

**PARTIAL RESULTS ON FRUITS ASSESSMENT OF SOME WALNUT
GENOTYPES PRESERVED AT RIFG PITESTI, ROMANIA**

Untaru Aurelian Valentin^{1*}, Botu Mihai¹, Stan Adelina², Butac Mădălina²

¹University of Craiova, Doctoral School of Engineering of Animal and Plant Resources, Romania

²Research Institute for Fruit Growing Pitești, Romania

*Correspondence author. E-mail: valentinuntaru@gmail.com

Keywords: walnut. germplasm. genotype. fruit. evaluation

ABSTRACT

Forty-five walnut genotypes, with different origins, from germplasm fund of RIFG Pitesti, Romania were evaluated, regarding fruit size (nut weight, size index – SI, index of roundness - IR and kernel percentage). The results obtained have highlighted the fact that in walnut collection from RIFG Pitesti there is a large phenotypic diversity. Thus, the average nut weight ranged from 8.00 g ('Novaci' cv.) to 22.00 g ('Geoagiu' 453 cv.). The largest fruits registered 'Geoagiu 453', 'Germisara', 'Ciprian Ion', 'Hartley' cvs. (over 20 g). The kernel percentage ranged from 30.66% ('Geoagiu 210' cv.) to 56.25% ('Valrex' cv.). The largest kernel percentage (over 50%) registered 'Recea', 'Valcor', 'Valrex', 'M 44-39', 'Sarmis', 'Velnița', 'Schinoasa', 'Ciumești 77', 'Cazacu', 'Chisinau', 'Fălești', 'Codrene' and 'Jupânești' cvs. It has been observed that some genotypes, although they have small fruits, have a high kernel percentage ('Valcor', 'Valrex', 'M 44-39', 'Sarmis', 'Schinoasa', 'Recea', 'Chandler', etc.) and other genotypes with large fruit have small kernel percentage ('Geoagiu 453', 'Germisara', 'Ciprian Ion', 'Hartley'. etc.). The values of the index of roundness varied from 0.64 mm on 'Recea' cv. (elongated form) to 1.01 mm on 'Secular' cv. (round form). Most of the genotypes studied (86.67%) had elongated fruits.

INTRODUCTION

The walnut (*Juglans regia* L.), known as Carpathian, Persian or English walnut, is one of the oldest fruit growing tree species, which growing in more than 60 countries all over the world (Avanzato et al., 2014; Iurea et al., 2018; Botu et al., 2019). Worldwide, the area cultivated with walnut in 2021 was 1,137,788 ha. which ensured a production of 3,500,172 tones (FAO Stat Database, 2023). The largest walnut productions are obtained in China, U.S.A., Iran, Turkey, Ukraine, Chile, France, etc. In Romania, the area cultivated with walnut in 2021 was 2,400 ha and walnut production was 54,250 tones. Our country is on the 5th place in the world, after China, U.S.A., Iran, Greece and on the 2nd place in E.U after Greece (FAO Stat Database, 2023). The walnut culture has a long tradition in Romania due to the favorable climatic conditions, fruit's nutritive value, wood's quality, etc. (Cociu et al., 2003; Cociu, 2007; Iurea et al., 2018; Botu et al., 2019). In this paper, 45 walnut genotypes (which come in the bearing in 2022), with different origins, from germplasm fund of RIFG Pitesti, Romania were evaluated, regarding fruit size (nut weight, size index – SI, index of roundness - IR and kernel percentage) in order to

identify the most valuable genotypes that will be recommended for spread in commercial orchards or use as genitors in breeding works.

MATERIALS AND METHODS

The research has been carried out at Research Institute for Fruit Growing Pitesti, Romania (central part of Romania, 44°53'56" Northern latitude, and 24°51'35" Eastern longitude), in walnut collection, established in 2019. The trees were planted at 8 x 6 m, 3 trees per genotypes and trained as flat open center, with drip irrigation systems. Soil is medium-textured, heavy-clay, with low humus content. The average multi-annual temperature was 10.0°C, the maximum temperature 38.8°C, whereas the minimum temperature -24.4°C; total annual rainfalls recorded was 678.1 mm. Compared to the baseline for 53 years period, there is a tendency to increase average temperatures in the winter months (January and February), which causes an early start of trees in vegetation with negative influences on resistance to late spring frosts. There is also a tendency to increase temperature in the summer months (June, July and August), which determines a low resistance to drought. Regarding precipitation, there is a rainfall exceeding in winter (121 mm) and a rainfall deficit in summer (153 mm).

Table 1

The walnut genotypes studied at RIFG Pitești

| No. | Genotype | Origin | No. | Genotype | Origin |
|-----|---------------|---------------------|-----|-----------------|--------------------------|
| 1 | Argeșan | Ro, RIFG Pitești | 24 | Orăștie | Ro, RSFG Geoagiu |
| 2 | Cazacu | Republic of Moldova | 25 | Pescianschi | Republic of Moldova |
| 3 | Chandler | U.S.A | 26 | Peștișani | Romania, RDS Tg. Jiu |
| 4 | Chișinău | Republic of Moldova | 27 | Recea | Republic of Moldova |
| 5 | Ciprian Ion | Ro, RSFG Geoagiu | 28 | Roxana | Romania, RIFG Pitești |
| 6 | Ciumești 77 | Ro, RIFG Pitești | 29 | Sarmis | Ro, RSFG Geoagiu |
| 7 | Claudia Ioana | Ro, RSFG Geoagiu | 30 | Schinoasa | Republic of Moldova |
| 8 | Codrene | Republic of Moldova | 31 | Secular | Romania |
| 9 | Costiugeni | Republic of Moldova | 32 | Sibișel | Ro, RSFG Geoagiu |
| 10 | Dacus | Ro, RIFG Pitești | 33 | Sibișel 252 | Ro, RSFG Geoagiu |
| 11 | Debriceni | Republic of Moldova | 34 | Sibișel 44 | Romania, RSFG Geoagiu |
| 12 | Fălești | Republic of Moldova | 35 | Sibișel 50 | Romania, RSFG Geoagiu |
| 13 | Geamăna | Republic of Moldova | 36 | Sibișel precoce | Romania, RSFG Geoagiu |
| 14 | Geoagiu 210 | Ro, RSFG Geoagiu | 37 | Șușița | Romania, RDS Tg. Jiu |
| 15 | Geoagiu 265 | Ro, RSFG Geoagiu | 38 | Tehama | U.S.A |
| 16 | Geoagiu 453 | Ro, RSFG Geoagiu | 39 | Timval | Ro, UC-SCDP Vâlcea |
| 17 | Germisara | Ro, RSFG Geoagiu | 40 | Valcor | Ro, UC-SCDP Vâlcea |
| 18 | Hartley | U.S.A | 41 | Valrex | Romania, UCv-SCDP Vâlcea |
| 19 | Jupânești | Ro, RIFG Pitești | 42 | Velnița | Romania, RSFG Iași |
| 20 | M44-39 | Ro, RDS Tg. Jiu | 43 | Verisval | Ro, UCv-SCDP Vâlcea |
| 21 | Mihaela | Ro, RIFG Pitești | 44 | Victoria | Romania, RDS Tg. Jiu |
| 22 | Miroslava | Romania, RSFG Iași | 45 | Vlădești | Romania, RIFG Pitești |
| 23 | Novaci | Ro, RDS Tg. Jiu | | | |

In 2022 (when the determinations were performed), the average annual temperature was with 1.6°C higher than the multiannual average, and the precipitation was with 151.8 mm lower than the multiannual average.

Forty-five walnut genotypes, grafted on *Juglans regia* seedling rootstock, were evaluated. Thirty-two genotypes are Romanian, ten from Republic of Moldova and three from U.S.A (Table 1).

In 2022, the following parameters were appreciated:

- nut weight (g) was determined with an electronic balance (30 fruits/each genotype);

- nut size index (SI) was calculated using formula $S = (D+d+h)/3$. where: D is maximum diameter, d is minimum diameter and h is the nut height;

- shape of walnuts was determined using the index of roundness (IR) – $IR = (D+d)/dh$;

- kernel percentage (% from nut weight).

The data was introduced in MS Excel and the following statistical index were calculated: average, standard deviation and coefficient of variability.

RESULTS AND DISCUSSIONS

In international trade the quality of in-shell and shelled walnut is very important. The quality of walnuts is also influenced by biometrical parameters and kernel percentage (Botu et al. 2019).

The nut size index is on average 36.83 mm, varied between 27.10 mm ('Novaci') and 42.45 mm ('Geoagiu 453') (Table 2).

Table 2

The dimensions and shape of the nuts of the genotypes studied
(RIFG Pitești - Mărăcineni, 2022)

| No. | Genotype | Nut height (mm) | d (minimum diameter) mm | D (maximum diameter) mm | Size index - SI | Index of roundness - IR |
|-----|---------------|-----------------|-------------------------|-------------------------|-----------------|-------------------------|
| 1 | Argeșan | 45.23 | 36.69 | 39.03 | 40.32 | 0.84 |
| 2 | Cazacu | 41.58 | 28.96 | 32.66 | 34.40 | 0.74 |
| 3 | Chandler | 42.03 | 32.14 | 34.16 | 36.11 | 0.79 |
| 4 | Chișinău | 40.14 | 32.10 | 34.32 | 35.52 | 0.83 |
| 5 | Ciprian Ion | 44.64 | 34.70 | 37.27 | 38.87 | 0.81 |
| 6 | Ciumești 77 | 31.16 | 29.11 | 31.00 | 30.42 | 0.96 |
| 7 | Claudia Ioana | 44.47 | 35.81 | 37.95 | 39.41 | 0.83 |
| 8 | Codrene | 45.91 | 35.34 | 38.47 | 39.91 | 0.80 |
| 9 | Costiugeni | 38.23 | 32.75 | 36.19 | 35.72 | 0.90 |
| 10 | Dacus | 32.25 | 26.45 | 27.78 | 28.83 | 0.84 |
| 11 | Debriceni | 40.19 | 34.24 | 36.57 | 37.00 | 0.88 |
| 12 | Fălești | 40.60 | 32.59 | 34.10 | 35.76 | 0.82 |
| 13 | Geamăna | 34.07 | 26.41 | 26.76 | 29.08 | 0.78 |
| 14 | Geoagiu 210 | 43.18 | 34.65 | 37.41 | 38.41 | 0.83 |
| 15 | Geoagiu 265 | 42.58 | 32.42 | 34.88 | 36.63 | 0.79 |
| 16 | Geoagiu 453 | 53.14 | 34.79 | 39.41 | 42.45 | 0.70 |
| 17 | Germisara | 49.62 | 35.85 | 39.49 | 41.65 | 0.76 |
| 18 | Hartley | 50.17 | 36.66 | 40.41 | 42.41 | 0.77 |
| 19 | Jupânești | 38.07 | 31.12 | 33.84 | 34.34 | 0.85 |
| 20 | M44-39 | 39.50 | 31.92 | 33.42 | 34.95 | 0.83 |

| | | | | | | |
|--------------------------------|---------------|-------|-------|-------|-------|------|
| 21 | Mihaela | 43.61 | 36.18 | 35.65 | 38.48 | 0.82 |
| 22 | Miroslava | 38.60 | 35.47 | 36.59 | 36.89 | 0.93 |
| 23 | Novaci | 28.16 | 25.42 | 27.73 | 27.10 | 0.94 |
| 24 | Orăștie | 51.88 | 33.88 | 35.84 | 40.53 | 0.67 |
| 25 | Pescianschi | 43.62 | 33.10 | 35.72 | 37.48 | 0.79 |
| 26 | Peștișani | 36.31 | 30.92 | 33.81 | 33.68 | 0.89 |
| 27 | Recea | 40.13 | 25.53 | 26.00 | 30.55 | 0.64 |
| 28 | Roxana | 43.32 | 37.40 | 36.25 | 38.99 | 0.85 |
| 29 | Sarmis | 42.48 | 33.14 | 34.50 | 36.71 | 0.80 |
| 30 | Schinoasa | 38.00 | 31.20 | 34.47 | 34.56 | 0.86 |
| 31 | Secular | 39.28 | 38.88 | 40.47 | 39.54 | 1.01 |
| 32 | Sibișel | 42.93 | 29.96 | 31.80 | 34.90 | 0.72 |
| 33 | Sibișel 252 | 43.47 | 33.39 | 36.32 | 37.73 | 0.80 |
| 34 | Sibișel 44 | 48.19 | 35.35 | 38.49 | 40.68 | 0.77 |
| 35 | Sibișel 50 | 42.62 | 38.14 | 37.91 | 39.56 | 0.89 |
| 36 | Sibișel prec. | 48.80 | 36.82 | 38.30 | 41.31 | 0.77 |
| 37 | Șușița | 37.05 | 32.29 | 35.39 | 34.91 | 0.91 |
| 38 | Tehama | 43.56 | 29.47 | 31.32 | 34.78 | 0.70 |
| 39 | Timval | 44.06 | 35.09 | 38.27 | 39.14 | 0.83 |
| 40 | Valcor | 39.79 | 32.69 | 35.60 | 36.03 | 0.86 |
| 41 | Valrex | 45.86 | 34.55 | 40.60 | 40.34 | 0.82 |
| 42 | Velnița | 47.38 | 36.96 | 38.63 | 40.99 | 0.80 |
| 43 | Verisval | 42.45 | 32.40 | 34.17 | 36.34 | 0.78 |
| 44 | Victoria | 46.58 | 31.36 | 33.46 | 37.13 | 0.70 |
| 45 | Vlădești | 42.14 | 34.22 | 34.52 | 36.96 | 0.82 |
| Average | | 42.16 | 33.08 | 35.26 | 36.83 | 0.82 |
| Standard deviation | | 5.14 | 3.27 | 3.54 | 3.61 | 0.08 |
| Coefficient of variability (%) | | 12.20 | 9.89 | 10.05 | 9.81 | 9.34 |

Of the Romanian genotypes, were noted by large fruits 'Argeșan', 'Geoagiu 453', 'Germisara', 'Orăștie', 'Sibișel precoce', 'Valrex' and 'Velnița' cvs. (SI has value over 40 mm). Of the American genotypes, 'Hartley' cv. was noted (SI=42.41 mm), and among the Moldovan ones the 'Codrene' cv. (SI=39.91 mm) (Table 2).

The index of roundness is on average 0.82 mm. The closer the index of roundness gets to 1.0, the more round is the nuts. The values of the index of roundness varied from 0.64 mm on 'Recea' cv. (elongated form) to 1.01 mm on 'Secular' cv. (round form). Most of the genotypes studied (86.67%) had elongated fruits (ovoid, ovo-conic, oblong and elliptical forms) (Table 2).

The coefficient of variability (%) for the nut size reached in average 9.81 for size index and 9.34% for index of roundness (Table 2), which indicates a small variability.

Our results are similar to those obtained by Botu et al. in 2019.

Average fruit weight is 13.41 g, ranged from 9.00 g ('Novaci') to 15.65 g ('Geoagiu 210'). The largest fruits registered 'Geoagiu 210', 'Germisara', 'Chandler', 'Costiugeni', 'Miroslava', 'Timval', 'Codrene', 'Geoagiu 453', 'Sibișel 50', 'Valrex', cvs. (over 15 g) (Table 3).

An important element for the shelled market is the kernel percentage, the best being the genotypes with the kernel percentage over 50% (Botu et al., 2019).

Table 3

Fruit weight and kernel percentage to the walnut genotypes studied
(RIFG Pitești - Mărăcineni, 2022)

| No. | Genotype | Nut weight (g) | Kernel percentage (%) | No. | Genotype | Nut weight (g) | Kernel percentage (%) |
|--------------------------------|---------------|----------------|-----------------------|-----|-----------------|----------------|-----------------------|
| 1 | Argeșan | 14.22 | 48.61 | 24 | Orăștie | 14.66 | 52.30 |
| 2 | Cazacu | 10.60 | 53.33 | 25 | Pescianschi | 13.39 | 52.73 |
| 3 | Chandler | 15.23 | 53.54 | 26 | Peștișani | 13.47 | 48.21 |
| 4 | Chișinău | 12.14 | 50.81 | 27 | Recea | 11.33 | 48.18 |
| 5 | Ciprian Ion | 13.77 | 49.31 | 28 | Roxana | 13.66 | 47.61 |
| 6 | Ciumești 77 | 11.11 | 53.65 | 29 | Sarmis | 12.04 | 51.63 |
| 7 | Claudia Ioana | 14.70 | 48.57 | 30 | Schinoasa | 12.29 | 51.66 |
| 8 | Codrene | 15.09 | 51.20 | 31 | Secular | 10.56 | 43.47 |
| 9 | Costiugeni | 15.20 | 48.00 | 32 | Sibișel | 12.00 | 47.04 |
| 10 | Dacus | 10.83 | 44.31 | 33 | Sibișel 252 | 14.20 | 48.57 |
| 11 | Debriceni | 14.50 | 44.44 | 34 | Sibișel 44 | 14.38 | 48.27 |
| 12 | Fălești | 13.88 | 52.22 | 35 | Sibișel 50 | 15.00 | 49.15 |
| 13 | Geamăna | 9.33 | 48.78 | 36 | Sibișel precoce | 14.86 | 48.34 |
| 14 | Geoagiu 210 | 15.65 | 48.47 | 37 | Șușița | 14.00 | 46.62 |
| 15 | Geoagiu 265 | 13.12 | 46.61 | 38 | Tehama | 13.57 | 47.30 |
| 16 | Geoagiu 453 | 15.00 | 48.93 | 39 | Timval | 15.17 | 49.93 |
| 17 | Germisara | 15.55 | 49.34 | 40 | Valcor | 13.26 | 50.84 |
| 18 | Hartley | 14.86 | 53.43 | 41 | Valrex | 15.00 | 54.25 |
| 19 | Jupânești | 12.20 | 52.44 | 42 | Velnița | 13.63 | 51.72 |
| 20 | M44-39 | 10.44 | 54.16 | 43 | Verisval | 12.70 | 47.15 |
| 21 | Mihaela | 13.65 | 49.78 | 44 | Victoria | 12.10 | 44.25 |
| 22 | Miroslava | 15.18 | 53.83 | 45 | Vlădești | 13.83 | 45.08 |
| 23 | Novaci | 9.00 | 46.87 | | | | |
| Average | | | | | | 13.34 | 49.46 |
| Standard deviation | | | | | | 1.73 | 2.95 |
| Coefficient of variability (%) | | | | | | 12.99 | 5.96 |



Figure 1. 'Velnița', 'Roxana', 'Ciprian Ion', 'Valcor', 'Sibișel Precoce' and 'Hartley' cvs. (large fruit, elongated, high kernel percentage)

The kernel percentage ranged from 43.47% ('Secular') to 54.25% ('Valrex'). The largest kernel percentage (over 50%) registered 'M44-39', 'Miroslava', 'Ciumești 77', 'Chandler', 'Hartley', 'Cazacu', 'Pescianschi', 'Jupânești', 'Orăștie', 'Fălești',

'Velnița', 'Schinoasa', 'Sarmis', 'Codrene', 'Valcor' and 'Chisinau' cvs. It has been observed that some genotypes, although they have small fruits, have a high kernel percentage ('Cazacu', 'Jupânești', 'Valcor', 'M 44-39', 'Sarmis', 'Schinoasa', etc.) and other genotypes with large fruit have small kernel percentage ('Geoagiu 453', 'Germisara', 'Sibisel50', 'Vlădești' etc.) (Table 3).

The coefficient of variability (%) for the nut size reached in average 12.54% for nut weight (medium variability) and 5.90% (small variability) for kernel percentage (Table 3).

CONCLUSIONS

The results obtained have highlighted the fact that in walnut collection from RIFG Pitesti there is a large phenotypic diversity. Of the Romanian genotypes, were noted by large fruits 'Geoagiu 210', 'Mihaela', 'Germisara', 'Geoagiu 453', 'Timval', 'Chandler', 'Codrene', 'Costiugeni' cvs., of the American genotypes, 'Hartley' cv. was noted, and among the Moldovan ones the 'Codrene' cv. The largest kernel percentage (over 50%) registered 'Cazacu', 'Chisinau', 'Ciumești 77', 'Codrene', 'Fălești', 'Jupânești', 'M 44-39', 'Miroslava', 'Valcor', 'Valrex', 'Sarmis', 'Velnița' and 'Schinoasa' cvs. It has been observed that some genotypes, although they have small fruits, have a high kernel percentage ('Valcor', 'Valrex', 'M 44-39', 'Sarmis', 'Schinoasa', etc.) and other genotypes with large fruit have small kernel percentage ('Geoagiu 453', 'Germisara', 'Ciprian Ion', 'Hartley' etc.).

Most of the genotypes studied (86.67%) had elongated fruits (ovoid, obovate, oblong and elliptical).

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