

Behavior of walnut biotypes (*Juglans regia* L.), from Cenei, Timis County

Scedei Daniela Nicoleta^{1*}, Iordănescu Olimpia Alina¹, Duma (Copcea) Anișoara¹, Beinșan Carmen¹, Alda S.¹, Alda Liana Maria¹, Moatăr Maria Mihaela¹, Blidariu Daciana Tiberia, Stoianov Z.¹

^{1*}Banat University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Timișoara, RO-300645, Romania

*Corresponding author. Email: dana_olaru78@yahoo.com

Abstract The walnut is a fruit species with important ecological and economic values, appreciated since ancient times by the inhabitants of the whole world. The walnut has attracted attention for the nutritional and therapeutic value of the fruits and for the quality, the fineness and the resistance of the wood. On the territory of today's Romania, the walnut has been identified since Roman occupation, over 2,000 years ago[26;27]. Walnut is grown first and foremost for its fruits, which can be consumed both fresh and processed. The walnut kernel, due to its high content in fats, carbohydrates, vitamins and minerals, is awarded in the fruit trade at the highest levels. The walnut kernel is a complete and concentrated food containing fatty substances (52-70%), protein substances (12-25%), sugars (5-25%), mineral substances (1.3-2.4%) etc. Green walnuts have a very high vitamin C content and are used in the preparation of sweetness, fine liqueurs and other products[18]. The energy value of one kg of walnut kernel is equivalent to: 1 kg bread + 0.5 kg meat + 0.5 kg potatoes + 0.5 kg fish + 0.5 kg dried plums + 1 kg pears, providing 6.364 calories[12]. In this paper we studied 5 walnut biotypes (Biotype 1051, Biotype 1052, Biotype 1053, Biotype 1054, Biotype 1055) from the locality Cenei, Timiș County, area from which we had the possibility to collect the biological material, following some characters and the main technological traits of the fruits. The trees are cultivated in the village, near houses, and the variety Geoagiu 65 was taken as control. The results obtained led to following observations: the fruits of the biotypes from Cenei had variable dimensions, thus the large diameter ranges from 30.32 mm in the biotype 1051 and 42.91 mm in the biotype 1053, the small diameter has values between 29.53 mm in biotype 1052 and 42.07 mm in biotype 1055, and in terms of average fruit height, the highest value was recorded in biotype 1051 (52.77 mm).

Key words

walnut, biotype, diameter, weight, shape

Walnuts (*Juglans regia* L.) are among the oldest widespread fruit species. In the last geological epochs and especially in the tertiary period, the walnut had a much greater spread than at present [26].

In our country, the walnut has been known since ancient times and there are data that confirm the perpetuation in the Carpathian-Danube area, our country being one of the largest walnut producers in the world [19; 26].

In all cultivated plants, but especially in walnut, the quantity and the quality of the production depends much on the biological characteristics and agroproductivity of the cultivated varieties. One of the most important tasks of scientific research in agriculture is the creation of new and increasingly valuable varieties, but also the indication of the most favorable areas of culture, because each variety gives

maximum and good quality yields only in the ecological areas that meet its biological requirements.

Extension of walnut plantations on the largest areas requires verification of the behavior of the varieties existing in these areas to establish the most appropriate assortment.

In Romania there have been numerous studies on the local walnut populations, especially in the Sibiușel - Geoagiu areas [12; 20; 8; 16; 6; 32], having as objective the selection and promotion in culture of valuable types from the aspect of fruit production and quality.

From 1985 to 1999, numerous researches were carried out in New Zealand, and the experiments concerned 22 varieties including 11 local selections, 4 European selections and 7 American selection [28].

Material and Method

In the present paper we studied 5 walnut biotypes and the Geoagiu 65 variety, taken as control. The samples (fruits) were collected from Cenad, Timis County, following some characters and the main technological traits of the fruits. Trees are grown in the within the village, close to the dwellings.

The biotypes studied: Biotype 1051, Biotype 1052, Biotype 1053, Biotype 1054, Biotype 1055.

The fruits were brought to the laboratory of the discipline of Pomiculture and Pomology, on which biometric, gravimetric and chemical determinations were performed, the results being presented in tables.

The large diameter, the small diameter and the height were measured with the chisel, the averages were calculated, the error of the mean, the coefficient of variability and the significance of the differences compared to the control.

The gravimetric determinations consisted of weighing the samples (30 fruits each in each variety), breaking, and weighing the components: kernel, shells and septums. The ratio between the weight of the kernel and the whole fruit, that is the ratio kernel/shell, is a feature of the biotype. There are biotypes whose kernel is large and fills the entire cavity. In other biotypes the kernel is small, leaving gaps especially to the outside of the cavity; some biotypes have so little core that half the cavity is empty. By shaking these nuts, the kernel, which is completely detached from the shell, strikes the cavity walls and produces a characteristic sound, hence the name "ringing nuts". The weight of these components from the total mass of the fruits was calculated as a percentage and is presented in the percentage tables.

The shape of the fruit is variable in all biotypes and varieties of walnuts. Spherical, spherical-turtled, ovoid, elongated, etc. are encountered, all of which are biotype-specific characters and important elements of pomological classification. For the characterization of fruits by shape, the shape index is used, which

represents the ratio of the height of the fruit multiplied by 100 and half the sum of the diameters, respectively:

$$If = (H \times 100) / ((D+d)/2)$$

Index values lower than 110 - are characteristic for spheroidal forms

Index values between 111 and 125 - are characteristic for ovoid forms

Index values bigger than 125 - are characteristic for ellipsoidal shapes

Finally, fruit size is an important biometric element. For the estimation of the fruit size, the size index is used, which represents the third of the sum of the large diameter, the small diameter and the height of the fruits, respectively:

$$Im = (D+d+H)/3$$

For the more complete characterization of the walnut biotypes from Banat, and from the point of view of the economic-food value, two synthesis indices were considered: fat index (I.s.gr.) and the index of protein substances (I.s.pr.), according to the formulas:

$$I.s.gr. = S.gr.\% \times M\% / 100;$$

$$I.s.pr. = S.pr.\% \times M\% / 100,$$

where:

S.gr.% = the percentage fat content of the kernel of each biotype;

S.pr.% = the percentage content in protein of the kernel;

M% = the percentage kernel content of fruit (nuts)..

Results and Discussions

In the present work the fruits were harvested from the locality Cenad, Timiș County, from trees grown in the village, near the dwellings.

The morphological characterization of the fruits was performed in the laboratory of the Department for fruit growing, Faculty of Horticulture, on the values of large diameter (D), small diameter (d) and height (H) for the biotypes studied, presented in tables 1, 2, 3.

Due to the close values of the two years (2017-2018) taken in the study, we considered their average value (fig. 1.).

Table 1

External characteristics of walnuts - large diameter (2017-2018)

Genotype	Fruit large diameter (mm)	% compared to control	Difference to control (mm)	Significance
Geoagiu 65	37,33	100,00	0,00	Control
1051	30,32	80,69	-7,01	000
1052	35,46	94,85	-1,87	-
1053	42,91	115,36	5,58	**
1054	41,76	112,18	4,42	*
1055	39,27	105,34	1,94	-

LSD 5% 4,07 mm

LSD 1% 5,38 mm

LSD 0,1% 6,92 mm

The external characteristics of the fruit in terms of large diameter (D) have values between 30.32 mm in the biotype 1051 and 42.91 mm in the biotype 1053.

The average of the control (Geoagiu 65) is 37.33 mm.

The rest of the biotypes have values within these limits.

Table 2

External characteristics of walnuts - small diameter (2017-2018)

Genotype	Fruit small diameter (mm)	% compared to control	Difference to control (mm)	Significance
Geoagiu 65	35,99	100,00	0,00	Control
1051	38,07	105,95	2,08	-
1052	29,53	81,55	-6,45	000
1053	30,88	85,40	-5,11	00
1054	31,38	86,84	-4,60	00
1055	42,07	117,40	6,09	000
	LSD 5%		3,25 mm	
	LSD 1%		4,29 mm	
	LSD 0,1%		5,52 mm	

The external characteristics of the walnut biotypes in terms of fruit small diameter (d) have values between 29.53 mm in the biotype 1052 and 42.07 mm in the

biotype 1055; the control has a value of 35.99 mm. It can be seen that two biotypes, 1052 and 1055, are very significantly negative in relation to the control variety.

Table 3

External characteristics of walnuts – fruit height (2017-2018)

Genotype	Fruit average height (mm)	% compared to control	Difference to control (mm)	Significance
Geoagiu 65	47,69	100,00	0,00	Control
1051	52,77	110,89	5,08	+
1052	34,39	71,51	-13,30	000
1053	34,56	74,19	-12,05	000
1054	37,87	78,96	-9,82	000
1055	50,67	106,38	2,98	-
	LSD 5%		4,71 mm	
	LSD 1%		6,22 mm	
	LSD 0,1%		7,99 mm	

The height of the fruits (h) has values between 34.39 mm for the biotype 1052 and 52.77 mm for the biotype

1051, and the control is 47.69 mm. We can observe that only the biotype 1051 is significant to the control.

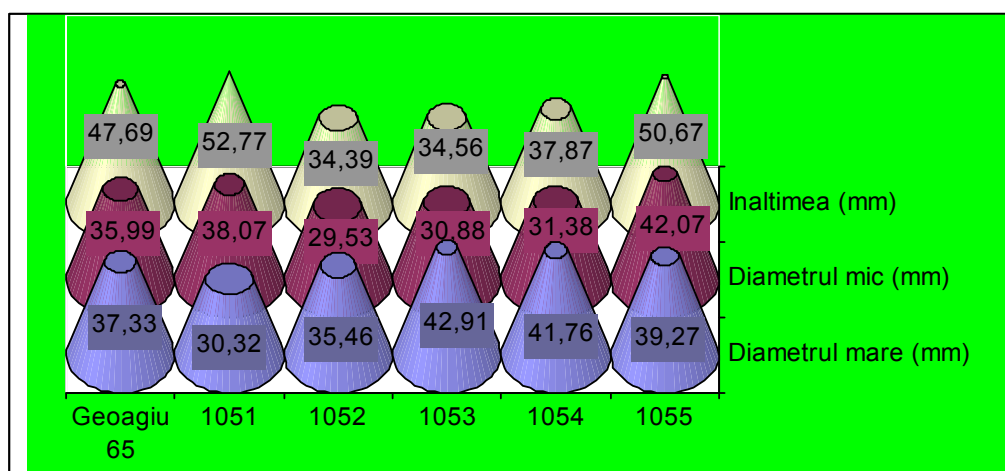


Fig. 1. Biometric measurements (Average of the years 2017-2018)

Table 4

Biometric elements in walnut biotypes (average value 2017-2018)

Genotype	Shape size (mm)			Im	If	Fruit shape
	D	d	H			
Geoagiu 65	37,29	35,93	47,73	40,31	132,24	ellipsoidal
1051	39,14	37,91	52,69	42,26	138,78	ellipsoidal
1052	31,09	29,43	34,33	31,61	114,92	ovoid
1053	33,98	30,65	35,48	32,70	114,77	ovoid
1054	32,83	31,02	37,52	33,79	119,12	ovoid
1055	44,16	41,97	50,59	45,57	118,91	ovoid

The fruit size index (Im) has values between 31.61 mm in the biotype 1052 and 45.57 mm in the biotype 1055, and Geoagiu variety 65 (control) has values of 40.31 mm.

The fruit shape index (If) is calculated to accurately determine the fruit shape. The shape index has values

between 138.78 in the biotype 1051, respectively 114.77 in the biotype 1053. A closer analysis of this index shows us that 1 variety has fruits of ellipsoidal form, plus the control variety, and 4 ovoid.

The main technological properties of fruits, in walnut biotypes, are presented in table 5.

Table 5

Technological properties of fruits, in walnut biotypes (average values 2017-2018)

Genotype	Average mass (gr)	% kernel	% shell
Geoagiu 65	21,07	45,90	54,10
1051	31,61	34,34	65,66
1052	9,21	38,81	61,19
1053	10,31	47,24	52,76
1054	13,41	39,71	60,29
1055	25,41	39,53	60,47

The average mass ranges from 9.21 in the biotype 1052 to 31.61 grams in the biotype 1051.

The core percentage ranges from 34.34% in the biotype 1051, to 47.24% in the biotype 1053. The percentage of kernels is very varied in the biotypes studied, thus: a single biotype, 1053, has a percentage of kernels over 42% and the control, and 4 of the studied biotypes have a satisfactory percentage of kernels, between 34.34 and 39.71 %.

The percentage content of the chemical components of the walnut kernel for the biotypes taken in the study are presented in the table 6.

It can be seen that the index of fatty substances is between 22.37 in the biotype 1055 and 35.41 in the biotype 1052, this biotype being good for extracting nut oil (fig. 2).

The protein index is between 6.73 in the biotype 1055 and 11.11 in the biotype 1054.

Table 6.

Percentage content of the chemical components of the walnut kernel

Biotype	Percentage of kernel content (mg. %)							Fat substance index	Protein substance index
	Fresh mass				Dry mass				
	Water	Mineral subst.	Fatty subst.	Protein subst.	Mineral subst.	Fatty subst.	Protein subst.		
1051	3,51	2,03	64,66	16,88	2,31	66,99	17,51	30,61	7,98
1052	4,63	1,63	64,97	15,00	1,79	68,11	15,71	35,41	8,18
1053	3,18	1,41	63,62	18,04	1,54	65,70	18,64	34,90	9,90
1054	3,48	1,81	63,15	22,03	1,87	65,42	22,83	31,83	11,11
1055	3,18	2,01	63,67	19,14	2,07	65,76	19,78	22,37	6,73
Geoagiu 65	1,51	1,51	66,35	18,82	1,55	68,39	19,47	36,30	10,31

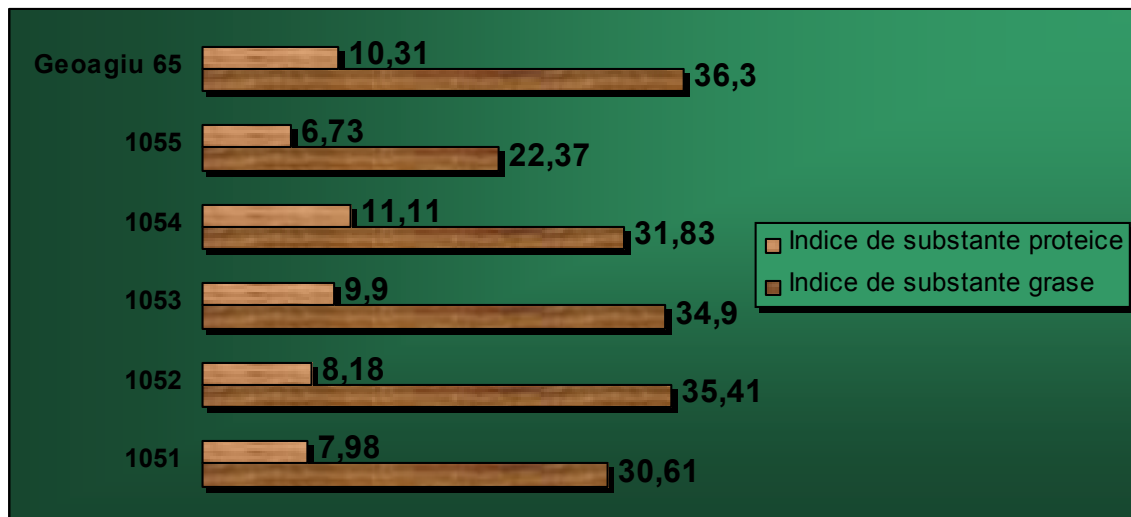


Fig. 2. The percentage content of the chemical components in the studied biotypes

Conclusions

The fruits of walnuts (biotypes) in Cenad have variable dimensions, so the large diameter ranges from 30.32 mm to the biotype 1051 and 42.91 mm in the biotype 1053, the small diameter of the fruits (d) has values between 29.53 mm in the biotype 1052 and 42.07 mm in the biotype 1055 and in terms of fruit height (h), the values ranged from 34.39 mm in the biotype 1052 to 52.77 mm in the biotype 1051.

It can be observed that the size of the fruits remained practically constant from one year to another during the two years (2017-2018), although the climatic conditions were different.

The fruit size index (Im) has values between 31.61 mm in the biotype 1052 and 45.57 mm in the biotype 1055, and the Geoagiu 65 variety (control) has values of 40.31 mm.

The shape index has values between 138.78 in the biotype 1051, respectively 114.77 in the biotype 1053. A closer analysis of this index shows us that 1 variety has fruits of ellipsoidal form, plus the control variety, and 4 are ovoid.

The percentage of kernel is very varied in the biotypes taken in the study, thus: a single biotype, 1053 (47.24%) has the percentage of kernel over 42%, and also the control; 4 of the studied biotypes have a satisfactory percentage of kernel, between 34.34% and 39.71%.

It is observed that the index of fatty substances is between 22.37 in the biotype 1055 and 35.41 in the biotype 1052, this biotype being good for extracting nut oil.

References

1. Akca Y. și colab. – 1999, A study on the selection of superior walnut types with lateral bud fruitfulness and

maximum of nut per cluster, Fourth International Walnut Symposium, Bordeaux, France.

2. Akca I., Sen S. M. – 1999, A study on the variability and selection a superior walnut trees within seedling population of around of Like, Van (Turkey), Fourth International Walnut Symposium, Bordeaux, France.

3. Akca I., Sen S. M. – 1999, Study of the selection of superior walnut trees in Hizan (Bitlis) population, Fourth International Walnut Symposium, Bordeaux, France.

4. Ayanoglu H., Bayazit S. – 1999, Selection of walnut genotypes in Hatay province of Turkey, Fourth International Walnut Symposium, Bordeaux, France.

5. Blidariu Aurelia, Drăgănescu E., Mihaș E. – 2003, Comportarea unor soiuri de nuc din partea de vest a țării, Simpozionul Științific Internațional “70 de ani ai Universității Agrare de Stat din Moldova”, Chișinău.

6. Blidariu Aurelia – 2004, Cercetări privind identificarea unor biotipuri de nuc din localitățile Pădureni și Sânicolaul Mare, Cercetări științifice seria a VIII-a a Facultății de Horticultură Timișoara, pag. 25-30.

7. Blidariu Aurelia și col. – 2005, Comportarea unor biotipuri locale de nuc din localitatea Timișoara, Simpozion Științific Horticultură, viticultură, silvicultură și protecția plantelor, Vol. 13, Chișinău.

8. Botu M., Achim Ghe., Botu I. – 1995, Selecții de nuc din județul Vâlcea cu perspective de omologare, Lucrări științifice Simpozionul “Probleme actuale ale modernizării culturii nucului”, Craiova, pag. 33-43.

9. Botu M. și col. – 1999, The behaviour of some walnut cultivars and selections in the first years after planting, Fourth International Walnut Symposium, Bordeaux, France.

10. Bucarciuc V. – 1997, Rezultate și perspective privind studiul, crearea de noi soiuri pomicele bacifere și omologarea lor în Moldova, Simpozionul Științific Internațional dedicat membrului corespondent al academiei de Științe a Republicii Moldova Gherasim Rudi, Universitatea Agrară de Stat Moldova, Chișinău.

11. Charlot G., Germain E., Prunet J.P. – 1998, *Le Noyer*, C.T.I.E.L., I.N.R.A., Paris.
12. Cociu V. - 1983, *Cultura nukului*, Edit. Ceres, București;
13. Cociu V. și col. – 1999, *Progrese în ameliorarea plantelor horticole din România*, vol. I (Pomicultura), Edit. Ceres, București.
14. Cociu V. - 2003, *Culturile nucifere*, Edit. Ceres, București;
15. Comanici I. G. – 1998, *Studii asupra formelor precoce de nuc*, Biodiversitatea vegetală a Republicii Moldova, Congr. II al Soc. Bot. din R.M., Chișinău.
16. Constantinescu N. și col. – 1967, *Pomicultură*, Edit. Agrosilvică, București.
17. Deaconu J. și col. – 1986, *Noi biotipuri de nuc selectați în principalele centre de cultură*, vol. XII, *Lucrări științifice I.C.P.P.*, Pitești.
18. Drăgănescu E. – 1993, *Comportarea unor soiuri de nuc în condițiile ecologice din partea de Vest a țării*, *Buletin U.S.A. Cluj Napoca*;
19. Drăgănescu E. – 1996, *Pomologie*, Edit. Mirton, Timișoara;
20. Drăgănescu E. și col. – 1999, *Researches concerning the genetic variability of walnut (Juglans regia L.) existent in Banat Romania*, Fourth International Walnut Symposium, Bordeaux, France.
21. Drăgănescu E. și col. – 2002, *Cercetări privind calitatea fructelor la unele biotipuri de nuc*, *Cercetări Științifice seria a V-a a Facultății de Horticultură Timișoara*.
22. Drăgănescu E., Mihut E. – 2005, *Cultura speciilor pomicele*. Ed. Waldpress, Timisoara.
23. Forde M. I. – 1975, *Walnut in "Advances in fruit breeding"*, Edit. by Jules Janet and Jones, Movre University Press, Vest Lafayette, Indiana.
24. Godeanu I., Popescu M. – 1979, *Influența factorilor climaticii asupra rodirii nukului*, *analele Universității din Craiova, Seria Biol. Agric.*, vol. IX;
25. Godeanu I., Cosmulescu Sina, Baci A. – 1997, *Selecții noi pentru cultura intensivă a nukului*, *Analele Universității din Craiova*, vol. II (XXXVIII);
26. Iordanescu Olimpia Alina, Olaru Daniela Nicoleta – 2014, *Pomologie (IFR)*, Ed. Agroprint, Timisoara;
27. Iordanescu Olimpia, Bala Maria, Sala Florin, Scedei Daniela, Toth Melinda. – 2018, *Characterization Of Some Walnut (Juglans Regia L.) Biotypes Based On The Biometrical And Biochemical Parameters Of Nuts*, *Agrolife Scientific Journal*, vol. 7, Issue 2, Bucuresti,
28. Mc. Neil D., Savage G.P. – 1999, *New Zealand walnut variety trials 1985-1989*, Fourth International Walnut Symposium, Bordeaux, France.
29. Mișuț E., Blidariu A., Iordănescu A. – 1999, *Cercetări privind arhitectura sistemului radicular la nuc*, *Cercetări Științifice seria a III-a a Facultății de Horticultură Timișoara*;
30. Mitre V. -2008, *Pomologie*, Edit. Todesco Cluj-Napoca;
31. Olaru Daniela Nicoleta, Iordănescu Olimpia Alina, Mălăescu Mihaela, Drăgunescu Aneta Anca, Blidariu Daciana, Răveanu Silvia Daniela, Chis S.jr – 2015, *The Behaviour Of Some Local Walnut Biotypes In Banat – Romania*. *Journal of Horticulture, Forestry and Biotechnology*, Volume 19 (4), pag. 47, Timisoara
32. Pandele Iuliana – 1966, *Caracterizarea biochimică a principalelor soiuri și tipuri de nuci, migdale și alune din R.S. România și stabilirea corelațiilor metabolice generale, specifice nuciferelor*, *Lucrări Științifice ale I.C. Horti-Viticole*, vol. IX, pag. 621-657.
33. Stefan N., Glaman Gh., Braniste N. – 2018, *Pomologia Romaniei*, vol. X, Ed. Ceres, Bucuresti;
34. Tîrșană O. – 2017, *Soiuri de nuc pentru înființarea livezilor profesionale*. *Pepiniera Voinești*, Ed. A 2-a – Chișinău: S.n.;
35. Voiculescu N. și col. – 1990, *Nucul*, revista producției vegetale, *Horticultura*;
36. WANG S., ZHAO B. – 1999, *A brief introduction to wallnut cultivar – present no. 1* – Fourth International Walnut Symposium, Bordeaux, France;
37. YARILGAC T., BALTA M.F.,BORASAN L., AND BULBUL C. - 2013, *Fruit Characteristic of Natural Walnut (Juglas regia L.) Genotypes of Catak and Taspinar Villages (Corum)*, *Proceedings of the IInd BALKAN Symposium on Fruit Goving*, vol. 1, Pitesti, Romania .
38. ^{xxx} - [FAO Statistical Database, faostat.fao.org](http://faostat.fao.org);
39. ^{xxx} – [Stat databse Gateway](http://statdatbase.com);
40. ^{xxx} – *Walnut Production manual University of California*.