

**EVALUATION OF THE TREE VIGOUR AND ANNUAL GROWTH  
OF SOME ROMANIAN WALNUT GENOTYPES FROM RIFG PITESTI  
COLLECTION**

Untaru Aurelian Valentin<sup>1\*</sup>, Botu Mihai<sup>1,2</sup>, Stan Adelina<sup>3</sup>

<sup>1</sup>University of Craiova, Doctoral School of Engineering of Animal and Plant Resources Romania

<sup>2</sup>University of Craiova, Faculty of Horticulture, Department of Horticulture and Food Science, Romania

<sup>3</sup>Research Institute for Fruit Growing Pitești, Romania

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

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**ABSTRACT**

*The walnut crop has a long tradition on the territory of Romania. One of the problems of walnut crop is tree size (about 25-30 m high), which makes difficult some technological practices (pruning, spraying and harvesting). The low vigour of the trees is not the most important objective in walnut breeding program, but it is necessary to find the genitors with this trait. The goal of this paper, is to evaluate the trees vigour of 32 Romanian walnut genotypes, from germplasm fund of RIFG Pitesti, Romania in order to identify the most valuable genotypes that will be recommended for spread in commercial orchards or use as genitors in breeding works. The results obtained have highlighted the fact that in walnut collection from RIFG Pitesti there is a large phenotypic diversity. The genotypes 'Sibișel 252', 'Claudia Ioana', 'Ciprian Ion', 'Geoagiu 265', 'Germisara', 'Jupânești', 'M 44-39', 'Orăștie', 'Roxana', 'Sarmis', 'Sibișel 44' were noted with low vigour. Also, 'Dacus' - generative rootstock has had a low vigour and can be recommended for grafting of walnut cultivars intended for intensive orchards.*

**INTRODUCTION**

The walnut crop has a long tradition on the territory of Romania due to the favorable climatic conditions, fruit's nutritive value, wood's quality, utility of other organs of the tree (leaves, bark, endocarp, etc.) in pharmaceutical industry (Cociu et al., 2003; Cociu, 2007; Iurea et al., 2018; Botu et al., 2019).

Increasing yields, decreasing the vigour of the tree, precocity and reducing the costs per hectare are the most important objectives of breeders and farmers (Devin and Bujdoso, 2022). It is known that dwarf walnut trees can reduce labor costs and increase the fruits production, by increasing the density of trees per hectare and also can facilitate performing cultural practices (Wang et al., 2014; Vahdati et al., 2019; Mohseniazar et al., 2021; Devin and Bujdoso, 2022). One of the problems of walnut crop is tree size (about 25-30 m high), which makes difficult some technological practices (pruning, spraying and harvesting) (Rezaee et al., 2008; Devin and Bujdoso, 2022).

The low vigour of the trees is not the most important objective in walnut breeding program, but it is necessary to find the genitors with this traits.

In goal of this paper, is to evaluate the trees vigour of 32 Romanian walnut genotypes, from germplasm fund of RIFG Pitesti, Romania 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 a distance of 8 x 6 m, 3 trees per genotypes. The trees were trained as flat open center, with drip irrigation systems. The average multi-annual temperature was 10.1°C, the maximum temperature 38.8°C, whereas the minimum temperature – 24.4°C; total annual rainfalls recorded was 673.2 mm. Compared to the baseline for 55 years period, the agricultural year, 2023-2024, was the hottest in the last 55 years, with 3.1°C over normal (13.2°C compared to 10.1°C as normal), following the multiannual climatic tendencies, but also much poorer in precipitation, with 193.2 mm (480.0 mm compared to 673.2 mm as it represents the normal interval October - September).

Thirty-two Romanian walnut genotypes, grafted on *Juglans regia* seedling rootstock, were evaluated.

In 2023-2024, the following parameters were appreciated:

- trunk diameter (mm) measured with the digital callipers at 30 cm above the ground and then calculate the surface of trunk section and annual growth;
- crown dimensions (height and diameter) in cm, and then calculate de crown volume (m<sup>3</sup>).

The data were included in an Excel database and interpreted using the following statistical index: average, standard deviation and coefficient of variability.

## RESULTS AND DISCUSSIONS

The trees vigour was appreciated in 2023 and 2024 by measuring the trunk diameter, after which the surface of the trunk section and the annual growth was calculated.

In the year 2023, the average value of the trunk diameter was 58.83 mm, ranging from 68.24 mm at 'Mihaela' cv. and 37.21 mm at 'Sibişel 252' cv. (Table 1).

The surface of the trunk section had an average value of 23.16 cm<sup>2</sup>, ranging from 36.56 cm<sup>2</sup> at 'Mihaela' cv. and 10.87 cm<sup>2</sup> at the 'Sibişel 252' cv. (Table 1).

In 2024, the average value of the trunk diameter was 62.88 mm, ranging from 80.80 mm at 'Mihaela' cv. and 45.13 mm at the 'Sibişel 252' cv. (Table 1).

The surface of the trunk section had an average value of 31.70 cm<sup>2</sup>, ranging from 51.25 cm<sup>2</sup> at 'Mihaela' cv. and 15.99 cm<sup>2</sup> at the 'Sibişel 252' cv. (Table 1).

The value of the variability coefficient was medium to high for both characteristics, indicating a very high variability and the possibility to choosing the genitors with low vigour for breeding program.

The increase in the trunk diameter had an average value of 9.05 mm. The largest annual growth was recorded 'Novaci' cv. (18.15 mm), and the smallest 'Valrex' cv. (3.05 mm) (Table 1).

The genotypes 'Sibişel 252', 'Claudia Ioana', 'Ciprian Ion', 'Dacus', 'Geoagiu 265', 'Germisara', 'Jupâneşti', 'M 44-39', 'Orăştie', 'Roxana', 'Sarmis', 'Sibişel 44' were noted with low vigour.

Within this group, two rootstocks, respectively 'Dacus' and 'Secular', were evaluated, 'Dacus' rootstock having a smaller vigour than 'Secular' rootstock.

Table 1

The growth vigour of Romanian walnut genotypes (Pitești-Mărăcineni, 2023-2024)

No.	Genotype	Trunk diameter (mm) 2023	Surface of trunk section (cm <sup>2</sup> ) 2023	Trunk diameter (mm) 2024	Surface of trunk section (cm <sup>2</sup> ) 2024	Growth increase (mm)
1	Argeșan	54.90	23.66	65.61	33.79	10.71
2	Ciumești 77	55.97	24.59	71.18	39.77	15.21
3	Jupânești	53.94	22.84	68.02	36.32	14.08
4	Mihaela	68.24	36.56	80.80	51.25	12.56
5	Roxana	48.78	18.68	56.64	25.18	7.86
6	Vlădești	62.38	30.55	68.41	36.74	6.03
7	Ciprian Ion	49.28	19.06	54.07	22.95	4.79
8	Claudia Ioana	49.76	19.44	58.01	26.42	8.25
9	Geoagiu 210	50.40	19.94	60.29	28.53	9.89
10	Geoagiu 265	45.96	16.58	54.38	23.21	8.42
11	Geoagiu 453	62.49	30.65	74.37	43.42	11.88
12	Germisara	44.73	15.71	52.96	22.02	8.23
13	Orăștie	47.52	17.73	52.67	21.78	5.15
14	Sarmis	45.19	16.03	53.84	22.76	8.65
15	Sibișel	61.36	29.56	65.47	33.65	4.11
16	Sibișel 252	37.21	10.87	45.13	15.99	7.92
17	Sibișel 44	49.98	19.61	59.92	28.18	9.94
18	Sibișel 50	40.13	12.64	55.80	27.90	15.67
19	Sibișel precoce	58.30	26.68	68.00	36.30	9.70
20	Miroslava	65.72	33.91	75.95	45.28	10.23
21	Velnița	62.82	30.98	74.96	44.11	12.14
22	Timval	57.70	26.13	64.89	33.05	7.19
23	Valcor	51.83	21.09	56.76	25.29	4.93
24	Valrex	56.80	25.33	59.85	28.12	3.05
25	Verisval	55.83	24.47	62.15	30.32	6.32
26	M44-39	49.26	19.05	54.84	23.61	5.58
27	Novaci	55.66	24.32	73.81	42.77	18.15
28	Pestisani	58.18	26.57	66.15	34.35	7.97
29	Șușița	57.30	25.77	68.12	36.43	10.82
30	Victoria	54.95	23.70	59.87	28.14	4.92
31	Dacus	47.22	17.50	55.11	23.84	7.89
32	Secular	62.69	30.85	74.07	43.07	11.38
<b>Average</b>		<b>53.83</b>	<b>23.16</b>	<b>62.88</b>	<b>31.70</b>	<b>9.05</b>
<b>Standard deviation</b>		<b>7.37</b>	<b>6.18</b>	<b>8.58</b>	<b>8.52</b>	<b>3.60</b>
<b>Coefficient of variability (%)</b>		<b>13.69</b>	<b>26.70</b>	<b>13.64</b>	<b>26.89</b>	<b>39.75</b>

The tree vigour was also evaluated by measuring the dimensions of the crown, respectively the trees height (m), the crown diameter (m) and the crown volume (m<sup>3</sup>) (Table 2).

The average trees height was 3.11 m with variations from 2 m at 'Novaci' cv. to 3.60 m at 'Ciumești 77' selection. The rootstocks taken in the study had a trees height, of 3.05 m at 'Dacus' and 3.25 m at 'Secular' rootstocks.

The average crown diameter was 1.93 m, ranging from 2.06 m (large diameter) and 1.81 m (small diameter).

After measuring these parameters, the crown volume was calculated, that had the average value of 9.68 m<sup>3</sup>, with a variation between 2.94 m<sup>3</sup> at 'Sibișel 50' cv. and 20.92 m<sup>3</sup> at 'Victoria' cv. Of the rootstocks, 'Dacus' had a small to medium volume (6.52 m<sup>3</sup>), and 'Secular' had a medium to large volume (11.25 m<sup>3</sup>) (Table 2).

At all the genotypes studied the trees height was greater than the crown diameter (Table 2).

Regarding the crown dimensions, were noted with low vigour the following cultivars: 'Ciprian Ion', 'Claudia Ioana', 'Germisara', 'Sarmis', 'Sibişel 252', 'Valrex' (Table 2).

Table 2

Crown dimensions of Romanian walnut (Piteşti-Mărăcineni, 2024)

No.	Genotype	Tree height (m)	Crown diameter - D (m)	Crown diameter - d (m)	Volume crown (mc)
1	Argeşan	3.15	1.80	1.55	6.94
2	Ciumeşti 77	3.60	1.60	1.45	6.57
3	Jupâneşti	3.55	2.20	1.80	11.15
4	Mihaela	3.70	2.30	1.80	12.21
5	Roxana	3.35	1.85	1.70	8.29
6	Vlădeşti	3.50	2.35	2.25	14.53
7	Ciprian Ion	2.75	1.70	1.40	5.19
8	Claudia Ioana	2.75	1.80	1.65	6.42
9	Geoagiu 210	3.10	2.65	1.90	12.59
10	Geoagiu 265	2.95	2.00	1.75	8.14
11	Geoagiu 453	3.40	2.20	2.00	11.77
12	Germisara	2.80	1.75	1.30	5.11
13	Orăştie	2.80	1.70	1.65	6.17
14	Sarmis	2.65	1.65	1.50	5.16
15	Sibişel	3.25	2.65	2.55	17.25
16	Sibişel 252	2.85	1.50	1.35	4.54
17	Sibişel 44	3.00	2.05	1.80	8.73
18	Sibişel 50	3.10	1.20	1.00	2.94
19	Sibişel precoce	3.20	2.05	1.90	9.80
20	Miroslava	3.25	2.50	2.25	14.39
21	Velniţa	3.10	2.50	2.10	12.87
22	Timval	3.02	2.85	2.45	16.65
23	Valcor	3.35	2.65	2.30	16.11
24	Valrex	2.95	1.85	1.45	6.30
25	Verisval	3.30	2.35	2.15	13.11
26	M44-39	2.60	1.85	1.80	6.80
27	Novaci	2.00	1.40	1.40	3.08
28	Peştişani	3.35	2.00	1.90	10.00
29	Şuşiţa	3.35	1.85	1.70	8.29
30	Victoria	3.40	2.90	2.70	20.92
31	Dacus	3.05	1.80	1.50	6.52
32	Secular	3.25	2.30	1.90	11.25
<b>Average</b>		<b>3.,11</b>	<b>2.06</b>	<b>1.81</b>	<b>9.68</b>
<b>Standard deviation</b>		<b>0.35</b>	<b>0.43</b>	<b>0.39</b>	<b>4.47</b>
<b>Coefficient of variability (%)</b>		<b>11.17</b>	<b>20.84</b>	<b>21.54</b>	<b>46.16</b>

The average number of annual shoots was 17.11 shoots/tree, most vegetative increases being at 'Argeşan' (46.50 shoots/tree), 'Mihaela' (40.60 shoots on the tree) and 'Sibişel' (36 shoots/tree) cvs. The fewest vegetative growths on the tree were recorded in the 'Novaci' cv. (2.50 shoots/tree), 'Peştişani' cv. (4.50 shoots/tree) and at the 'Dacus' rootstock (5 shoots/tree) (Table 3).

The average length of the shoot was 43.39 cm, ranging from 77.25 cm to 'Ciumeşti 77' selection and 23.86 cm at 'Şuşiţa' cv (Table 3).

Table 3

Number and length of annual shoots of Romanian walnut genotypes  
(Pitești-Mărăcineni, 2024)

No.	Genotype	No. of shoots/tree	Length of shoots/tree (cm)	
			Average length (cm)	Variation limits (cm)
1	Argeșan	46.50	35.87	10-100
2	Ciumești 77	8.50	77.25	35-125
3	Jupânești	21.50	46.10	20-85
4	Mihaela	40.60	51.36	15-105
5	Roxana	17.50	47.38	10-95
6	Vlădești	30.00	39.20	15-90
7	Ciprian Ion	15.00	50.89	15-90
8	Claudia Ioana	20.50	60.11	20-100
9	Geoagiu 210	16.50	31.91	10-70
10	Geoagiu 265	14.50	44.85	10-105
11	Geoagiu 453	21.50	43.62	15-80
12	Germisara	12.50	60.31	25-100
13	Orăștie	12.00	37.49	20-80
14	Sarmis	9.00	40.20	20-80
15	Sibișel	36.00	55.86	25-80
16	Sibișel 252	6.00	57.97	20-80
17	Sibișel 44	14.50	38.89	15-75
18	Sibișel 50	22.00	63.41	25-95
19	Sibișel precoce	11.00	31.42	15-80
20	Miroslava	8.50	24.53	15-45
21	Velnița	12.50	50.34	15-90
22	Timval	13.50	43.79	20-85
23	Valcor	26.00	38.43	15-75
24	Valrex	19.00	48.98	15-80
25	Verisval	16.50	35.97	15-60
26	M44-39	10.00	38.12	15-60
27	Novaci	2.50	25.41	10-35
28	Peștișani	4.50	34.58	15-60
29	Șușița	9.00	23.86	15-65
30	Victoria	21.50	39.12	15-75
31	Dacus	5.00	37.91	20-55
32	Secular	23.50	33.23	10-105
<b>Average</b>		<b>17,11</b>	<b>43.39</b>	
<b>Standard deviation</b>		<b>10,26</b>	<b>12.07</b>	
<b>Coefficient of variability (%)</b>		<b>59,98</b>	<b>27.82</b>	

It is observed that there is no correlation between the average number of shoots/tree and their average length. For example, the selection 'Ciumești 77' has a small number of shoots on the tree (8.50 shoots/tree), but of very long length (77.25 cm). Also, at 'Argeșan' cv. the vegetative increases are numerous, but of medium length (35.87 cm) (Table 3).

Also, it can be seen that at the same genotype, on the same tree, the length of the shoots is very varied from 10 cm to 100 cm and even more (Table 3).

The coefficient of variability was very high for both traits, indicating a great variability of these characters to the Romanian genotypes studied (Table 3).

The results obtained regarding the trunk diameter, surface of trunk section and annual growth are in accordance with the results obtained by Iurea et al. (2018) for 'Miroslava', 'Germisara', 'Jupânești' and 'Sibișel' cvs., as well as with the results

obtained by Botu et al. (2017) for 'Argeșan', 'Germisara', 'Jupânești', 'Sarmis', 'Sibișel 44', 'Valcor', 'Valrex' and 'Velnița' cvs.

### CONCLUSIONS

The results obtained have highlighted the fact that in walnut collection from RIFG Pitesti there is a large phenotypic diversity and possibility to identify the most valuable genotypes that will be recommended for spread in commercial orchards or use as genitors in breeding works.

The genotypes 'Sibișel 252', 'Claudia Ioana', 'Ciprian Ion', 'Geoagiu 265', 'Germisara', 'Jupânești', 'M 44-39', 'Orăștie', 'Roxana', 'Sarmis', 'Sibișel 44' were noted with low vigour.

Also, 'Dacus', the generative or seedling rootstock has had a low vigour and can be recommended for grafting of walnut cultivars intended for intensive orchards.

### REFERENCES

Botu M., Alabedallat Yazan F.J., Bucura F., Geana E.I., Vladu M., 2019. The productive capacity and quality of several walnut cultivars (*Juglans regia* L.) grown in North Oltenia, Romania. *Notulae Botanicae Horti Agrobotanici* 47(3): 574-579.

Cociu V., Achim Gh., Botu I., Botu M., Cepoiu N., Cosmulescu S., Deaconu I., Godeanu I., Iancu M., 2003. *Culturile nucifere [Nuts Crop]*. București: Ed. Ceres.

Cociu V., 2007. *Nucul, alunul, migdalul [Walnut, hazelnut and almond tree]*. București: Ed. M.A.S.T.

Devin S.R., Bujdoso G., 2022. Walnut genotypes for high density orchards. *Horticulture*, no. 8, 490.

Iurea E., Sîrbu S., Corneanu M., Perju I., Boboc C.I., 2018. Determinations of the tree vigor and annual growth at some walnut genotypes from the Romanian North-Eastern area. *Current Trends in Natural Sciences*, vol. 7, Issue 13: 95-101.

Mohseniazar M., Vahdati K., Aliniaiefard S., Wang Y., 2021. Cloning and in silico characterization of GAI gene and its promoter region from dwarf/precocious and vigorous/non-precocious Persian walnut genotypes. *Acta Hortic.*, no. 1315: 313-318.

Rezaee R., Vahdati K., Grigoorian W., Valizadeh M., 2008. Walnut grafting succes and bleeding rate as affected by different grafting methods and seedling vigour. *J. Hortic. Sci. Biotechnol*, no. 8: 94-99.

Vahdati K., Arab M.M., Sarikhani K.S., Sadat Hoseini M., Leslie C.A., Brown P.J., 2019. Advances in walnut (*Juglans regia* L.) breeding strategies. Chapter 13. *Adv. Pbreed. Strateg*, no. 4: 401-472.

Wang G.A., Zhang Q., Huang M.M., Yakup A., 2014. The breeding of Six Xinjing dwarf walnut cultivar. *Acta Hortic.*, no. 1050: 151-160.