

WINTER HARDINESS OF REPRODUCTIVE ORGANS OF THE WALNUT CULTIVARS IZVOR 10, LARA AND FERNOR AT EXTREME LOW TEMPERATURES

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Abstract

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The wide distribution of the species *Juglans regia* L. is due to its winter hardiness, which is different for the separate cultivars. The continuous spell of cold weather in Bulgaria in the period of deep winter dormancy of the walnut trees caused the minimum temperature drop down to minus 24.4°C. The aim of the study was to establish the winter hardiness of the reproductive organs of the introduced French walnut cultivars Lara, Fernor and the Bulgarian one Izvor 10. The results showed that the cultivars Izvor 10 and Fernor exhibited greater winter hardiness of the reproductive organs compared to Lara cultivar. It was established that within the same cultivar, the male flower buds (catkins) showed less winter hardiness than the female flower buds in Izvor 10 and Fernor cultivars. Growing the cultivars Izvor 10 and Fernor is recommended for the colder (northern) regions of the country where the mentioned minimum temperature of minus 24.4°C is often registered.

Key words: *Juglans regia* L., French cultivars, cold-hardiness

Introduction

Juglans regia L. species is a nut species with high plasticity and, to a certain degree, it is tolerant to low winter temperatures in different geographical areas, suffering no winter injuries. Its wide distribution is due to its winter hardiness, which is different for the separate cultivars. Germain et al. (1999) mentioned that the Californian cultivars were unsuitable to be grown in the colder climate in France. According to Nedev et al. (1983), frost damages in Bulgarian cultivars were reported only when the temperatures dropped down below minus 20°C. Carpathian walnut is considered to be the most cold hardy in the world, displaying resistance to temperatures of minus 32-35°C without injuries at all (Mitra et al., 1991 and Domoto, 2002).

Winter hardiness of walnut is not only a varietal characteristic. According to Améglio et al. (1999), it is in a positive correlation with the reserve carbohydrates accumulated during the previous year and stored in the trunk. The low temperature duration also affects winter hardiness of walnut. Terziev (2002) announced that the injuries in a certain culti-

var are more severe when the trees were exposed to low winter temperatures for a longer period.

The aim of the study was to establish winter hardiness of the reproductive organs of the introduced French walnut cultivars Lara and Fernor and of the Bulgarian one Izvor 10.

Material and Methods

The investigation was carried out in 2012 in a fruit-bearing walnut plantation established in the spring of 2003 on the territory of the Fruit-Growing Institute – Plovdiv, at an altitude of 130 m, 42°14' N latitude and 24°75' E longitude. The plantation was grown under irrigation. The introduced French cultivars Lara and Fernor and the Bulgarian cultivar Izvor 10 were the object of the investigation. All the studied cultivars were grafted on common walnut (*Juglans regia* L.) rootstock. A permanent cold front positioned across the country in the period 26 January – 4 February 2012. The temperatures in the region of the Fruit-Growing Institute – Plovdiv dropped down to minus 24.4°C. During the extremely cold weather period there was no wind at all and the buds had

been covered with snow (2-3 cm) fallen before the cold spell. The trees were at the stage of deep winter dormancy. Immediately after the cold front swept through the country, shoots of the studied cultivars were collected for observations at a height of 2.0-2.5 m above the ground. They were placed in water and left for slow acclimatization at a low positive temperature (+2-3°C) for a three-day period, after which the temperature was gradually increased to +20°C. That temperature was maintained for two weeks. After that, the flower buds (both male and female) were cut with a scalpel. The percentage of frost damages in the separate cultivars was reported, using a binocular.

Three trees of each cultivar were observed, randomly located in the plantation, the buds of each tree representing a separate replication. Each category of the buds (male and female) for each cultivar was represented by 50 buds from a tree, i.e. 150 for each category.

The data obtained were statistically processed by Duncan's test (Steele and Torrie, 1980).

Results and Discussion

Figure 1 presents the absolute minimum air temperatures for the period 26 January – 5 February 2012. It could be seen that the cold spell reached its maximum of minus 24.4°C on 1 February 2012, followed by warming weather. On 5 February, the absolute minimum temperature was already 0.0°C.

According to Nedev et al. (1983) and Terziev (2002), the lowest temperature of minus 24.4°C is crucial to walnut cultivars. In our experiment, absolute minimum temperatures

within the range of -13°C to -24.4°C were reported for six days (28 January to 2 February). According to the investigations carried out by Terziev (2002), the continuous effect of low winter temperatures, crucial to the certain cultivar, caused greater damages than the short spell of a low temperature of the same value.

Data presented in Table 1 showed that the continuous cold spell caused a different degree of damages to the male and the female flower buds in the studied cultivars. The most cold-hardy proved to be the buds of the cultivar Izvor 10. Its catkins (the male buds) were more resistant to frost than the catkins of the other two cultivars Lara and Fernor. Comparison of the two French cultivars showed that the catkins of Fernor demonstrated better frost resistance. The female buds of Fernor also showed better frost resistance. The established frost damages were 32.0% versus 90.0% of the female flower buds of Lara cultivar, the difference being statistically significant. Concerning that characteristic, no statistical significance was found between the cultivars Izvor 10 and Fernor.

Table 1
Winter hardiness of the reproductive organs of the cultivars Izvor 10, Lara and Fernor

Cultivar	Frost damages percentage, %	
	Male buds	Female buds
Izvor10	40.7 c	23.3 b
Lara	98.0 a	90.0 a
Fernor	84.7 b	32.0 b

Statistically different at P=5%

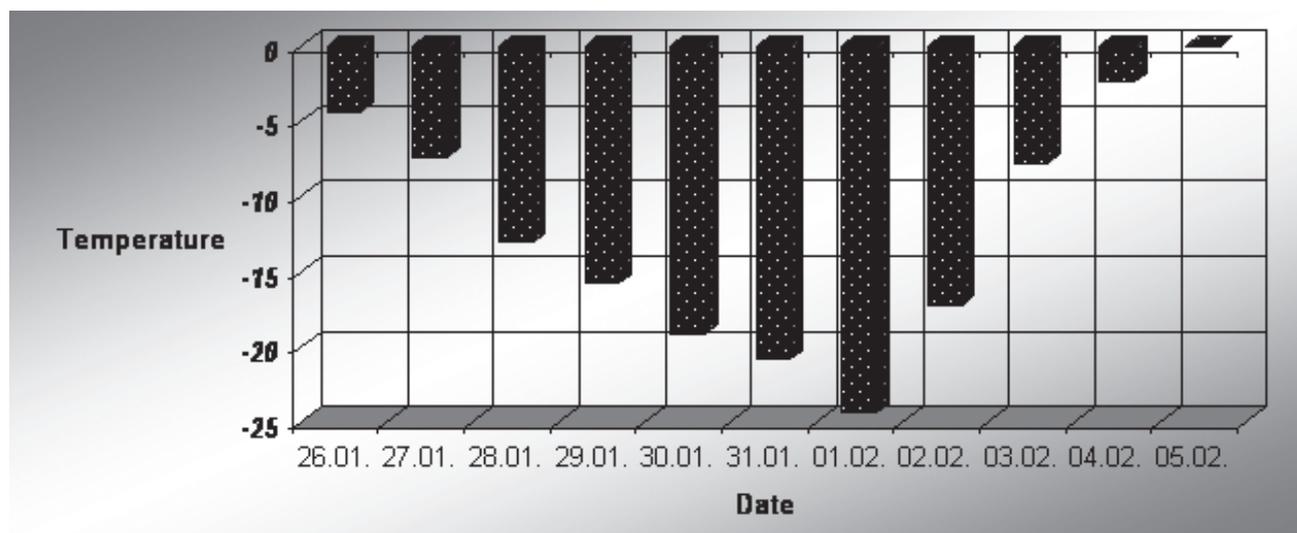


Fig. 1. Absolutely minimum air temperatures for the period 26 January – 5 February 2012 year

Within the cultivar, the response of the male (catkins) and the female flower buds to frost is quite interesting. It has proved statistically that the catkins of Izvor 10 and Fernor were more susceptible to frost than their female buds, which led to a higher percentage of damages in the male buds. In Izvor 10 frost damages were 40.7% versus 23.3% and in Fernor – 84.7% versus 32.0%, respectively. In Lara cultivar there was no statistically significant difference between the frost damages in the reproductive organs, which was due to the lower hardiness of the cultivar, leading to a high percentage of frost damages in both catkins and the female flower buds.

Conclusions

Izvor 10 and Fernor cultivars showed better winter hardiness of the reproductive organs than Lara cultivar. Within the same cultivar, the male flower buds of Izvor 10 and of Fernor demonstrated less frost resistance than the female flower buds.

The cultivars Izvor 10 and Fernor are suitable to be grown in those regions of the country (mainly the northern ones), where winter temperatures often fall down to minus 24.4°C.

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