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ROOTING OF BLACK MULBERRY (*Morus nigra* L.) HARDWOOD CUTTINGS

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A B S T R A C T

Propagation of mulberry through cuttings is still one of the most cost-effective methods for clonal regeneration. This study was conducted in order to determine the influence of cutting's collection time and planting methods for hardwood cuttings on the rooting percentage of black mulberry (*Morus nigra* L.). The dormant cuttings were prepared from one-year-old shoots during January, February and March, 2001. Hardwood cuttings treated with 5 g l^{-1} IBA were rooted in perlite using bunches (BP) and rows (RP) as well as in hydroponics (HP). Rooting percentage, callusing percentage, number of roots per rooted cutting and average root length (cm) were evaluated. The average rooting of black mulberry cuttings varied from 3.3 to 60.0%. The best rooting percentage was obtained from bunch planting and for January cuttings. Among the three methods examined, bunch planting seems to be the best for the rooting of black mulberry hardwood cuttings.

Key words: mulberry, *Morus nigra* L., rooting, cuttings

INTRODUCTION

Mulberry can be propagated thro-ugh seeds, cuttings, grafting or tissue culture. Since cross-pollination is the rule in mulberry (Reich, 1992), propagation by seeds does not con-serve true-to-typeness owing to its heterozygous nature. Method of conventional vegetative propagation by budding or grafting is not practical since it requires special labour-power and expensive nursery practice. Also, the success of grafting depends on internal factors like exudation, compa-tibility, activity of cambium, as well as external conditions like temperate and humidity and characteristics of soil (Reich, 1992). Tissue culture

techniques can be used for mulberry propagation, even though guaranteed protocols have not yet been reported (Bhau and Wakhlu, 2001). In vitro propagation methods need specialistic staff and expensive facilities. Propagation of plants through cuttings is still one of the most cost-effective methods of clonal regeneration. Great differences exist among plants of different species and cultivars in the rooting ability of cuttings. Also, rooting ability of stem cuttings depends on a number of factors, including environmental conditions, cutting's collection time, age of mother plant, treatments with plant growth regulators (Ohyama and Oka, 1987; Sharma et al., 1994; Ünal et al., 1992; Yýldýz and Koyuncu, 2000).

Propagation of mulberry saplings by cuttings is a widely used and popular method (Alizhanov, 1984; Aleksandrow, 1988; Ünal et al., 1992; Yýldýz and Koyuncu, 2000). The high fresh weight, black-purple colour and extraordinary taste of black mulberry fruits increasingly attract consumers and therefore the need for those plants has increased recently. The aim of this investigation was to determine the influence of cutting collection time and planting method of hardwood cuttings on the rooting percentage and root quality of black mulberry (*Morus nigra* L.).

MATERIAL AND METHODS

Hardwood cuttings were collected from native black mulberry (*M. nigra* L.) genotype M-11, which was evaluated as promising in previous research at Mamatlar, Turkey (latitude 37° 55´N, longitude 30° 55´E and altitude 930 m). The dormant cuttings (20-25 cm) containing at least 4-5 axillary buds were prepared from vigorous one-year-old shoots during January, February and March, 2001.

The cuttings were dipped in an aqueous suspension of 0.3% Benlate. The 2 cm basal parts of them were dipped in 5 g l^{-1} indolebutyric acid (IBA) in 50% aqueous ethanol for 5 seconds. These cuttings were planted using 3 different methods. In the first two: bunches (BP) (15 cuttings per bunch) and rows (RP) the cuttings were planted in agri-perlite heated beds (22±2°C) with intermittent misting. The third method, hydroponic planting (HP), was applied as principal components and layout of a simple Nutrient Film Technique (NFT) without nutrient (water only) in the rooting solution. Five cuttings were placed per polyethylene pot filled with agri-perlite, and transferred into closed tunnels in a greenhouse. After 90 days, all cuttings were lifted from the beds and evaluated for rooting percentage, callusing percentage, num-ber of roots per rooted cutting and average root length (cm). Cuttings were considered to have callus when the basal callus was at least as wide as ½ diameter of the basal end. The experiments were performed in 3

rep-licates, each consisted of 15 apical-cuttings. In BP 15 cuttings per bunch and in HP three pots were considered as a replicate. Data obtained were subjected to an analysis of variance. Comparison of menas was performed using Student's t-test (Least Signifi-cant Difference LSD) at P=0.05.

RESULTS

Planting methods and cutting collection time had a significant effect on the rooting percentage (Tab. 1). It was the highest (60%) for January cuttings in BP method, while the lowest (3.3%) for February cuttings in RP. The first method gave the best rooting results for all examined collection times. Cuttings taken in January rooted most successfully irrespective of the planting procedure. Significant differences were found in the callus formation depending upon the cutting's collection time and plan-ting method. In general, the callusing was the highest in RP. The greatest root number of per rooted cutting (2.2) was obtained for those collected in January in BP method. The planting practice had a significant effect on this parameter ($P<0.001$). However, neither planting method nor cutting collection time significantly affected the mean root length which was between 0.7 and 2.36 cm (Tab. 1).

DISCUSSION

Because many studies reported the effect of IBA on the rooting of mulberry cuttings, we used only one concentration of this compound, based on the former study of Yýldýz and Koyuncu (2000). The results obtained in the present research indicate that the rooting percentage, callusing and root number per rooted cutting were significantly affected by the planting method and the time of cutting's collection. From 3 to 60% of cuttings were rooted in this study. McCormack (1985) Özkan and Arslan (1996) and Ünal et al. (1992) estimated the rooting success of mulberry as 21-50% (stem cuttings), 55-67% (hardwood cuttings), 4-18% (hardwood cuttings), respec-tively. On the other hand, Yýldýz and Koyuncu (2000) obtained the rooting rate from 0% (without bottom heat – control) to 89.3% (with bottom heat – 5000 ppm IBA). The above differences may be attributed to various physiological conditions, genetic constitution of the stock plants, cutting's collection time, treatments and anatomical charac-teristics. It was also reported that the rooting success of mulberry stem cuttings depended on the favourable environmental conditions and genotype (Ohyama and Oka, 1987; Jain et al., 1990). Moreover, since many varie-ties have a poor rooting ability this practice is restricted to only certain months of the year (Narayan et al., 1989; Chitra and Padjama, 2002). Adventitious roots frequently emerge through the callus, leading to the belief that callus formation is essential for rooting because the dif-

ferentiation within callus leads to the formation of root initials (Hartmann et al., 1997). We observed a relationship between the callusing rate and rooting, except for RP method.

Table 1. Rooting responses [%], callusing [%], mean number of roots per rooted cutting and mean of root length [cm] in black mulberry

Collection time	Planting method	Rooting [%]	Callusing [%]	No. of roots	Length of roots [cm]
January	row-planting	0.0	56.7	0.0	0.0
	hydroponic planting	6.7	0.0	0.7	1.0
	bunch-planting	60.0	60.0	2.2	1.1
February	row-planting	3.3	96.7	0.3	1.7
	hydroponic planting	10.0	0.0	1.5	0.7
	bunch-planting	33.3	33.3	2.1	1.6
March	row-planting	0.0	33.3	0.0	0.0
	hydroponic planting	0.0	0.0	0.0	0.0
	bunch-planting	10.0	16.7	1.8	2.3
LSD [5%]		10.9	12.2	0.97	NS

In conclusion, among the three methods examined, bunch planting seems to be the best for the rooting of black mulberry hardwood cuttings. This method may be highly advantageous for large-scale planting of hardwood cuttings in the nursery practice, especially for man-power. We expect that this study will prompt further research concerning the root-ing of black mulberry and other deciduous species reproduced by hardwood cuttings. However, BP method should be taken into consideration also for the propagation by cuttings of other woody species

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UKORZENIANIE ZDREWNIAŁYCH SADZONEK CZARNEJ MORWY (*Morus nigra* L.)

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STRESZCZENIE

Rozmnażanie morwy przez ukorzenianie sadzonek pędowych jest nadal jedną z najbardziej opłacalnych metod wegetatywnej reprodukcji. Badania miały na celu

określenie wpływu terminu uzyskania zdrewniałych sadzonek czarnej morwy (*Morus nigra* L.) i metod ich sadzenia na procent ukorzeniania. Sadzonki pobrano z jednorocznych pędów w stanie spoczynku w styczniu, w lutym i marcu 2001 roku. Zdrewniałe sadzonki potraktowane kwasem indolowomasłowym w stężeniu 5 g l^{-1} były ukorzeniane w perlicie, w wiązkach (BP) lub w rzędach (FP) oraz w hydroponice (HP). Określano procent sadzonek ukorzenionych, procent sadzonek tworzących kalus, liczbę korzeni na ukorzenioną sadzonkę i średnią długość korzenia w cm. Średnio od 3,3 do 60% sadzonek zostało ukorzenionych. Najlepsze rezultaty uzyskano pobierając sadzonki w styczniu i sadząc w wiązkach. Wspomniana metoda wydaje się najlepsza dla ukorzeniania zdrewniałych sadzonek czarnej morwy.

Słowa kluczowe: czarna morwa, *Morus nigra* L., ukorzenianie, sadzonki