

Walnut Graft-Union Callused by Heating Cable

Damiano Avanzato

Fruit Tree Research Institute, Via di Fioranello, 52 00134 Roma, Italy

Trials were performed using electric heating cable instead of hot-pipe callusing to maintain walnut grafts at the recommended 25 to 27C for callusing. Hot-callus pipe and hot-callus cable gave similar results. Best results were obtained when cable was used on in-situ-grafted walnut seedlings. Under nursery conditions graft take was 70%. At the end of the growing season plants had achieved a grade-out similar to 1-year-old grafted plants.

INTRODUCTION

Sitton (1931) showed that for callusing the graft-union in walnut (*Juglans regia*) it is necessary to maintain a temperature around the union of 25 to 27C for about 4 weeks. Lagerstedt (1981) among others later developed the hot callusing pipe (HCP) as a piece of propagation equipment for grafting a range of difficult-to-graft species.

Hot callusing pipe is capable of increasing the graft-take of several plant species (Dunn, 1995) and is known to be successful on walnut (Avanzato and Tamponi, 1987). However, even using this technique, walnut plants do not achieve the minimum height of 1.2 m required by the commercial nurseries (Moraldi and Lanzi, 1993). The poor growth that appears when the plants are bench grafted (Lantos, 1995; Stanisavljevic and Mitrovic, 1997), may be a result of the transplanting shock. To simplify the hot callusing technique and to stimulate the growth of the grafted plants several comparative experiments were conducted using electric-heating cable instead of hot-water pipes to provide the temperature lift.

Initially, the HCP technique was simplified by just wrapping a heating cable around the graft union. Several trials using this technique were performed. Results were similar from both pipe and cable but in each case there was poor growth after callusing. To overcome the problem of transplant shock, an insulated low voltage cable, covered by Velcro tape and connected to a thermostatically controlled central heating panel, was arranged and used on in-situ-grafted walnut seedlings. Under nursery conditions the graft take was about 70% and at the end of the growing season the plants achieved a sale standard height, and stem diameter comparable to 1-year-old plants grafted by HCP.

MATERIALS AND METHODS

Randomized block trials were designed in different places and years. One-year-old walnut seedlings were cleft grafted and the graft union was wrapped with aluminium foil and heated at 27C for 4 weeks. The hot-callus-cable system was a 45-volt heating cable, a sensor to monitor the temperature of the graft union, and a thermostat. For HCP the procedure described by Lagerstedt (1981) was used. Graft take percentage (after 4 weeks of callusing), stem height, and diameter (recorded at end of vegetative season) were submitted to statistical analysis.

Comparison of Cable and Pipe for Bench Grafted Transplanted Plants. The efficacy of the hot callus cable was compared with HCP at the Fruit Tree Research

Institute of Rome. 'Hartley' and 'Sorrento' cultivars were bench grafted in March 1987 and 1988, respectively, and placed horizontally on the hot pipe or heating cable heating the graft union only. To maintain the humidity, the plants were covered with polythene and the scions exposed to environmental conditions.

Hot Callus Cable Used for Bench-Grafted Plants Left in Situ. In Italy the experiment was carried out at the Fruit Tree Research Institute of Rome. One hundred seedlings were bench grafted, callused by hot callus cable during April 1989, and left in the grafting site to complete the growing season. Equal numbers of seedlings were grafted with cultivars 'Sorrento' or 'Del Carril'; the graft union was either wrapped with wet cloth or left unwrapped.

Another trial was conducted in India in February 1996 in Jammu, at the Horticultural Department of the Jammu and Kashmir Government, funded by the UN Food and Agriculture Organisation. For efficient and quick handling of the heating system, the cable was inserted into a waterproof cloth tube stitched onto Velcro fastening tape. Seedlings were grafted with a local cultivar, 'Rajouri', by an inexperienced budder and then left in the grafting site for the full growing season.

Hot Callus Cable Used in the Field. This trial, funded by the FAO, was conducted in March 1994 at the Seed and Plant Improvement Institute of Karaj. The experiment was designed to compare the effect of wet cloth and heat from pipe or cable around the graft union. Seedlings were grafted in situ with local clone, K144, and the graft-union heated by electric cable. Another group of seedlings were bench grafted, callused for 4 weeks by a HCP system, and transplanted. Heating was applied either immediately or 48 h after grafting in both methods.

RESULTS

Bench Grafted, Transplanted Plants. The percentage of success in HCP treatment was slightly but not significantly higher than with hot-callus cable. With the hot pipe, a graft-take of 82% in 1986 and 62% in 1987 was obtained against a graft-take with cable of 78% and 58%, respectively (Table 1). After transplanting, the plants achieved an average height of 35 cm at the end of vegetative season.

Table 1. Graft-take (%) of hot callus pipe vs. hot callus cable.

Year	Cultivar	HCP ^x	HCC ^x	Control
1986	Hartley	82 a ^y	78 a	< than 1 b
1987	Sorrento	62 a	58 a	< than 1 b

^x Hot callus pipe = HCP, hot callus cable = HCC

^y Means within a row followed by the same letter are not significantly different (P=0.05, Student-Newman-Keuls test); 40 seedlings per treatment.

Bench Grafted Plants Left in Situ. In Rome a positive graft-take response was observed for the hot callus-cable treatment in different genotypes ('Sorrento', 69% and 'Del Carril', 77%), with an increase of 9% when the graft union was wrapped

with wet cloth. The grafted plants achieved a maximum height of 66 cm during the growing season.

In Jammu the results were influenced by the subtropical climate with day temperatures between 15 and 27C and night temperature not below 10C. In the control, 40% graft-take was observed but was significantly different from the 70% obtained with hot callus cable. The grafted plants achieved a height of 55 cm in 4 months and at the end of the vegetative season, height and thickness were above the required standards (Table 2).

Table 2. Graft-take and height (cm) of grafted plants in Jammu.

Treatment	Success (%)	Height after 4 months	8 months
With hot callus cable	70 a	55 a	135 a
Without callus cable	40 b	8 b	105 b

Column means with similar letter do not differ significantly (P=0.05, Student-Newman-Keuls test); 45 seedlings per treatment.

Hot Callus Cable Used in the Field. The results of graft-take using hot callus cable with or without wet cloth were similar to those with HCP when the heat treatment was immediate (Table 3). The only exception being for plant height at the end of the growing season where hot callus cables in situ resulted in a height seven times greater. Graft-take increased when wet cloth was used and decreased when heating was delayed. With hot callus cable plant height was not influenced by the cloth or by delayed heating. The 3-months-old grafted plants obtained by hot callus cable treatment were comparable to 15-months-old, hot-callus-pipe-treated plants (Table 4).

Table 3. Graft-take and plant height.

Parameter	HCP ^x immediate		HCC ^x immediate		HCC delayed	
	-WC	+WC	-WC	+WC	-WC	+WC
Graft-take (%)	55 a ^y	74 b	53 a	70 b	38 a	55 b
Height (cm)	20 a	20 a	130 a	140 a	130 a	150 a

^x Hot callus pipe = HCP, hot callus cable = HCC

^y Results in the same row with similar letter do not differ significantly (P=0.05, Student-Newman-Keuls test); 100 seedlings per treatment.

Table 4. Size of the plants callused by hot callus cable and hot callus pipe.

Parameter	3 months old (from hot cable)	15 months old (from hot pipe)
Trunk diameter (cm)	1.02 a	1.03 a
Trunk height (cm)	1.36 a	1.00 b
Trunk volume (cc)	66.79 a	49.97 b

Row means with similar letter do not differ significantly ($P=0.05$, Student-Newman-Keuls test).

DISCUSSION

The experiences with the electric cable method of hot callusing tried under different geographical and agroclimatic conditions show the potential of this technique in fast production of grafted walnut plants. The main aim of using electric cable was to simplify the hot callusing method and evaluate its efficiency in in-situ-grafted seedlings. The results did not show any significant difference between pipe and cable treatments in terms of graft-take and growth.

When the seedlings were bench grafted, callused by electric cable, and left in situ, scion development was enhanced and within a few months plants achieved marketable height.

LITERATURE CITED

- Avanzato D. and G. Tamponi.** 1987. L'innesto a marza del noce (*Juglans regia* L.): una nuova tecnica. *Frutticoltura* 12:23-26.
- Dunn, N.D.** 1995. The use of hot pipe callusing for bench grafting. *Comb. Proc. Intl. Plant Prop. Soc.* 45:139-141.
- Lagerstedt, H.B.** 1981. A new device for hot callusing graft unions. *HortScience* 16:529-530.
- Lantos, A.** 1995. Winter bench grafting of walnut varieties. *Comb. Proc. Intl. Plant Prop. Soc.* 45:146-148.
- Moraldi, S. and M. Lanzi.** 1993. Il riscaldamento localizzato dell'innesto nella produzione vivaistica del noce. *Frutticoltura* 1:53-56.
- Sitton, B.G.** 1931. Vegetative propagation of the black walnut. *Tech. Bull.* 119. Michigan State University.
- Stanisavljevic, M. and M. Mitrovic.** 1997. Effect of variety on successful of nursery trees of walnut (*Juglans regia* L.). *Acta Hort.* 442:281-283.