Propagation of *Maackia amurensis* Rupr. & Maxim. by Softwood Cuttings[1]

Steve McNamara[2], William R. Graves[3], and Harold Pellett[4]
University of Minnesota Landscape Arboretum
Chanhassen, MN 55317

Abstract

Softwood terminal stem cuttings were collected at two developmental stages from twenty mature trees of Amur maackia (*Maackia amurensis* Rupr. and Maxim) growing in Minnesota, Maryland, and Washington DC. Cuttings were treated with either 0 or 2500 ppm (0.25%) of a potassium salt formulation of indole-3-butyric acid (K-IBA) and stuck under intermittent mist with bottom-heat. Cuttings were evaluated for rooting after 12 weeks. Cutting collection date did not affect rooting of most genotypes. Treatment with K-IBA nominally improved root rating scores and root numbers. All trees exhibited the capacity for rooting with individual rooting percentages ranging from 19% to 92%. Based upon mean visual ratings, cuttings from 14 of the 20 trees produced root systems of acceptable quality. These findings indicate that mature *Maackia amurensis* trees can be propagated by softwood cuttings, but refinement of the rooting protocol may be required to achieve acceptable levels of rooting for some genotypes.

Index words: Amur maackia, adventitious rooting, asexual propagation, K-indole-3-butyric acid, genotypic variation.

Significance to the Nursery Industry

This study demonstrates the feasibility of rooting softwood cuttings from mature trees of Amur maackia (*Maackia amurensis* Rupr. and Maxim). While substantial tree-to-tree variation in rooting was observed, all trees from which cuttings were collected exhibited rooting potential. A simple method of clonal propagation should facilitate introduction of superior selections of this species. Propagation of selections on their own roots will eliminate potential incompatibility problems that may occur when grafting onto seedling rootstocks.

Introduction

Interest in small trees is increasing as landscape professionals seek out plants suitable for small urban and residential planting sites. One tree worthy of more widespread use is Amur maackia (*Maackia amurensis*), which combines small stature with noteworthy landscape qualities and environmental adaptability.

Amur maackia is slow-growing in youth, developing a round-headed crown that may ultimately reach 12 m (40 ft) tall by 9 m (30 ft) wide. Specimens at the Minnesota Landscape Arboretum are only 4–6 m (15–20 ft) tall by 4–5 m (15 ft) wide after 32 years.

Amur maackia possesses multiple-season, landscape appeal. (2, 5, 7). Emerging foliage is covered with a silver indumentum in spring. The pinnately compound leaves become dark olive-green with maturity and give the tree a fine, lacy appearance throughout the summer. A display of 10–15 cm (4–6 in) long racemes with creamy white flowers is produced in June and July. Flowers may last for several weeks, providing interest at a time when few other trees are in bloom. Amur maackia lacks any appreciable autumn leaf coloration, but the exfoliating character of the greenish-bronze bark adds subtle interest during the winter months.

Amur maackia tolerates a range of soil conditions and has performed well on difficult urban sites (8). Unlike some other leguminous landscape trees, Amur maackia fixes nitrogen in association with rhizobial bacteria (1). Native to Manchuria and Korea, it possesses excellent cold hardiness and has withstood temperatures of –42°C (–44°F) in midwinter laboratory freezing tests (authors' unpublished data). At present, there are no known serious insect or disease pests of this species (4).

Although becoming more widely known in the United States in recent years, Amur maackia is not commonly available from the nursery industry. Plants are typically propagated by seed and substantial genotypic variation in growth rate, foliage quality, plant form, and bark character have been observed. Development of asexual propagation techniques would allow for selection of superior genotypes and promote more widespread use of the species. Little information is available on asexual propagation of Amur maackia. Attempts to graft Amur maackia onto Japanese pagodatree (*Sophora japonica* L.) rootstocks have resulted in graft incompatibility (9). The species can be propagated by root cuttings (3), but this method is typically unsuitable for commercial production.

To our knowledge, propagation of Amur maackia by softwood cuttings has not been explored. The objective of this study was to evaluate the potential for propagating mature genotypes of this species by softwood cuttings. The effect of genotype, collection date, and IBA treatment on rooting were investigated.

Materials and Methods

Rooting potential of softwood cuttings from twenty mature genotypes of Amur maackia was evaluated in Summer 1992. Trees included in this study were growing at three geographic locations. Ten trees (MN1 through MN10) were growing in the collections of the University of Minnesota Landscape Arboretum-Chanhassen (44° 50' N latitude).

[1]Received for publication November 8, 1993; in revised form April 11, 1994. Journal Series Paper No. 20925 of the Minnesota Agricultural Experiment Station. Journal Paper No. J-15657 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA 50011.

[2]Scientist. University of Minnesota Landscape Arboretum, Chanhassen, MN 55317.

[3]Assistant Professor. Department of Horticulture, Iowa State University, Ames, IA 50011

[4]Professor. University of Minnesota Landscape Arboretum, Chanhassen, MN 55317.

These trees were half-siblings ranging from 25 to 32 years of age. Five trees (DC1 through DC5) growing at the United States Department of Agriculture National Arboretum, Washington, DC. (38° 54' N latitude) were at least 50 years old. A second group of five trees (MD1 through MD5) growing in nearby Sligo Creek Park, Silver Spring, MD, were estimated to be 10 to 20 years old. This group had a distinctly different leaf morphology, with the individual leaflets being smaller and more numerous than on trees at the other two sites.

A preliminary experiment conducted in 1991 indicated cuttings of one Minnesota genotype could be rooted when collected in mid-July. Cuttings collected in July might be more lignified than is considered optimal for rooting of other woody species (6). It was therefore decided to compare rootability of cuttings collected in mid-July with those collected earlier in the growing season. An attempt was made to collect cuttings from the three geographic locations at the same stage of phenological development. Initial collections were made when terminal shoots were fully expanded and had just begun to stiffen (May 27, 1993, in Washington, DC/Maryland, June 8, 1993, in Minnesota). The second collections were made approximately 5 weeks later (July 3 in Washington DC/Maryland, July 15 in Minnesota).

On each collection date, terminal shoots were collected in the morning, wrapped in moist packing material and placed in polyethylene bags. Cuttings from the Washington DC/Maryland collection sites were shipped via overnight air-freight to Minnesota. All cuttings were stuck within 48 hr of collection.

There was substantial variation in length of the current year's growth among genotypes. Because some shoots were as short as 0.9 cm (0.35 in), no attempt was made to standardize the length of cuttings. Cuttings were prepared by manually removing all but the two uppermost fully expanded leaves. The base of each cutting received a fresh 45° slanting cut and two 2.54 cm (1.0 in) opposing vertical wounds through the bark. (The two wounds were made on the basal-half of cuttings less than 2.54 cm (1 in) long.)

Cuttings of each genotype were randomly divided into two treatment groups. Treatments consisted of immersing the basal 2.5 cm (1.0 in) of each cutting in either 2500 ppm (0.25%) of the potassium salt formulation of indole-3-butyric acid (K-IBA) or distilled water for 5 sec. Individual cuttings were stuck to a depth of 5 cm (2 in) in 390 cm^3 containers (2.38 in-square band, Anderson Die and Mfg., Portland, OR) containing a medium of coarse perlite:sphagnum peat moss (2:1 by vol). Cuttings from each collection were completely randomized in seven plastic flats (48 cuttings/flat). Flats from the two collection dates were randomized also.

Cuttings were rooted in a quonset-type hoophouse covered with an inflated double layer of polyethylene. Relative humidity was maintained near 100% with a combination of intermittent mist (10 sec every 8 min) and a high-pressure fog system (Environmental Cooling Concepts, Inc., Palm Springs, CA) operating from 0800 to 2030 hr. The house was covered with shade cloth (50% light transmission) to moderate interior temperatures. Ventilation fans were used to exhaust warm air from the house during the day. Bottom heat was supplied via a circulating hot water system in the greenhouse floor. Average daily maximum and minimum temperatures in the cutting canopy and in the rooting medium were 30 ± 2°C/19 ± 2°C (86 ± 4°F/66 ± 4°F) and 29 ± 3°C/23 ± 2°C (84 ± 5°F/73 ± 4°F), respectively. Light levels measured in the cutting canopy at midday (1200 to 1300 hr) with a quantum sensor (LI-COR, Inc., Lincoln, Nebraska) ranged from 65 to 550 $\mu mol \cdot m^{-2} \cdot s^{-1}$ depending on weather conditions. High pressure sodium lamps providing 50 $\mu mol \cdot m^{-2} \cdot s^{-1}$ of supplemental light were used to maintain a 16-hr photoperiod from August 1 through October 15.

Cuttings were evaluated for rooting after 12 weeks. Primary and secondary roots were counted to quantify root development. Cuttings also received a subjective rating score from 0 to 5 utilizing photographic standards (Fig. 1). Length of each cutting and number of intact leaflets at harvest were recorded.

A 2 (IBA treatment) × 2 (collection date) × 20 (genotype) factorial of treatments was arranged in a completely randomized design. Analysis of variance and regression analyses were conducted using SAS's general linear model procedure (SAS Institute, Cary, NC).

Results and Discussion

Analysis of variance showed large differences in rooting among the 20 genotypes (Table 1). Treatment with 2500 ppm K-IBA significantly increased root number and root score, but the practical significance of the effects of IBA are questionable. Averaged over all trees, mean root scores for nontreated and IBA-treated cuttings were 2.4 and 2.7, re-

Table 1. Rooting response of softwood terminal stem cuttings from 20 trees of Amur maackia. Data for cuttings taken at two developmental stages and treated with two concentrations of IBA were combined.

Tree[z]	Rooting %	Rooting score[y]	No. primary roots	No. secondary roots
MD-1	69	2.3	2.4	22.6
MD-2	53	1.6	1.2	9.2
MD-3	19	1.2	0.6	4.0
MD-4	38	1.2	0.6	6.5
MD-5	81	2.8	5.3	40.5
DC-1	87	3.3	5.6	50.1
DC-2	78	2.9	6.0	45.9
DC-3	92	3.8	9.3	71.2
DC-4	67	2.4	4.0	29.0
DC-5	87	3.7	8.0	73.5
MN-1	55	2.1	4.5	31.6
MN-2	39	1.8	2.7	29.8
MN-3	62	1.9	2.8	24.8
MN-4	89	3.6	8.3	65.2
MN-5	76	2.6	6.0	36.4
MN-6	61	2.3	3.6	36.0
MN-7	81	3.2	7.2	60.6
MN-8	89	3.8	9.8	94.5
MN-9	76	2.5	5.4	27.6
MN-10	49	1.9	2.6	50.1
LSD (0.05)	—	1.2	3.7	35.2

[z]MD = trees in Sligo Creek Park, Montgomery Co., MD; DC = trees at the U.S. National Arboretum, Washington, DC; MN = trees at the University of Minnesota Landscape Arboretum, Chanhassen, MN. N per tree ranged from 53 to 72.

[y]Rooting was scored qualitatively from 0 (poorest) to 5 (best).

spectively, and the genotype × IBA interaction was nonsignificant. Therefore, data from both IBA treatments were combined. Similar patterns were observed for root number data.

Rooting percentages ranged from 19% for tree MD-3 to 92% for DC-3 (Table 1). Sixteen of the 20 genotypes had rooting percentages greater than 50%. Mean rooting score ranged from 1.2 to 3.8. Cuttings with a rating of 2.0 or higher were considered acceptable for transplanting. Fourteen genotypes had mean rating scores of 2.0 or greater.

A single-degree-of-freedom contrast showed that cuttings from the National Arboretum trees had the highest mean rooting scores and numbers of primary and secondary roots while the Maryland trees had the lowest. Leaf morphology suggested that the Maryland trees were genetically distinct from those in Washington DC, and Minnesota, possibly belonging to the species *M. chinensis* Takeda. Whether this was a factor in the performance of cuttings from the Maryland trees is unknown because differences in environmental conditions under which the trees were growing at the 3 sites could also have affected rooting.

Collection date did not influence rooting of most genotypes. Because this study compared the effect of only two sampling dates on rooting, no firm recommendation can be made with regard to the optimal time for cutting collection. It appears, however, that the 5-week interval between collections should have been sufficient to detect meaningful changes in rootability. The appearance, rigidity, and, presumably, physiological condition of the cuttings differed substantially on the two collection dates. The absence of a timing effect on rooting suggests a fairly broad window of opportunity exists for successful rooting of Amur maackia.

Length of cuttings was not correlated with rooting score or numbers of primary and secondary roots, indicating that cuttings as short as 1.0 cm (0.4 in) can be rooted. Use of short cuttings would maximize the number of propagules that could be obtained from a single stock plant if subterminal cuttings can be used successfully.

The best-rooted cuttings had root systems comparable to those of seed-propagated plants (Fig. 1). Adventitious roots were fibrous, highly branched, and lifted easily with little breakage. Rooted cuttings from this study transplanted successfully and overwintered in a cold-storage facility with minimal losses. Long-term performance of these plants is being evaluated.

Although cuttings rooted reasonably well, rooting likely was impaired by the considerable loss of leaflets that occurred during the rooting period (data not shown). The cause was not determined, but excessive wetting of foliage may have been a contributing factor because the misting regime was not adjusted to compensate for daily variations in light and temperature in the house.

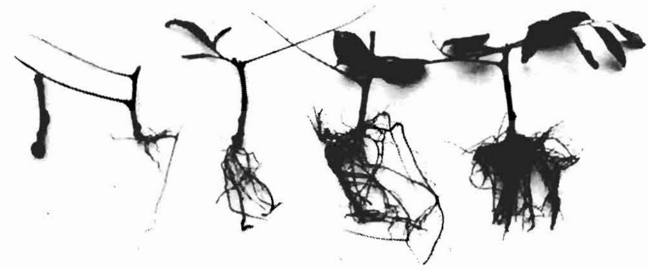

Fig. 1. Softwood cuttings of Amur maackia representing the range of rooting observed 12 weeks after sticking. Shown, from left to right, are cuttings rated from 1 to 5. Cuttings that did not callus were given a rating of 0.

Interest in using Amur maackia as a landscape tree is increasing, but the species remains obscure in the nursery trade and no superior genotypes have been selected. This research shows that asexual propagation is a viable alternative to seedling production. Refinement of the rooting protocol described herein should facilitate propagation and introduction of superior selections.

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