increase in yields for both cultivars. The average yield per tree increases to 54.10 kg for Glowhaven and 26.39 kg for Cresthaven.

During dormancy, consistently low, positive temperatures play an important role in the accumulation of phospholipids in cell membranes, which ensure the proper functioning of vegetative and reproductive buds. During this period, when warm and cold days alternate, the process of phospholipid accumulation is disrupted, leading to disturbances in the normal physiology of the buds (Erez et al., 1997).

The results show that, despite the low positive temperatures required by both cultivars being met, during the period November 2023 to February 2024 during winter dormancy, higher daily temperatures (above 7°C) had an adverse effect on the physiological activity of the fruit buds of the Cresthaven cultivar, which is a prerequisite for a reduction in yield in 2024 (Figure 3).

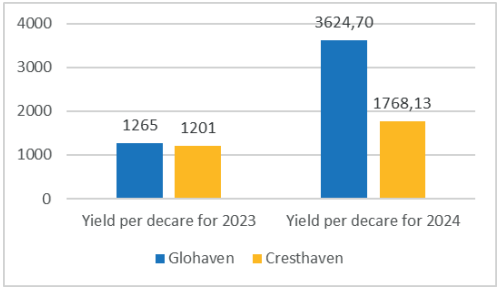


Figure 3. Average yield per hectare, by cultivar, for 2023 and 2024
Source: Author's calculations based on measurements in 2023-2024

With identical costs per decare, the Glowhaven cultivar provides significantly higher yields and profits, with average annual profitability exceeding that of Cresthaven, demonstrating higher economic potential and better adaptation to regional climatic conditions (Table 5).

Table 5. Economic calculations for growing peaches of the Glowhaven and Cresthaven cultivars, at an average selling price of BGN 3.50/kg

| Cultivars | Yield per hectare in kg in 2024. | Expense per decare in BGN | Revenue per decare in BGN | Profit per decare in BGN | Average annual profitability per decare in |
|---|---|---|---|---|---|
| Glowhaven | 3624,70 | 3813,62 | 12686,45 | 8871,83 | 233% |
| Cresthaven | 1768,13 | 3813,62 | 6188,46 | 2372,84 | 62% |

Source: Author's calculations based on measurements in 2023-2024.

## CONCLUSIONS

The comparative analysis between Glowhaven and Cresthaven reveals statistically significant differences between the cultivars. Glowhaven is distinguished by a larger stone weight and a smaller fruit height and width. Other statistically significant differences are the smaller width and thickness of the stone. Despite the larger fruit

size of the fruit in Cresthaven, the Glowhaven cultivar is distinguished by a more than twofold higher yield at the end of the analyzed period. The Glowhaven cultivar demonstrates higher adaptability to climatic conditions. The results obtained define it as more economically profitable for cultivation in the conditions of the Plovdiv region. The reported differences in yields, under equal agrotechnical conditions, are a prerequisite for a subsequent multifactorial analysis in which yields are considered as the dependent variable over the long term.

## ACKNOWLEDGEMENTS

This research work was carried out with the support of the Agricultural Academy – Sofia, Bulgaria, and it was also financed under Project Number OL-20.

## REFERENCES

Alexandrov, V. A., & Hoogenboom, G. (2000). The impact of climate variability and change on crop yield in Bulgaria. Agricultural and forest meteorology, 104(4), 315-327.

Altan, H., Altan, B., Bircan, M., Arslan, R., Subaşı, O. S., Çalışkan, O., & Moreno, M. Á. (2025). Effect of Prunus Hybrid Rootstocks on Yield and Fruit Quality in Peach-Nectarine Cultivation in Low Chilling Areas of the Eastern Mediterranean Region of Türkiye. Applied Fruit Science, 67(2), 1-12.

Barayschuk, G. V., Sokolova, M. A., Bendova, A. Y., & Degtyarev, A. I. (2025). Comparative evaluation of Siberian peach fruits. Contemporary Horticulture, (1), 15-24.

Bélanger, J., & Pilling, D. (2019). The state of the world's biodiversity for food and agriculture. FAO;.

Cai, T., You, L., Yang, X., Hao, S., Shao, Q., Wang, H., & Chen, Y. (2023). Fertilization of peach for yield and quality, and optimization of nitrogen application rates in China: A meta-analysis. Scientia Horticulturae, 313, 111917.

Cipriani, G., Terlizzi, M., Bevilacqua, D., Di Cintio, A., Rosato, T., & Sartori, A. (2013). Peach Breeding programme for new and different traits. Pomological and phenological data analysis with a ranking method. In VIII International Peach Symposium 1084 (pp. 27-32).

Drew, P. & Wang, D. Establishment and productivity of Nectarine Grafted Over Mature Peach Under Furrow, Drip and micro-spray irrigation. Drip, and micro-spray irrigation. http://dx.doi.org/10.2139/ssrn.5163216

Duncan, D. B., 1955. Multiple range and multiple F tests. Biometrics 11 (1),1-42.

Erez, A., Wang, S. Y., & Faust, M. (1997). Lipids in peach buds during dormancy, a possible involvement in dormancy control. Advances in Horticultural Science, 128-132.

European Commision (2018). EU agricultural outlook for markets and income, 2018–2030.

FAOSTAT (2025) https://www.fao.org/faostat/en/#data

Harhash, M. M., Mosa, W. F., & Zaitoon, Y. A. (2025). Influence of Spraying Bio-stimulants on Yield and Quality of Peach cv. Florida Prince. Egyptian Academic Journal of Biological Sciences, H. Botany, 16(1), 89-104.

Harter, H. L., 1960. Critical Values for Duncan's New Multiple Range Test. Biometrics, 16 (4), 671–685.

Iglesias, I., & Echeverria, G. (2022). Current situation, trends and challenges for efficient and sustainable peach production. Scientia Horticulturae, 296, 110899.

İkinci, A., & Bolat, İ. (2018). Yield and quality performance of some peach varieties grown under Sanliurfa ecological conditions. African Journal of Agricultural Research, 13(2), 47-53.

Ivanova, D. (2015). Agroclimatic assessment of winering for fruit growing cultures. Agricultural University – Plovdiv, Scientific Works, vol. LIX, book 3, 161-165.

Lesmes-Vesga, R. A., Cano, L. M., Ritenour, M. A., Sarkhosh, A., Chaparro, J. X., & Rossi, L. (2022). Rootstocks for commercial peach production in the southeastern United States: current research, challenges, and opportunities. Horticulturae, 8(7), 602.

Malyshev, A. V. (2020). Warming events advance or delay spring phenology by affecting bud dormancy depth in trees. Frontiers in Plant Science, 11, 856.

Manganaris, G. A., Minas, I., Cirilli, M., Torres, R., Bassi, D., & Costa, G. (2022). Peach for the future: A specialty crop revisited. Scientia Horticulturae, 305, 111390.

Mendiburu, F. (2021). Statistical Procedures for Agricultural Research. Retrieved from https://cran.r-project.org/web/packages/agricolae.

Mihaylova, D., Popova, A., Desseva, I., Petkova, N., Stoyanova, M., Vrancheva, R., & Lante, A. (2021). Comparative study of early-and mid-ripening peach (Prunus persica L.) varieties: Biological activity, macro-, and micro-nutrient profile. Foods, 10(1), 164.

Milatović, D., Nikolić, D., & Djurović, D. (2010). Variability, heritability and correlations of some factors affecting productivity in peach. Horticultural Science, 37(3), 79-87.

Nagy, A., Riczu, P., Tamás, J., Szabó, Z., Nyéki, J., & Soltész, M. (2012). Irrigation management of a peach orchard. International Journal of Horticultural Science, 18(1), 19-24.

Ondrášek, I., Rampáčková, E., Mrázová, M., & Nečas, T. (2022). Analysis of some phenological, pomological and qualitative traits of different cultivars of peach germplasm. In X International Peach Symposium 1352 (pp. 609-618).

Pashova, S. (2024). Study of the quality of peaches, nectarines and apricots based on morphological characteristics. Economics and computer science, (1), 18-35.

Penso, G. A., Citadin, I., Scariotto, S., Santos, C. E. M. D., Junior, A. W., Bruckner, C. H., & Rodrigo, J. (2020). Development of peach flower buds under low winter chilling conditions. Agronomy, 10(3), 428.

Petrov A. and Grigorov Y. – 1981 Publishing House Hristo G. Danov 157 pages

Rankova, Z., Staneva, I., & Tityanov, M. (2021). Efficiency and selectivity of the herbicide combination Pledge 50 WP and Targa Super 5 EC in peach orchards.

Staneva, I., Akova, V., & Kornov, G. (2020). The influence of some bioproducts on the yield and chemical composition of the peaches under the conditions of integrated plant production. Scientific Papers. Series B, Horticulture. Vol. LXIV, No. 2, 113-118.

Staneva, I., Kornov, G., & Gospodinova, M. (2018). Effect of fertilization with bio-products on the yield of the peach cv.'Glohaven'under the conditions of integrated plant production.

Surányi, D. (2020). Comparative analysis of peach and nectarine cultivars based on their ecological and biological indicators. International Journal of Horticultural Science, 26, 7-26.

Tareen, M. J., Wang, X., Ali, I., Bibi, Y., Tareen, M. N., Fiaz, S., ... & Qayyum, A. (2022). Influence of Scion/Rootstock reciprocal effects on post-harvest and metabolomics regulation in stored peaches. Saudi Journal of Biological Sciences, 29(1), 427-435.

Vanalli, C., Casagrandi, R., Gatto, M., & Bevacqua, D. (2021). Shifts in the thermal niche of fruit trees under climate change: The case of peach cultivation in France. Agricultural and Forest Meteorology, 300, 108327.

Vuković, M., Ljubobratović, D., Matetić, M., Brkić Bakarić, M., Jurić, S., & Jemrić, T. (2025). Evolution of Non-Destructive and Destructive Peach 'Redhaven' Quality Traits During Maturation. Agronomy, 15(6), 1476.