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COMPARISON OF TWO METHODS OF WALNUT GRAFTING

ABSTRACT. In earlier experiments with walnut grafting positive results were recorded with warming the area of the graft union. Such a treatment enhanced the percentage of successful grafting (60-65%) depending on the time of this practice – the later the time of grafting the better were its results (Porębski et al., 1999). In the present experiment the chip-budding in a heated glasshouse was used. Additionally applied warming of the grafted place raised the positive results to 80%.

Key words: walnut, grafting, chip-budding

INTRODUCTION. Investigations conducted so far on walnut grafting distinctly indicate two main factors determining a high percentage of successful growth. These factors are the temperature (26 °C for three weeks) and the date of grafting (Černy, 1963; Lagerstedt, 1981; Porębski et al., 1999). Most studies concerned winter grafting of walnut since poor results were obtained with other methods such as summer grafting 15-20% (Kantarci and Jacob, 1988), transplanting 14.5% (Gautam and Chauhan, 1990), or tissue culture 42.8% (Ripetti et al., 1994).

In the climatic conditions of Poland the summer chip-budding of walnut is risky and practically possible only in years with average daily temperatures not falling below 18 °C during such a treatment (Porębski, 1994; Kantarci and Jacob, 1988). Our recent studies mainly concentrated on methods, which made possible to expose the graft union to elevated temperatures, however not the whole plant but only the place where the components met. Such a treatment of walnut ensures a successful graft union but it does not initiate the vegetation of the whole plant. For this purpose a device for hot-callusing graft unions constructed by Lagerstedt and modified by Piskornik (Lagerstedt, 1981; Piskornik, 1995) was used.

Interesting results were obtained with this device and a 60-65% efficiency was recorded depending on the time of walnut grafting (Porębski et al., 1999). The success in winter walnut grafting in hand with the callusing device encouraged the authors to conduct similar experiments, this time associated with winter chip-budding. The present work aimed at increasing the efficiency of walnut propagation using two methods – grafting and chip-budding in conditions of a heated glasshouse with two variants of treatment (plants locally warmed or not warmed) and winter chip-budding on forced rootstocks. The grafting of walnut was mainly used as the point of reference for the results obtained with chip-budding.

MATERIAL AND METHODS. One-year-old seedlings of walnut (*Juglans regia* L.) were used for grafting and chip-budding. The plants obtained from the nursery were heeled in moist sawdust in a cold store at +2 °C and high air humidity of about 90%. All budsticks were cut in late autumn before the frost and kept in a cold store in moist sawdust, additionally wrapped with polyethylene sheet.

The device for local heating was made according to that described by Piskornik (1995). The device for hot-callusing was composed of one or more pipes of polyvinyl chloride (PCV), 5 cm of inside diameter and about 6 m in length. Slots covering 1/3 circumference of the pipe were cut at intervals of 3-5 cm. The width of slots exceeded the thickness of the rootstock together with the scion in the place of their union. A smaller PCV pipe 12.5 mm in diameter filled with water and sealed at both ends was inserted into the longer pipe. Along the small pipe on its both sides a heating cable (PG CAYc, produced by Cracow Cable Plant) was fastened with an adhesive tape. The pipe for hot-callusing was to stabilise the temperature by periodical switching on/off the heating cable. In that pipe the temperature was controlled and monitored using a contact thermometer fastened in one of the slots and connected with an electric feeding controller. The pipe was fixed on a glasshouse table at an appropriate distance from the substrate. Plants grafted in hand were inserted in the slots in such a way that the place of grafting (of the union) was directly above the heating element, and were insulated with covers prepared from a PCV pipe of a similar size (Fig. 1).The roots of the rootstock were covered with moist substrate (compost soil, sawdust, or peat). Graft insulation in the slots was to reduce the losses of heat and electric energy. A simplified method of insulation consisted of a sticky plaster, adhesive tape, or strips of foam rubber wrapped around the hot-callusing pipe. In this case the covering rubber was cut above the slots and the grafted plants were inserted through the cuts. This was found to be the best method for insulating graft unions and retarding the heat loss. After the insulation of scions the heating device was switched on and the temperature in the pipe was maintained at an optimum level for the growth of the callus tissue. For most woody plants this temperature ranges from 25 to 27 ^{o}C. In comparison with the device for hot-callusing described by Lagerstedt (1981), the present improvement consisted of using elastic PCV stoppers which facilitated rapid fastening and insulating scions in the slots of the pipe (Fig. 1).

The rootstocks were planted in plastic pots of 130 cm diameter twice: on February 10 and March 10, to be kept in a glasshouse at 18-22 ^{o}C.

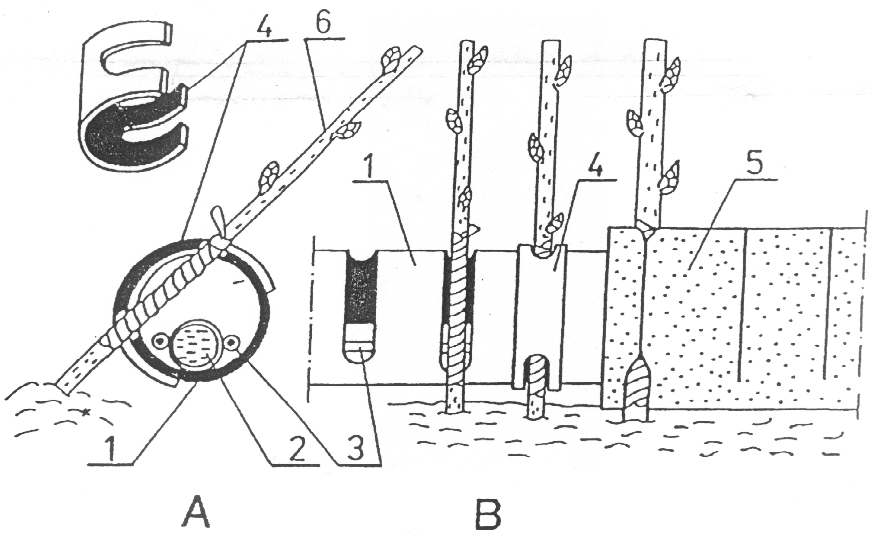

Figure 1. Device for hot-callusing graft unions of trees and bushes: A – cross-section, B – general view of the hot callusing pipe with a grafted tree in place. Two types of graft insulation in slots are shown; PCV elastic half-ring (4) and foam rubber (5); 1 – PCV pipe with slots, 2 – smaller, inner pipe filled with water, 3 – electric heating cable, 4 – PCV elastic half-ring to retard heat loss, 5 – foam rubber insulation, 6 – graft union placed in a slot cut in the pipe, above the heating cable. The root systems are covered with a moist peat or sawdust

The first two combinations were grafted one day after planting. One combination with grafted rootstocks was placed on a glasshouse table, another one in the device for hot-callusing. The temperature of 26 °C at the place of grafting was maintained for three weeks. Then the grafts were taken out of the callusing device and placed on a glasshouse table next to the first combination.

The third and fourth combination consisted of rootstocks planted also on February 10, though chip-budded a week later. One-year-old shoots of the cultivar 'Resovia' were used in this treatment. Budding discs reaching 1/3 of the graft diameter were taken from the grafts. The places of scion union were wrapped with plastic strips.

After chip-budding of the rootstocks some of them were placed on a glasshouse table (combination 3) and others in the hot-callusing device (combination 4). After three weeks all the chip-budded rootstocks were cut above the budding place and put on a glasshouse table.

The last two combinations were walnuts chip-budded in a glasshouse (18-20 ^{o}C) on previously forced rootstocks. At the time of chip-budding they were in full vegetation, already showing a 10-15 cm increase. In both combinations the chip-budded walnut rootstocks were subjected to a local warming in the hot-callusing device. After three weeks they all were cut above the budding place and left in a glasshouse. Differences between these combinations were only in the date of planting rootstocks for forcing (February 10 or March 10) and in the date of chip-budding (March 16 or April 1).

The rootstocks prepared by the above methods remained in a glasshouse (about 18-20 ^{o}C) until planting in a nursery in late May.

In the hot-callusing device the temperature of 26 ^{o}C was maintained in all the samples. The time of heating was also the same - three weeks.

The percentage of successful grafting and the height of juvenile plants were determined at the time of planting them in soil. Each combination consisted of five rootstocks in four replications. The results obtained were verified by an analysis of variance, the significance of differences were evaluated using the Duncan`s t - test at P=0.05. Statistical analysis was carried out on transformed values according to the Freeman-Tukey`s angular transformation.

RESULTS AND DISCUSSON. According to the data published up to now, successful walnut grafting depends mainly on the temperature and time of this practice. The present experiment showed also other factors such as the method of chip-budding and the treatment of rootstocks and grafts.

The use of a device for thermal stimulation of callus development significantly improved the quality of walnut grafting and to the greatest extend affected the number of successful grafts. The grafted, though non-callused plants showed the percentage of successfully grafted plants smaller by almost a half. Still poorer results were found in the case of chip-budded juvenile walnut trees, which showed the lowest percentage of successful grafting (12.1%) in comparison with the locally heat-treated plants (26.9%) (Tab. 1).

Table 1. Percentage of successful chip-budding and grafting in applied treatments

Treatment	Date of rootstock planting	Date of grafting	Percentage of successful grafting		
			2000	2001	average for 2000-2001
Grafting	10 Feb.	11 Feb.	30.0 c*	35.7 b	32.9 c
Grafting + warming of grafting place	10 Feb.	11 Feb.	60.0 d	64.3 d	62.1 e
Chip-budding	10 Feb.	17 Feb.	7.5 a	16.6 a	12.1 a
Chip-budding + warming of grafting place	10 Feb.	17 Feb.	15.0 b	38.7 b	26.9 b
Chip-budding + warming of grafting place	10 Feb.	16 March	82.5 e	81.3 e	81.9 f
Chip-budding + warming of grafting place	10 March	1 Apr.	65.0 d	45.5 c	55.3 d

* Values designated with the same letters within columns do not significantly differ at P=0.05

Very good performance was obtained in the combinations with budding applied to previously forced and chip-budded walnut rootstocks. The best results (81.9%) were recorded for plants chip-budded on March 16 on forced and callused rootstocks. The chip-budding with no additional treatments gave the lowest percentage of successfully grafted walnut (12.1% on average).

The date of budding was less important though statistically significant. Plants grafted on February 11 (combination 2) and those budded on March 16 (combination 5) showed a high percentage of successful grafting (62.1 and 81.9%, respectively). The experiment did not confirm the opinion that a later grafting may ensure more successful grafting, as was observed in earlier studies (Porębski et al., 1999). The present investigation contradicts the view of Černy (1963) that the grafting should be performed during a full dormancy of plants. It appeared, however, that the use of the hot-callusing device makes the time of budding of no significance.

Table 2. Mean height of juvenile trees [cm] measured in late May at the time of planting depending on grafting method and treatment

Treatment	Date of rootstock planting	Date of grafting	Height of tree [cm]		Mean for 2000-2001
			2000	2001	
Grafting	10 Feb.	11 Feb.	26.0 c	24.0 cd	25.0 c
Grafting + warming of grafting place	10 Feb.	11 Feb.	37.0 d	28.0 de	32.5 d
Chip-budding	10 Feb.	17 Feb.	24.0 bc	15.0 a	19.5 b
Chip-budding + warming of grafting place	10 Feb.	17 Feb.	24.0 bc	22.0 bc	23.0 bc
Chip-budding + warming of grafting place	10 Feb.	16 March	22.0 b	28.5 e	25.3 c
Chip-budding + warming of grafting	10 March	1 Apr.	17.0 a	18.8 ab	17.9 a

* Explanation – see Table 1

In the two years of the present study the effect of different treatments on the growth of juvenile walnut was not clear. Significantly the highest trees (32.5 cm) were noted in grafted and callused plants. Walnuts chip-budded on rootstocks, which were forced and treated with higher temperatures locally at the graft union, also showed a tendency to better growth (25.3 cm). The lowest trees were recorded for plants budded on April 1 on forced and hot-callused rootstocks – 17.9 cm on average (Tab. 2). The difference is only due to the delayed budding and hence the postponed vegetation in this combination.

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