

## PROPERTIES OF FRENCH WALNUT CULTIVARS GROWN UNDER ENVIRONMENTAL CONDITIONS OF THE ČAČAK REGION

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*SUMMARY: In this paper, we have studied major pomotechnological properties and productivity of standard French walnut cultivars ('Marbot', 'Parisienne' and 'Franquette'), newly developed ones ('Ferner', 'Fernet') and standard cv. 'Elit', grown in the region of Čačak. Newly bred cultivars had more favourable vegetation onset, although their fruits were smaller, with lower fruit weight. The average yield per tree ranged from 8.7 kg in 'Elit' to 13.7 kg in 'Fernet' (the highest yield was in 'Ferner', 15.0 kg), i.e. from 870 to 1370 kg (1500 kg/ha). The lowest kernel ratio per tree was in 'Elit' (4.5 kg, 450 kg) while it was the highest in 'Fernet' (6.6 kg, 660 kg/ha) and 'Ferner' (7.4 kg, 740 kg/ha).*

**Key words:** walnut, cultivars, phenology, fruit, productivity.

### INTRODUCTION

Walnut assortment both on the global scale and in Serbia is not rich, and it is mainly concentrated in major walnut growing regions. The largest walnut producers, Hungary, Romania and Bulgaria, are primarily focused on the assortment of their regions and they grow local, domestic cultivars (Mitrović et al., 2007). Interestingly enough, there are differences in the assortment in terms of vegetation onset. Owing to frequent occurrence of late spring frosts, there has been pronounced interest in mid-late and late cultivars among walnut producers (Korać et al., 1998).

Introduced French walnut cultivars with late vegetation onset (after May 5) grown in the Čačak region are the subject of a serious study. Their properties are uncommonly interesting for our region, i.e. besides late vegetation onset, they have sturdy trees, healthy leaves (no occurrence of *Gnomonia leptostyla* has been observed), their resistance to low winter temperatures is good, they are excellent croppers bearing quality fruits (Germain (1996) and Germain et al. (1997)). It is for the above reasons that major pomotechnological properties and productivity of newly bred French cultivars

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('Fernor', 'Fernet') have been investigated along with those of 'Marbot', 'Parisienne' and 'Franquette', and Slovenian cv 'Elit'.

## MATERIALS AND METHODS

The studied walnut cultivars ('Marbot', 'Parisienne', 'Franquette', 'Fernor', 'Fernet', and 'Elit' as standard) were planted in 2001 (planting distance 10 x 10 m) in a trial field at a location in the region of Čačak. The introduced walnut cultivars were obtained from INRA Institute (Bordeaux, France). Grafted two-year old plants were of exquisite health status, trees in the planting were well maintained and all cultural practices were applied.

Monitoring of phenology included different stages, i.e. onset, full and end of leafing, inflorescence onset and shedding, emergence of female flowers and their pollination capacity, and fruit ripening. Productivity of the studied cultivars was monitored by successive collecting of ripe fruits (split shuck) and measuring. At the season's end, yield per tree was checked and calculated per unit of land. The paper presents the average three-year results (2005 – 2007) and includes phenological and pomological properties, and fruit and kernel yield per unit of land for each season. The results were subjected to statistical analysis, analysis of variance and LSD test.

## RESULTS

The earliest leafing was observed in 'Parisienne' (May 2), and the latest in 'Fernor' and 'Elit' (May 6). Full flowering was first reported in 'Parisienne' (May 7), and the latest in 'Elit' (May 10), whereas the end of leafing was first in 'Marbot' and 'Parisienne' (May 10), and the latest in 'Elit' (May 13). In conclusion, in terms of leafing, control cv. 'Elit' was somewhat later than the studied French walnut cultivars (Table 1).

Inflorescence was the earliest in 'Marbot' (May 3), and the latest in 'Fernet' (May 9), whereas inflorescence onset was the first in 'Marbot' (May 9), and the latest Franqete (May 14). Female flowers with pollination capacity emerged first in 'Marbot' and 'Parisienne' (May 7), and latest in 'Fernet' and 'Elit' (May 9). As for fruit ripening (chuck split), 'Marbot' was the earliest (October 2) and 'Franquette' was the latest (October 10). In terms of inflorescence and flowering, some of the studied cultivars performed a few days earlier than standard cultivar Elit.

Table 1. Phenological properties of the studied walnut cultivars  
*Tabela 1. Fenološke osobine ispitivanih sorti oraha*

Cultivar <i>Sorta</i>	Leafing <i>Listanje</i>			Inflorescence <i>Reše</i>		Female flower parts <i>ženski cvetovi</i> <i>Ženski cvetovi</i>		Ripe ning <i>Sazr evanje</i>
	Onset <i>Početak</i>	Full <i>puno</i>	End <i>kraj</i>	Pollination <i>prašenje</i>	Pollination <i>Oprašivanje</i>	Occurrence <i>pojava</i>	Pollination Capacity <i>Sposobni za oprašivanje</i>	
Marbot	4.05	8.05	10.05	3.05	9.05	7.05	10.05	2.10

Parisienne	2.05	7.05	10.05	6.05	11.05	7.05	9.05	4.10
Franquette	4.05	8.05	11.05	9.05	14.05	8.05	10.05	6.10
Fernor	6.05	9.05	12.05	8.05	13.05	8.05	10.05	9.10
Fernete	5.05	8.05	12.05	7.05	12.05	9.05	11.05	10.10
Elit	6.05	10.05	13.05	8.05	12.05	9.05	11.05	8.10

Fruit length was the lowest in 'Parisienne' (36.8 mm), and the highest in 'Fernor' (43.0 mm). As for fruit width and thickness, it was the greatest in 'Marbot' (34.1 mm and 39.7 mm, respectively) and the lowest in 'Elit' (30.6 mm and 31.0 mm, respectively). The investigation revealed that the French cultivars were larger than standard 'Elit'. Analysis of variance and LSD test pointed to highly significant differences among the studied cultivars. In contrast, as regards thickness, and width in particular, high significances were observed only among certain cultivars.

Fruit weight was lowest in 'Elit' (10.6 g), and highest in 'Marbot' (12.4 g), whereas 'Fernete' and 'Franquette' had the highest kernel mass (5.3 g and 5.8 g). Kernel ratio was lowest in 'Fernete' (44.0%) and highest in 'Elit' (51.7%). Analysis of variance and LCD test revealed that only fruit weight of 'Marbot' and 'Fernor' had highly significant difference in comparison with the other cultivars. In respect to kernel mass, high significances were identified among all the studied cultivars.

As regards kernel content, high significances were observed in 'Elit' and 'Marbot'. Shell was the thinnest in fruits of 'Fernete' (1.0 mm), and the thickest in 'Fernor' and 'Franquette' (1.3 mm). Shell thickness was negligible, therefore statistical significances were not determined. Shell was in the shades of yellow, while kernel was light brown in all the studied cultivars (Table 2).

The cropping of walnuts grown in our region has not been particularly investigated. In our study, cropping was the lowest in 'Marbot' and 'Elit' (in their fifth leaf), i.e. (3 kg/tree), and it was the highest in 'Fernor' (6.0 kg/tree). In the following year, production was the lowest in 'Elit' (9.0 kg/tree), and the highest in 'Fernor' and 'Fernete' (14.0 kg/tree). In their third year, production per tree in 'Elit' and 'Fernor' was 14 kg/tree and 25.0 kg/tree, respectively. Analysis of variance and LSD test showed highly significant differences of 'Fernor', 'Fernete' and 'Franquette' as compared to the other cultivars in all the years of study (Table 3).

Table 2. Pomo-technological properties of the studied walnut cultivars

*Tabela 2. Pomološko-tehnološke osobine ispitivanih sorti oraha*

Properties <i>Osobine</i>		Cultivar/ <i>Sortas</i>						LSD	
		Marbot	Fernor	Fernete	Franquette	Parisienne	Elit	0.05	0.01
Fruit <i>Plod</i> (mm)	Length <i>visina</i>	39.8	43.0	39.5	39.4	36.8	38.9	0.82	1.11
	Width <i>širina</i>	34.1	33.4	34.0	33.8	33.6	30.6	0.78	1.06
	Thickness <i>debljina</i>	39.7	33.7	33.1	31.1	32.4	31.0	0.99	1.35
Fruit weight (g) <i>Masa ploda</i>		12.4	11.8	11.9	12.0	11.0	10.6	1.34	1.82
Kernel mass (g) <i>Masa jezgre</i>		5.7	5.8	5.3	5.8	5.7	5.5	0.87	1.18

Ratio (%) <i>Randman</i>	46.0	49.3	44.0	48.0	51.5	51.7	7.28	9.86
Shell thickness (mm) <i>Debljina ljuske</i>	1.2	1.3	1.0	1.3	1.1	1.2	0.20	0.28
Shell colour <i>Boja ljuske</i>	SY	BY	SY	SY	BY	L		
Kernel colour <i>Boja jezgre</i>	LB	LB	LB	LB	LB	LY		

SY – straw yellow/*slamasto žuta*; LB- light brown/*svetlo braon*; BY – bright yellow/*svetlo žuta*; LY – Light yellow/*svetlo žuta*; L – Light/*svetla*.

Over the entire period of study, the total yield per tree was the lowest in 'Elit' (26.0) and the highest in 'Fernor' (45.0 kg). From the aspect of unit of land, the total production ranged between 2,600 and 4,500 kg/ha in the same cultivars. Similarly, statistical data analysis inferred highly significant differences between 'Fernor', 'Ferneté' and 'Franquette' on the one hand, and the other cultivars on the other hand. Over the three-year period, the average yield per tree ranged between 8.7 kg ('Elit') and 13.7 kg ('Ferneté'), while 'Fernor' (15.0 kg, i.e. from 870 to 1,370 kg, 1,500 kg/ha) had the highest average production per tree, which is in accordance with the previous results and statistical analysis. Measuring of kernel ratio showed the average yield per tree and unit of land. The lowest kernel content per tree was observed in 'Elit' (4.5 kg), and the highest in 'Ferneté' (6.6 kg, 660 kg/ha) and 'Fernor' (7.4 kg, 740 kg/ha). In this case, kernel production in 'Fernor', 'Ferneté' and 'Franquette' was significantly different in comparison with the other cultivars.

Table 3. Productivity of the studied walnut cultivars

*Tabela 3. Rodnost ispitivanih sorti oraha*

Season <i>Godina</i>		Productivity / <i>Rodnost</i> kg/tree						LSD	
		Mar bot	Fernor	Fern ete	Franq uette	Parisi enne	Elit	0.05	0.01
V		3	6	5	5	4	3	0.90	1.22
VI		11	14	14	12	10	9	1.19	1.62
VII		16	25	22	21	15	14	1.36	1.84
Total yield <i>Ukupno plodova</i>	kg/tree <i>kg/stab.</i>	30	45	41	38	29	26	1.71	2.32
	kg/ha <i>kg/ha</i>	3,000	4,500	4,100	3,800	2,900	2,600	440.4	596.8
Average yield <i>Prosečno plodova</i>	kg/tree <i>kg/stab</i>	10	15	13.7	12.7	9.7	8.7	0.91	1.23
	kg/ha <i>kg/ha</i>	100	1,500	1,370	1270	970	870	82.13	111.3
Kernel ratio (%) <i>Randman jezgra</i>		46	49.3	44	48	51.5	51.7	7.28	9.86

Average kernel yield	kg/tree <i>kg/stab</i>	4.6	7.4	6.6	6.1	5	4.5	0.76	1.03
<i>Prosečno jezgre</i>	kg/ha <i>kg/ha</i>	460	740	660	610	500	450	76.21	103.27

## DISCUSSION

The first results about newly developed French walnut cultivars Fernor and Fernet were published by Germain et al. (1996 and 1997). The cultivars were moderately vigorous, of late flowering and low susceptibility to bacteria. These cultivars bear fruits on lateral flowers, bear fruits early but more abundantly in comparison with 'Franquette'. Fruit weight in 'Fernor' and 'Fernete' ranges from 10 to 12 g and 11 to 13 g respectively, whereas kernel content in these cultivars is 49% and 54%, respectively. Similar results about these cultivars have been reported by Džuvinov et al., (2004), kernel ratio ranging from 42 to 47% and 48 to 52%, respectively. Under our conditions of growing, fruit weight and kernel ratio of fruits of these cultivars were lower, which is the result of the old age of studied tree, applied cultural practices and duration of the study. All the reports are in accordance with the results obtained by Mitrović et al. (2005) in the study of these cultivars.

Cultivar specificities of the other studied cultivars were reported when grown under our conditions, in terms of phenological and fruit properties. Observed differences in respect to fruit weight and size are due to the applied cultural practices (Korać et al., 1998).

Besides phenological properties (late vegetation onset), cvs 'Fernor' and 'Fernete' have very high cropping performance. Among the studied cultivars, these cultivars had the most abundant cropping and kernel yield. Thus, according to Korać et al. (1998), the average walnut production in walnut growing regions of Serbia amounted to 3, 5 and 8 kg/tree (in the fifth, sixth and seventh year of production, respectively).

## CONCLUSION

Comparative analysis of major pomotechnological properties of newly developed French cultivars 'Fernor' and 'Fernete' and standard cvs 'Marbot', 'Parisienne', 'Franquette' and 'Elit' revealed that the former have more favourable phenological characteristics and higher production capacity. In comparison with the latter, 'Fernor' and 'Fernete' also had more favourable vegetation onset and smaller fruits with lower fruit weight. These cultivars also displayed the highest production and kernel yield, which is their most pronounced specificity. Over the three-year period of study, the average yields per tree ranged from 8.7 kg ('Elit') to 13.7 kg ('Fernete'), and the highest production per tree was 15.0 kg ('Fernor'), i.e. (870 to 1370 kg, 1500 kg/ha). The lowest kernel content per tree was observed in 'Elit' (4.5 kg), and the highest in 'Fernete' (6.6 kg, 660 kg/ha) and 'Fernor' (7.4 kg, 740 kg/ha).

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## OSOBINE FRANCUSKIH SORTI ORAHA U AGROEKOLOŠKIM USLOVIMA ČAČKA

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### Izvod

Ispitivane su važnije pomološko-tehnološke i produktivne osobine standardnih francuskih sorti oraha (Marbot, Parisienne i Franqete), novijih (Fenor, Fernet) uporedo sa standardnom sortom Elit, na području Čačka (centralna Srbija). Novije sorte (Fenor, Fernet) su u odnosu na ostale sorte imale povoljnije, vreme početka vegetacije i sitnije plodove, sa manjom masom. Među ispitivanim, ove sorte su ostvarile najveću rodnost i najveći prinos jezgre, što je njihova posebna vrednost. Za trogodišnji period ispitivanja, prosečni prinosi po stablu bili su od 8,7 kg (Elit) do 13,7 kg (Fenete) i najviše 15,0 kg (Fenor), ili od 870 do 1370 kg, odnosno 1500 kg/ha. Najmanji sadržaj jezgre po stablu bio je kod sorte Elit (4,5 kg), a najveći kod sorte Fenete 6,6 kg, (660 kg/ha) i sorte Fenor (7,4 kg) ili 740 kg/ha.

**Ključne reči:** orah, sorte, fenologija, plod, rodnost.

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