

## AVANTAJELE SI DEZAVANTAJELE OFERITE DE CULTURA SOIURILOR DE NUC CU FRUCTIFICARE LATERALA IN ZONA SUBCARPATICA A OLTENIEI ADVANTAGES AND DISADVANTAGES OFFERED BY GROWING LATERAL BEARING WALNUT CULTIVARS IN THE SUB-CARPATHIAN AREA OF OLTENIA

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### Abstract

Romania is a country where walnut culture has tradition. This fruit crop has good productive potential but it is necessary to grow adequate cultivars in concordance with the ecological conditions and market demands. Lateral bearing walnut cultivars are grown in many countries due to their productivity and precocity. For this reason, cultivar testing program carried out at SCDP Valcea from 1994 was focused also on introduction and evaluation of lateral bearing walnut cultivars from abroad in order to establish the most appropriate Romanian and introduced cultivars to be grown in the sub-Carpathian area of Oltenia. Laterar bearing walnut cultivars proved to be precocious regarding their coming into production, also the yields obtained were up to 40% higher in the case of 'Ferjean', 'Vina', 'Hartley' and 'Lara' comparatively with 'Franquette', which was used as control. These cultivars showed higher susceptibility to bacterial blight then 'Franquette' and Romanian cultivars in the sub-Carpathian area of Oltenia ecological conditions.

**Keywords:** walnut, *Juglans regia*, cultivars, evaluation

**Cuvinte cheie:** nuc, *Juglans regia*, soiuri, evaluare

### 1. Introduction

There are many cultivars of walnut (*Juglans regia* L.) worldwide with very different characteristics agrobiological characteristics, these cultivars offer a choice for the most valuable in terms of production, fruit quality, adaptation to different environmental conditions, etc.

The research work conducted in different ecological zones of the world have shown how the specific behavior of each kind of walnut cultivar in accordance with its genotype under the given environmental conditions (Ramos, 1985; Aleta and Ninot, 1997; Botu, 1998; Germain et al, 1999; Botu et al., 2000; Cociu et al., 2003; Tudor, 2010).

In Romania, a country with tradition and production potential in walnut culture, the research activity has been directed towards the assessment of domestic and foreign cultivars with terminal bearing. These cultivars are less productive, but adapted to the ecological conditions in the areas with vocation for this fruit crop culture and vocation and less susceptible to diseases; they cultivars have encountered plenty of difficulties for several reasons in order to be promoted into culture in fruit farms (mainly due to difficulty of grafting propagation) .

The lateral bearing cultivars were extended in many countries, but their requirements for certain environmental conditions and technological level needed for their growing diminish the advantages brought by them through high productivity.

The research conducted at SCDP Vâlcea on some lateral bearing walnut cultivars of different geographical origin aimed to evaluate them and to highlight the advantages and disadvantages of their growing into the sub-Carpathian region of Oltenia.

### 2. Materials and methods

The research activity on this topic at SCDP Valcea was conducted from 1994 to 2009 and was based on the study of 10 lateral bearing walnut cultivars which were compared with 'Franquette', an old French variety with terminal bearing, which was used as control.

The cultivars which were studied have different geographical origin and are most popular worldwide: 'Ferjean', 'Fernette', 'Fernor', 'Lara' (from France) and 'Hartley', 'Payne', 'Pedro', 'Tehama', 'Serr' and 'Vina' (from USA).

'Franquette' (originated in France) is the most popular walnut variety grown in many countries, this cultivar has terminal or standard bearing.

All the cultivars from this study have been grafted on *Juglans regia* seedlings. Planting was done at 9 m by 8 m (139 trees per hectare). Each cultivar was represented by five trees. The trees were trained as a mixed pyramid and were annually fertilized with 100 kg of N, 20 kg of P and 40 kg K, phytosanitary

spraying were done in accordance with Vâlcea Plant Protection Inspectorate warnings. Observations and measurements were carried out on trees' growth and yielding.

### 3. Results and discussions

The behaviour of lateral bearing walnut cultivars and the results obtained were dependent on technological and climatic conditions of the sub-Carpathian region of Oltenia.

The climate of this area is mild continental with Mediterranean influences. In 112 years time the annual average temperature was 10.2°C, the absolute minimum one of -27°C (in 1967) and the annual amount of rainfall of 712 mm.

During the study of fructification time of the walnut cultivars (1996-2009 period) the annual average temperatures have fluctuated between 9.8°C (in 1997) and 12.0°C (in 2007 and 2009).

The lowest absolute minimum temperature was -22.7°C (in 2006), in the other years during study period temperatures did not go below -16°C.

In the first days of April minimal temperatures of -5°C, -6°C were recorded, but did not affect the flowers and shoots' development.

The rainfall ranged from 493 mm (2008) to 1085 mm (2005) per year, registering a substantial deviation from the normal rainfall quantity of the area.

Taking into account this determinant context of climatic conditions, the lateral bearing walnut cultivars had a trunk cross sectional area (TCSA) ranging from 518 cm<sup>2</sup> (,Pedro') to 665 cm<sup>2</sup> (,Tehama'), much lower than the terminal bearing cultivar ,Franquette' (742 cm<sup>2</sup>) used as control (Table 1). All the cultivars which have terminal bearing differ very significant negative or distinct significantly negative compared with ,Franquette'.

The crown volumes ranges from 118.8 m<sup>3</sup> (,Ferjean') to 165.8 m<sup>3</sup> (,Tehama'). Crown volume of these varieties differ significant distinct negative from ,Franquette' (180.5 m<sup>3</sup>), with the exception of ,Tehama' (165.8 m<sup>3</sup>) which is significantly different.

After 16 years from planting (16th leaf) the lateral bearing cultivars have less than the control cultivar which has terminal bearing, ,Franquette'. These varieties begin their annual growth cycle (bud break) during April (April 7th to 19th), almost same time like terminal bearing walnut cultivars and usually after the appearance of spring frosts (Table 2).

Blooming time is distinguished as period between flowering of female flowers (15.04 - ,Serr' and 7.05 - ,Fernor') and male or catkins flowering time (from 14.04 - ,Lara' and ,Payne' to 29.04 - ,Fernor'), which occurs between 14.04. and 17.05. The limit of female flowering time extends from 15th of April till 16th of May and the limits of male flowering time occurs from 14th of April till 17th of May. The control cultivar ,Franquette' is the latest flowering walnut variety (from 28.04 to 09.05 the male flowers blooming occurs from 28.04 to 09.05 and in the case of female ones from 03.05 to 21.05).

Compared with ,Franquette', the lateral bearing varieties bloom earlier (same time with the Romanian walnut cultivars), or simultaneously with it. All these varieties have proved to be protandrous under the climatic conditions of sub-Carpathian area of Oltenia. In some years the temperature conditions may change the walnut cultivar flowering dichogamy.

Entry into fructification of these cultivars can occur from third or fourth year after planting (Table 2). Fruit production in the 3rd leaf is low (28-83 kg / ha) and in the case of ,Franquette' is none. Starting with the 4th leaf the fruit yield reaches 153 kg / ha (case of ,Tehama') and goes up to 500 kg / ha (,Vina'). In the 5th year the yield limits varied from 278 kg / ha (,Payne') and 848 kg / ha (,Vina'). ,Franquette' walnut cultivar achieved much lower yields in those years (respectively 83 and 278 kg / ha).

The yielding was increasing slowly for all the cultivars, same time with the growth of crown and fruiting elements.

The cumulative yield in the first nine years was relatively low (7.29 t / ha for ,Tehama' due to 8.45 t / ha for ,Ferjean'), but much higher than the control cultivar ,Franquette' (6.56 t / ha) (Table 3). The average annual yield for 5 years was of 0.81 to 0.94 t / ha / year in the case of cultivars with lateral bearing habits and only 0.73 t / ha for ,Franquette'.

During the 10th to 14th fruit bearing years (12-16 years after planting), the average yield reached 1.74 t / ha / year (case of ,Tehama') due to 2.40 t / ha / year (for ,Ferjean'). The cultivar ,Franquette' achieved an average annual output of 1.70 t / ha, much lower than most varieties with lateral bearing. Exceptions to this rule are the varieties ,Serr' and ,Tehama' which do not differ significantly compared with ,Franquette' from point of view production. The most productive varieties were found to be: ,Ferjean' (2.40 t / ha), ,Vina' (2.26 t / ha), ,Hartley' (2.24 t / ha), ,Fernor' (1.94 t / ha) and ,Lara' (1.88 t / ha), all with very significantly different yields compare with the control.

Starting with the 12th leaf of fructification, since the tree crowns have the tendency to cover almost all the orchard soil with their projection, all varieties are increasing their yield by 145-212% compared to the yields recorded in the 10th leaf. Terminal bearing cultivars have 40% less productive potential than the lateral bearing ones.

The lateral bearing walnut cultivars' fruits can be grouped into the category of large size fruits (Size index = 34.9 to 39.9 mm) and average weight of 10.9 g (,Fernor') to 13.9 g (,Pedro') (Table 4).

The degree of uniformity of the walnuts is medium (uet o the values of the coefficients of variation (S %) which range from 16.5 to 21.3%) and the kernel efficiency situated between 46.8% (,Tehama') and 53.0% (,Serr'). The cultivars ,Ferjean' (50.8%), ,Lara' (50.3%) and ,Serr' (53.0%) have highest kernel ratios.

The fruit shell is thin (0.9 to 1.4 mm) for all cultivars from this study and this facilitates the breaking and easy deployment of the kernel.

Kernel tegument color is yellow of various shades, and the taste is pleasant. There are no very significant quality differences between the fruits of lateral bearing cultivars and the terminal bearing ones.

Lateral bearing walnut cultivars proved more susceptible to bacterial blight (*Xanthomonas campestris* pv. *Juglandis*) and anthracnose (*Gnomonia leptostyla*) in the ecological conditions of sub-Carpathian region of Oltenia. In the rainy years the bacterial attack goes on fruits from 8.5% (,Ferjean') to 14.1% (,Vina') compared with 4.8% (case of ,Franquette'). Anthracnose attack on leaves riches 4.7% (,Fernette') to 5.9% (,Tehama'), versus 4.2% in the case of ,Franquette'. Levels of attack of these diseases were recorded when five phytosanitary treatments were performed per year with copper based products.

#### 4. Conclusions

Growing of lateral bearing walnut cultivars in the sub-Carpathian area of Oltenia and other similar regions is limited by low temperatures during winter and late spring frosts which can occur after budbreak and flowering.

During the study period (1994-2009) the lateral bearing cultivars had normal growth and bearing being not affected by temperatures up to - 22.7°C (2006) recorded in the area.

All the 10 lateral bearing walnut cultivars studied emphasized a lower growth vigor then control (,Franquette').

Coming into fructification occurred 3 to 4 years after planting in the case of lateral bearing cultivars, these means 1-2 years earlier than 'Franquette'.

Productive potential of the lateral bearing cultivars is 40% higher then the terminal bearing walnut cultivars. High yields were recorded in the 14th leaf for 'Ferjean', 'Vina', 'Hartley' and 'Lara'.

The lateral bearing cultivars tested in the sub-Carpathian area of Oltenia conditions proved to be more susceptible to bacterial blight and anthracnose then the terminal type cultivars, for this reason their pathogen control program is more demanding.

#### 5. References

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**Table 1 The behavior of lateral bearing walnut cultivars in the process of growth under the conditions of the sub-Carpathian area of Oltenia (16th leaf)**

No.	Cultivar	Trunk cross sectional area (cm <sup>2</sup> )			Crown volume (m <sup>3</sup> )		
		SST cm <sup>2</sup>	Difference (±)	Significance	Quantity (m <sup>3</sup> )	Difference (±)	Significance
1	'Ferjean'	530	-212	ooo	118.8	-61.7	ooo
2	'Fernette'	552	-190	ooo	142.5	-38.0	oo
3	'Fernor'	660	-82	oo	155.1	-25.4	oo
4	'Lara'	615	-127	ooo	145.6	-34.9	oo
5	'Hartley'	615	-127	ooo	139.9	-40.6	oo
6	'Payne'	530	-212	ooo	132.0	-48.5	ooo
7	'Serr'	572	-170	ooo	141.7	-38.8	oo
8	'Tehama'	665	-77	oo	165.8	-14.7	ns
9	'Pedro'	518	-224	ooo	120.4	-60.1	ooo
10	'Vina'	561	-181	ooo	142.5	-38.0	oo
11	'Franquette'	742	-	-	180.5	-	-

LSD 5% = 61.2 LSD 1% = 76.6 LSD 0.1% = 101.7 LSD 5% = 15.5 LSD 1% = 28.7 LSD 0.1% = 41.7

**Table 2 Blooming and coming into bearing of lateral bearing walnut cultivars tested into the sub-Carpathian area of Oltenia**

No.	Cultivar	Bud break time	Blooming time*		Type of flowering (Dichogamy)	Coming into bearing		
			Female flowers	Catkins		3rd leaf (kg/ha)	4th leaf (kg/ha)	5th leaf (kg/ha)
1	'Ferjean'	19-25/04	30/04-08/05	28/04-10/05	protandrous	83	403	570
2	'Fernette'	17-23/04	06/05-14/05	28/04-16/05	protandrous	28	292	528
3	'Fernor'	09-13/04	07/05-16/05	29/04-19/05	protandrous	28	264	542
4	'Lara'	10-15/04	16/04-25/04	14/04-03/05	protandrous	42	264	403
5	'Hartley'	17-25/04	28/04-07/05	18/04-09/05	protandrous	42	250	375
6	'Payne'	07-15/04	16/04-25/04	14/04-08/05	protandrous	28	222	278
7	'Serr'	16-22/04	15/04-27/04	13/04-30/04	protandrous	42	292	500
8	'Tehama'	16-22/04	20/04-29/04	20/04-17/05	protandrous	42	153	292
9	'Pedro'	14-18/04	21/04-30/04	18/04-14/05	protandrous	42	292	514
10	'Vina'	11-17/04	19/04-29/04	20/04-09/05	protandrous	69	500	848
11	'Franquette' (Control)	11-16/04	28/04-09/05	03/05-21/05	protandrous	-	83	278

\* In the case of Romanian walnut cultivars the flowering time of female flowers took place from 15/04 to 10/05 and in the case of male ones (catkins) from 16/04 to 09/05.

**Table 3 Fruit yield of lateral bearing walnut cultivars tested in the sub-Carpathian area of Oltenia**

No.	Cultivar	Cumulative yield (3rd to 11th leaf) (t/ha)	Fruit yield (t/ha)					Average yield (12th to 16th leaf) (t/ha)	Difference (±)	Significance
			12th leaf 2005	13th leaf 2006	14th leaf 2007	15th leaf 2008	16th leaf 2009			
1	'Ferjean'	8.45	1.4	1.8	2.3	3.4	3.1	2.40	+0.700	***
2	'Fernette'	7.65	1.2	1.7	1.8	2.0	2.5	1.84	+0.140	**
3	'Fernor'	7.87	1.3	1.6	1.8	2.3	2.7	1.94	+0.240	***
4	'Lara'	7.89	1.3	1.7	2.0	2.8	1.6	1.88	+0.180	***
5	'Hartley'	8.07	1.4	1.7	2.1	2.7	3.3	2.24	+0.540	***
6	'Payne'	7.32	1.2	1.5	1.7	2.0	2.7	1.82	+0.120	*
7	'Serr'	7.63	1.3	1.5	1.7	1.7	2.6	1.76	+0.060	ns
8	'Tehama'	7.29	1.2	1.4	1.6	1.8	2.7	1.74	+0.040	ns
9	'Pedro'	7.95	1.2	1.8	1.7	1.8	2.6	1.82	+0.120	*
10	'Vina'	8.22	1.4	1.7	2.0	2.7	3.5	2.26	+0.560	***
11	'Franquette' (Control)	6.56	1.2	1.6	1.8	1.9	2.0	1.70	-	-

LSD 5% = 0.098 LSD 1% = 0.132 LSD 0.1% = 0.155

**Table 4 The fruit morphological characteristics of lateral bearing walnut cultivars**

No.	Cultivar	Fruit weight and kernel efficiency				Shell thickness (mm)	Kernel color
		Average fruit weight			Kernel ratio (%)		
		Fruit weight (g)	Standard deviation (s)	Coefficient of variability (s%)			
1	'Ferjean'	11.0	2.1	19.1	50.8	1.1	light yellow
2	'Fernette'	11.2	2.0	17.9	48.1	1.3	light yellow
3	'Fernor'	10.9	1.8	16.5	49.4	1.2	yellow
4	'Lara'	12.7	2.7	21.3	50.3	1.4	yellow
5	'Hartley'	11.7	2.1	17.9	49.2	1.0	yellow
6	'Payne'	11.4	1.9	16.7	49.4	0.9	yellow
7	'Serr'	12.9	2.2	17.1	53.9	1.0	light yellow
8	'Tehama'	11.1	2.1	18.9	46.8	1.1	yellow
9	'Pedro'	13.9	2.8	20.1	47.4	1.2	light yellow
10	'Vina'	12.1	2.3	19.0	49.9	1.1	yellow
11	'Franquette' (mt)	12.0	2.5	20.8	48.3	1.3	yellow