Vegetative Stem Cutting Propagation of *Idesia polycarpa*[1]

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Abstract

Idesia polycarpa, Igiri tree, is a deciduous ornamental tree with 10 to 20 cm (4 to 8 in) long panicles of yellow-green flowers in spring and summer, maturing to ornamental orange-red berries in fall and winter. There are limited vegetative propagation protocols established for *I. polycarpa*. The objective of this study was to evaluate the effectiveness of different timing and auxin concentration combinations on rooting success of shoot tip cuttings. In 2009, there were nine collection dates of softwood cuttings during the summer and three indole-3-butyric acid (K-IBA) concentrations of 0, 5,000, and 10,000 mg·L^{-1} (PPM). Increasing the K-IBA rate to 10,000 mg·L^{-1} resulted in higher rooting percentages for most collection dates, though rooting percentage did not exceed 32% for any given treatment combination. The date cuttings were taken did not affect rooting percentage. Cuttings that did not receive K-IBA did not root. In 2010, the impact of cutting harvest date (softwood in June and semi-hardwood in September) and the effect of K-IBA rate (0, 10,000, and 20,000 mg·L^{-1}) on rooting was determined. There was no statistical difference between the two higher concentrations, but both improved rooting versus the nontreated control, which did not root. Softwood cuttings showed a higher rooting percentage and greater root length compared to semi-hardwood cuttings.

Index words: auxin, indole-3-butyric acid, semi-hardwood cutting, softwood cutting.

Species used in this study: Igiri tree (*Idesia polycarpa Maxim*.).

Significance to the Horticulture Industry

Idesia polycarpa is an attractive ornamental deciduous tree with dark green leaves, red petioles, and fragrant 10 to 20 cm (4 to 8 in) long pendent panicles of yellow-green flowers appearing from April to June. Fruits are orange-red and keep their color for long periods of time. Vegetative propagation for this species is difficult and poorly understood. Seed propagation is possible, but the form of the resulting trees is variable and sometimes undesirable; therefore clonal propagation is preferred. Softwood or semi-hardwood cuttings that did not receive K-IBA did not root. Softwood cuttings treated with 10,000 or 20,000 ppm K-IBA had improved rooting compared to semi-hardwood cuttings treated with these rates of K-IBA.

Introduction

Idesia polycarpa, Igiri tree, (Salicaceae) is a deciduous medium to large-sized tree [8 to 21 m (26 to 69 ft) tall] native to mixed broadleaved and evergreen forests of central and western China, southern Japan, Korea, and Taiwan (Yang and Zmarzty 2007). It occurs at elevations ranging from 400 to 3,000 m (1312 to 9843 ft), corresponding to United States Department of Agriculture (USDA) cold hardiness zones 6 to 9 [maximum cold tolerance to –23 C (–9 F)]. As an ornamental tree, *I. polycarpa* is grown primarily for its dark green cordate foliage with acuminate tips and fragrant 10 to 20 cm (4 to 8 in) long pendent panicles of yellow-green flowers appearing from April to June. Fruits are orange-red berries maturing in September and October. Berries keep their color for long periods of time, often lasting throughout winter. *Idesia polycarpa* is typically dioecious, though self-fertile clones are known to exist in cultivation (Dirr 2009). Because trees are large and more than one is often required for fruit set, vegetative propagation of self-fertile trees could be advantageous for nursery growers.

There is no recent in-depth documentation of vegetative propagation methods of *I. polycarpa*. Doran (1957) indicated a 16-hr soak in 25 mg·L^{-1} K-IBA resulted in 76% rooting success of late July softwood cuttings stuck in sand under mist. Cuttings made from roots pieces of 2 to 5 year old seedlings can also be effective (Ji et al. 2008). Systems for micropropagation of stem segments *in vitro* are being investigated (Jiang et al. 2006) and are a promising method for rapid propagation. Seed propagation has not been closely evaluated; however seedlings may vary from the mother plant. The objective of this study was to evaluate timing of cutting collection during the growing season and exogenous auxin applications on root initiation of *I. polycarpa*.

Materials and Methods

Shoot cuttings were harvested from five 5-yr-old trees located within the Longwood Gardens nursery in Kennett Square, PA (39.866986°, –75.659151°). These trees were grown as rooted cuttings obtained from three individual plants. Cuttings 15 cm (6 in) in length were taken from actively growing terminal shoots of each tree and contained four to five nodes. Harvest dates were June 1, June 15, June 29, July 13, July 27, and August 13, 2009. At each date, 15 cuttings were harvested from each of the five trees. Each group of 15 cuttings was treated as a replicate. The basal 3 cm (1.2 in) of each cutting was wounded on opposite sides with pruning shears and treated by dipping for ten seconds with 0, 5,000, or 10,000 mg·L^{-1} K-IBA (PhyoTechnology Laboratories, Shawnee Mission, KS) dissolved in deionized water. The cuttings were then placed in a 3:1 peat:perlite (v/v) medium amended with 0.88 kg·m^{-3} (1.5 lb·yard^{-3}) of Root Shield® granules (BioWorks Inc., Victor, NY). The growing containers were PL-38-STAR-DP plug trays with 38 cells per tray (T.O. Plastics, Inc., Clearwater, MN). Individual cells measured 12.70 cm (5 in) deep by 5.43 cm (2.1 in) wide, giving a total volume of 220 cm^3 (12 in^3) per cell. Treated cuttings were placed randomly in individual cells, with all cuttings from each replication stuck in single trays. The distal portion of each leaf was trimmed by two-thirds to reduce transpiration. The experiments took place in a greenhouse covered with two layers of polyethylene at Longwood Gardens. Greenhouse temperature was maintained at a minimum

[1]Received for publication May 26, 2016; in revised form August 19, 2016.

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of 21 C (70 F) and vented with at 29 C (84 F). Plants were misted every six minutes for eight seconds during daylight hours. High pressure sodium lights in the greenhouse ensured long days and ran from 3:30 to 8:30 pm every day. Cuttings remained in mist for eight weeks and then they were evaluated for rooting percentage and number of new roots. When conducting root counts, single roots arising from callus tissue were considered to be a single root regardless of the amount of branching. Rooting percentage data were arcsine transformed and new root data were square-root transformed prior to analysis to achieve normal distributions. All data were statistically analyzed with ANOVA and means presented were separated by LSD test at $P = 0.05$ (SAS Version 9.3, SAS Institute, Cary, NC).

In 2010, shoot-cuttings were harvested from four trees that were also used in 2009. Cuttings 15 to 20 cm (6 to 8 in) in length were taken randomly from the terminal shoots of each tree. Dates that cuttings were harvested were June 8 and September 7. Cuttings on June 8 were softwood taken from actively growing shoot tips and had firm bases. September 7 cuttings were semi-hardwood and excised from partially lignified shoot tips.

Most experimental details in 2010 were identical to those in 2009. The primary differences are listed below. Cuttings were treated with 0, 10,000, or 20,000 mg·L^{-1} K-IBA dissolved in deionized water and nursery trays were arranged in 4 blocks corresponding to the 4 trees. Cuttings remained in mist culture for eight weeks, when they were evaluated for rooting percentage and length of the longest root, which arose from callus tissue and directly from the stem.

Results and Discussion

In 2009, cuttings that received no K-IBA did not root at all. Further analyses compared the treatments that received K-IBA at 5,000 or 10,000 mg·L^{-1}. K-IBA treatment ($P \leq 0.05$), but not cutting date ($P = 0.18$), affected the rooting percentage. There was also no interaction between K-IBA treatment and cutting date on rooting percentage ($P = 0.30$). Across all dates, the increase in K-IBA concentration to 10,000 mg·L^{-1} resulted in a higher rooting percentage (Fig. 1). Neither treatment significantly affected the number of new roots that formed on rooted cuttings (data not shown). However, the 10,000 mg·L^{-1} K-IBA applications did tend to cause higher numbers of new roots to form, but this difference was not statistically significant.

Similar to 2009, cuttings in 2010 did not root without auxin application, so subsequent analyses looked at differences in the 10,000 and 20,000 mg·L^{-1} K-IBA treatment rates. Although rooting percentages were higher with softwood cuttings from June with 20,000 mg·L^{-1} K-IBA, neither cutting date ($P = 0.07$) nor K-IBA rate ($P = 0.33$) had a significant effect on rooting percentages (Fig. 2). There was no interaction between harvest date and K-IBA rate.

After 8 weeks in culture in 2010, rooted cuttings exhibited a much higher number of roots compared to those from 2009 and individual primary roots were difficult to distinguish. The length of the longest root (LLR) was used as an independent variable to quantify root growth (Fig. 3). For cuttings on both dates, the 20,000 mg·L^{-1} K-IBA treatment resulted in cuttings with slightly greater LLR than cuttings receiving 10,000 mg·L^{-1}, but this difference was not statistically significant. Across both hormone treatments, June softwood cuttings had a LLR of 4.83 cm compared to 1.32 cm for September semi-hardwood cuttings. This effect was statistically significant ($P = 0.007$). There was no interaction between date and K-IBA rate.

Results demonstrated the necessity of auxin applications to *I. polycarpa* cuttings for rooting in artificial media, despite the wide range of rooting percentages presented here. Also, there is empirical evidence (Fig. 1) that K-IBA concentration may affect the number of new roots on rooted cuttings and subsequent root elongation. However, the benefits of using K-IBA concentrations above 10,000 mg·L^{-1} may not

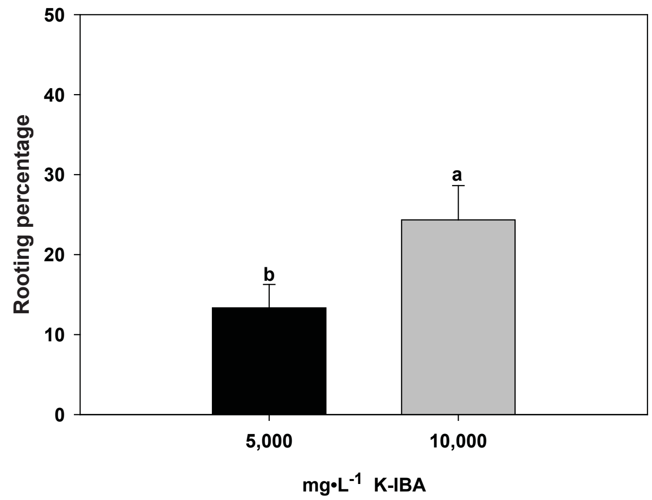

Fig 1. Effect of K-IBA rate on rooting percentage of *Idesia polycarpa* cuttings averaged across all harvest dates in 2009. Nontreated cuttings had 0 rooting percentage. Lines above the bars indicate standard error. Bars with different letters indicate significant differences in rooting percentage means (means separation by LSD) between K-IBA rates ($P \leq 0.05$). Rooting percentage scale represents actual percentages; statistical analyses were performed on arcsine transformed values.

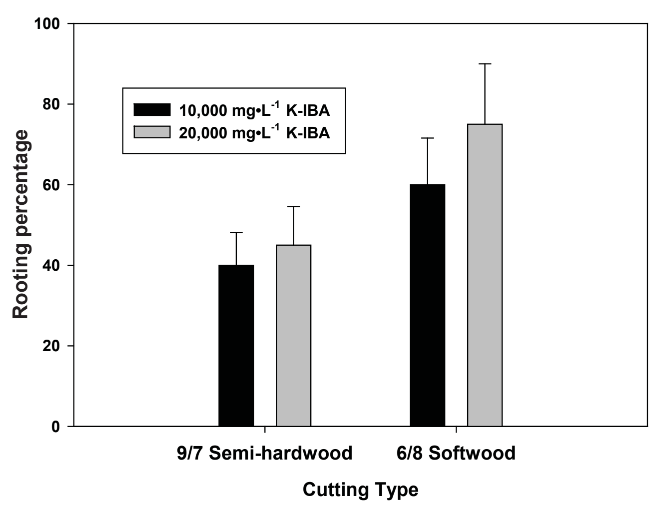

Fig. 2. Effect of K-IBA rate and two 2010 cutting dates/types on rooting percentage (+SE) of *Idesia polycarpa* cuttings. Lines above the bars show standard error. Nontreated cuttings had 0 rooting percentage. Rooting percentage scale represents actual percentages; statistical analyses were performed on arcsine transformed values. Cuttings were taken either June 8 or September 7, 2010.

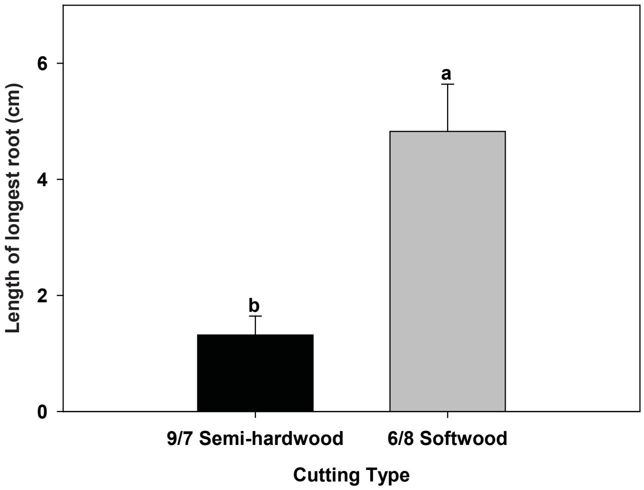

Fig. 3. Effect of two 2010 cutting dates/types on length of the longest root of rooted *Idesia polycarpa* cuttings averaged across the 2 K IBA rates. The softwood cutting were taken June 8 while the semi-hardwood cuttings were taken September 7. Lines above the bars indicate standard error. Bars with different letters indicate significant differences in root length means (means separation by LSD) between the two cutting types (P = 0.007), 4.83 cm for softwood and 1.32 cm for semi-hardwood cuttings. Cuttings were taken either June 8 or September 7, 2010.

be worth the extra expense, given that these observed differences were minimal. This effect needs further evaluation. The outcome of the 2010 study suggests that softwood cuttings taken earlier in the season before they start to harden off possess significantly more rooting potential. Similarly, cuttings from June 2009 appeared to root better than those later in the growing season (data not shown), although this finding was not statistically significant.

This study provides new and pertinent information on stem cutting propagation of *I. polycarpa*. However, new studies are proposed that look at standardizing the rooting environment by examining how the type of rooting media, media temperature, air temperature, light, and mist frequency affect rooting of softwood cuttings. Additionally, some clones may be more receptive to rooting than others, so identification of these clones that also possess desirable characteristics, such as improved form, flowering, self-fertility, and sterility/seedless fruit, is also important to the future usage of *I. polycarpa* in the landscape. Of those aforementioned characteristics, self-fertility of flowers and fruit sterility will be important in future development. Self-fertile clones eliminate the need for additional plants for cross pollination. *Idesia polycarpa* flowers at a young age and produces abundant seed that germinate readily without stratification; attributes that could be associated with invasiveness. However, the authors have not observed such tendencies in trial plantings. The fruit do not readily senesce from the tree and are retained throughout the winter, limiting dispersal. Further, for reasons that are unclear, birds have not been observed eating the red berries. Whether fruit retention and avian feeding preferences are localized is not yet known. As *I. polycarpa* is planted more as an ornamental, a greater understanding of these issues will be gained.

Literature Cited

Dirr, M.A. 2009. Manual of Woody Landscape Plants, Their Identification, Ornamental Characteristics, Culture, Propagation, and Uses. 6th ed. Stipes Publishing L.L.C., Champaign, IL. p. 522–523.

Doran W.L. 1957. Propagation of woody plants by cuttings. Univ. of Mass. Agr. Expt. Sta. Bul. 491. p. 42.

Jiang Z., Z. Liang, G. Liu, and T. Sun. 2006. Stem segment culture in vitro of *Idesia polycarpa* Maxim. Chinese Agr. Sci. Bul. 22(12):393.

Ji Y., Z. Zhu, Z. Liang, and Z. Jiang. 2008. The experiment of *Idesia polycarpa* Maxim. root cutting reproduction. J. Jiangsu For. Sci. & Tech. 2:13–15.

Yang Q. and S. Zmarzty. 2007. Flacourtiaceae, p. 112–137. *In*: Z. Wu and P.H. Raven (Eds.). Flora of China. Clusiaceae through Araliaceae. Science Press, Missouri Botanical Garden Press.