

WALNUT PROPAGATION USING A HOT WATER INSTALLATION AND GROWING THE OBTAINED PLANTS IN CONTAINERS

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Abstract

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Walnut is among the fruit species difficult to be propagated and therefore different techniques and methods have been developed all over the world to improve the survival percentage of the new plants. The aim of the present experiment was to study the possibility of walnut propagation using a hot water installation and growing the obtained plants in containers. The experiment was carried out in the period 2013-2015 at the Fruit-Growing Institute. One-year old seedlings of common walnut (*Juglans regia* L.) were used as rootstocks, grafted with 'Izvor 10' cultivar. The plants were put for callus formation in the constructed hot water installation. Successfully propagated plants were grown in containers for two years. The results show that the developed hot water installation leads to obtaining 83.1% of successfully propagated plants. It was established that the newly grafted plants could be grown in containers for two years. After the first year the average stem diameter was 14.2 mm and the average plant height 22.4 cm. In the second year of growing in the containers the plants reached an average stem diameter of 24.5 mm and an average height of 110.8 cm. The conclusion was drawn that the constructed hot water installation favoured the production of a high percentage of successfully propagated plants, which could be grown in containers for two years.

Key words: *Juglans regia* L.; planting material; propagation; containers

Introduction

Walnut is among the fruit species difficult to be propagated and therefore different methods of producing walnut planting material have been developed all over the world (Kuniyuki and Forde, 1985; Atefi, 1997; Özkan et al., 2001; Solar et al., 2001; Barut, 2001; Chandel et al., 2006; Vahdati and Zareie, 2006; Suk-In et al., 2006; Gandev and Arnaudov, 2011). In the recent years the hot callus method is becoming more important in walnut propagation (Atefi, 1997; Avanzato and Tamponi, 1988; Avanzato, 1999; Avanzato et al., 2006; Erdogan, 2006; Gandev, 2007a, 2008, 2009). According to the adopted principles of the method, the necessary temperature for callus formation is provided by using an electric heating cable. The shortcomings of the method when applied

in practice are: 1) large electricity consumption in industrial production and 2) electrical hazard in wet environment. That is why it became necessary to find alternative means of heating that could provide the suitable temperature for the callus formation without the use of electricity. In agricultural practice it is adopted to plant the grafted plants obtained by the hot callus method in the nursery in the open in order to produce standard planting material (Gandev, 2007b). That approach has three major shortcomings: 1) transfer of the plants outdoors in spring can expose them to frost damages; 2) production of planting material outdoors in the nursery does not allow planting of the trees in a permanent location all the year-round and 3) digging the planting material out of the ground destroys the root system of the trees that has a negative effect on their initial growth habits. In the other

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fruit species those shortcomings are overcome by growing them in containers (Harris and Bassuk, 1993).

The aim of the experiment was to study the possibility of producing walnut planting material by propagating the plants applying the hot callus method, using a hot water installation, and growing the obtained plants in containers.

Materials and Methods

The experiment was carried out in the period 2013-2015 at the Fruit-Growing Institute. One-year old seedlings of common walnut (*Juglans regia* L.) produced outdoors in a nursery, were used as rootstocks. In the middle of March cleft grafting was performed with 'Izvor 10' cultivar. The scions were collected from mother trees in dormant season. Grafting was performed with scions having 2-3 well-developed buds. After grafting the scion tips were dipped in paraffin to protect from drying out. The place of grafting was loosely bound with a 2 mm rubber tube to provide aeration. Then the grafted plants were placed for callus formation in the hot water installation. The installation is a close water system, in which the hot water circulating in the water pipes placed in tunnels, maintains a permanent temperature of 27°C (\pm 1°C) in the tunnels. The installation comprises of a boiler, a water pump, metal U-shaped tunnels with doors, pipes for the flowing hot water and stopcocks. Water in the boilers is maintained at 50°C. Water flow in the pipes is controlled by stopcocks, i.e. the water amount in each pipe determines the temperature in each tunnel. The grafted plants were laid horizontally, transversely to the U-shaped tunnel, the place of grafting being exactly over the water pipe providing the heat. The plant roots were covered with wet sand and then the tunnel doors were closed. Beforehand the tunnels were filled to 1/3 with perlite, which was intermittently moistened to provide an air humidity of 80-90% at the place of grafting. A temperature of 27°C (\pm 1°C) was maintained in the tunnels for four weeks. At the end of the fourth week the hot water installation was switched off. The successfully propagated plants were potted in 14-liter containers. 'Suli Flor' SF1 peat substrate was used, annually changing it. Then the plants were adapted, without exposing them to direct sunlight. They were placed indoors at a temperature of 15°C (\pm 3°C). After about a month the plants were transferred outdoors in a shaded field. The survival percentage of the plants propagated using the hot water installation, was reported in two weeks.

The experiment comprised of two variants according to the age of the plants grown in the containers:

Var. 1: One-year old plants;

Var. 2: Two-year old plants.

The vegetative habits of the plants grown in the containers were reported after their first and after their second vegetation season. The following characteristics were observed: stem diameter (immediately below the place of grafting), the height of the new growth (above the place of grafting), the number of new growing roots and the mean length of the growing roots.

The percentage of successfully propagated plants using the constructed hot water installation provides information about the suitability of that installation. The percentage was calculated every year in three separate tunnels of the installation – in the first, middle and the final one, each tunnel being treated as a separate replicate in the reporting year. Each tunnel was represented by 100 plants. The vegetative habits of the plants grown in the containers were reported for 25 plants in each variant, each plant considered a separate replicate.

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

Results and Discussion

The results presented in Table 1 show that in all the three experimental years the survival percentage of the plants propagated in the hot water installation varied within 81.0% to 85.7%. The results were sustainable in the separate years and no significant differences were established in the percentage of callus forming plants. The survival percentage was 83.1% in average for the period. That percentage of callus forming plants is close to the percentage obtained when using the conventional method with an electric heating cable, mentioned in other studies (Avanzato et al., 2006; Erdogan, 2006; Gandev, 2008, 2009), which proves that the principally new hot water installation shows a good efficiency in walnut propagation.

Table 1

Suitability of the installation for callus formation

Year	Survival percentage of propagated plants, 'Izvor 10' cultivar, %
First (2013)	81.0 a
Second (2014)	85.7 a
Third (2015)	82.7 a
<i>In average for the period</i>	<i>83.1</i>

Duncan's multiple range test at P = 5%

The average values of the vegetative habits of the plants grown in containers are presented in Table 2. It was established that in the first years after potting the plants in the containers the average plant height was 22.4 cm (Var. 1) and

in the second year – 110.8 cm (Var. 2). Those results show that during the second year in the containers (Var. 2) the plant growth was more vigorous and the increment in height was about five times larger compared to the results during the first year (Var. 1). Concerning stem diameter and number of growing roots, higher values for those two characteristics were reported in the two-year old plants (Var. 2), but the difference to the one-year old plants (Var. 1) was about twice bigger, i.e. it was not as dramatic as the difference established in plant height. Unlike the above mentioned vegetative characteristics, the average length of the new growing roots of the one-year and two-year old plants did not differ statistically – 8.8 cm is in Var. 1 and 9.0 cm in Var. 2, respectively. We believe that this is due to the limited space for root development in the containers.

Table 2

Vegetative habits of successfully propagated plants of ‘Izvor 10’ cultivar grown in containers (in average for the period 2013-2015)

Age of plants	Stem diameter, mm	Increment in height, cm	New growing roots, number	Average length of the new roots, cm
One-year	14.2 a	22.4 a	20.4 a	8.8 a
Two-year	24.5 b	110.8 b	46.3 b	9.0 a

Duncan's multiple range test at P = 5%

Conclusions

The constructed hot water installation favoured the production of a high percentage of successfully propagated plants.

The successfully propagated plants in the hot water installation can be grown in containers for two years, the growth habits of the plants being more vigorous during the second year.

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