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Evaluation of Auxin (K-IBA) Concentrations on Rooting Success of maple (*Acer*) Stem Cuttings

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Summary

Initial experiments were conducted to evaluate auxin (K-IBA) concentrations on the rooting of selected *Acer* species. the results indicate that water-soluble K-IBA concentrations used in this study do not have a significant effect on rooting success in these seven maple selections after 6 to 7 weeks. Further rooting in all seven maple selections was observed 90 days after initiation, suggesting that greater rooting success could potentially be achieved with extended time in the propagation flats before transplanting.

INTRODUCTION

When selecting trees for the urban landscape, species that exhibit high adaptability and tolerance to tough conditions as well as attractive features are preferable. Many species of maples (*Acer*) have been selected and bred to meet the high demands of dense urban environments (Dirr and Heuser, 2006). A key limiting factor for the commercial availability of some desirable selections is the lack of reliable protocol for vegetative cutting propagation that can be applied on a large scale. Rooting success has been reported by both academic researchers and commercial propagators, however results are too broadly variable for the reported protocols to be considered practical for wide-scale commercial production (Brock, 2014). While other methods of clonal propagation exist, such as grafting or in vitro micropropagation, vegetative propagation from stem cuttings is generally considered the most convenient and cost-effective technique for propagating woody plants (Gabriel et. al, 1961).

Currently, maples are primarily propagated through grafting (Brock, 2014). While this method of propagation is effective on a large-scale, grafting is known to be expensive, labor-intensive, and time-consuming. This method requires technical expertise that is not always readily available in the labor force, and several years are required for grafted plants to reach maturity and produce seed (Tousignant et al., 2003). Another major limitation of grafting is that rootstocks do not always match the hardiness of the scion grafted onto them. Consequently, the broad adaptability of some species relative to cold hardiness and soil conditions may be lost, leading to delayed decline and failure. Additionally, grafted trees are prone to developing suckers that compete with the desired scion (Brock, 2014). If vegetative cutting techniques can be further improved and standardized, this method of clonal propagation has the potential to provide commercially viable selections of broadly adaptable trees for upper Midwest climates while also eliminating other issues associated with grafting (Dirr and Heuser, 2006).

The objective of this experiment was to examine how the following species and cultivars respond to vegetative propagation using varying concentrations of the water-soluble growth hormone Indole-3-butyric acid Potassium Salt (K-IBA): *Acer miyabei* 'Morton' State Street® (miyabe maple), *Acer platanoides* 919-61*1 (Norway maple), *Acer circinatum* × *A. pseudosieboldianum* 'Morton UW' Morning Starburst™ 644-81*1, *Acer pseudosieboldianum* 263-99*1 (Korean maple), *Acer triflorum* 269-2017*1 (three-flowered maple), and two selections of *Acer platanoides* × *A. truncatum* TBN 14.121, TBN 13.128 (purpleblow maple hybrid) (**Table 1**).

MATERIALS AND METHODS

Cuttings were collected from seven *Acer* selections (**Fig. 1**) growing in The Morton Arboretum living collections and tree breeding nursery on June 22 and 23, 2022. Samples were collected between 9:00 a.m. and 12:00 p.m. At the time of collection, daytime temperature ranged from 80°F to 85°F. Collection days followed two days of high temperatures reaching up to 98°F. Semi-hardwood cuttings of 4 to 8 in. were taken at random from the trees and placed into zip locked bags. All samples were stored in a walk-in cooler maintained at 42°F.

Table 1. Descriptions of species and cultivars selected for propagation study.

Species	Cultivar/ Common Name	Accession Number	Description
Acer miyabei 'Morton'	State Street® Miyabe maple	Tree Breeding Nursery (TBN)	- Zone 4-8 - Highly adaptable in urban environments - Upright, oval shaped, limited spread - Potential substitute for Norway maple
Acer platanoides	Norway maple	919-61*1	- Zone 4-7 in East - Zone 4-8 in West - Highly adaptable, shade and sun tolerant, heat and cold hardy - Tolerant of a variety of soils - Great shade tree - Criticized for being overplanted and invasive in the Northeast/Canada
Acer triflorum	Three-flowered maple	269-2017*1	- Zone 4-8 - Best in full sun and moist, acidic, well-drained soil - Consistent fall color - Does well in East, slower growing in West
Acer platanoides × *truncatum*	Purple blow maple hybrid	TBN-C RF 14.121	- Zone 4-8 - Heat and drought tolerant - Can survive heat dry summers of Midwest - Reasonably cold hardy - Tolerant of variety of soils
Acer circinatum × *A. pseudosieboldianum* 'Morton UW'	Morning Starburst™ maple	644-81*1	- Zone 5-8 (tentative, still evaluating) - Vivid crimson fall color
Acer pseudosieboldianum	Korean maple	263-99*1	- Zone 3-8 - Very cold hardy (can survive below -40 F) - Wide spreading
Acer platanoides × *A. truncatum*	purple blow maple hybrid	TBN-C RF 13.128	- Zone 4-8 - Valued as heat and drought tolerant tree - Can survive heat dry summers of Midwest - Reasonably cold hardy - Tolerant of variety of soils

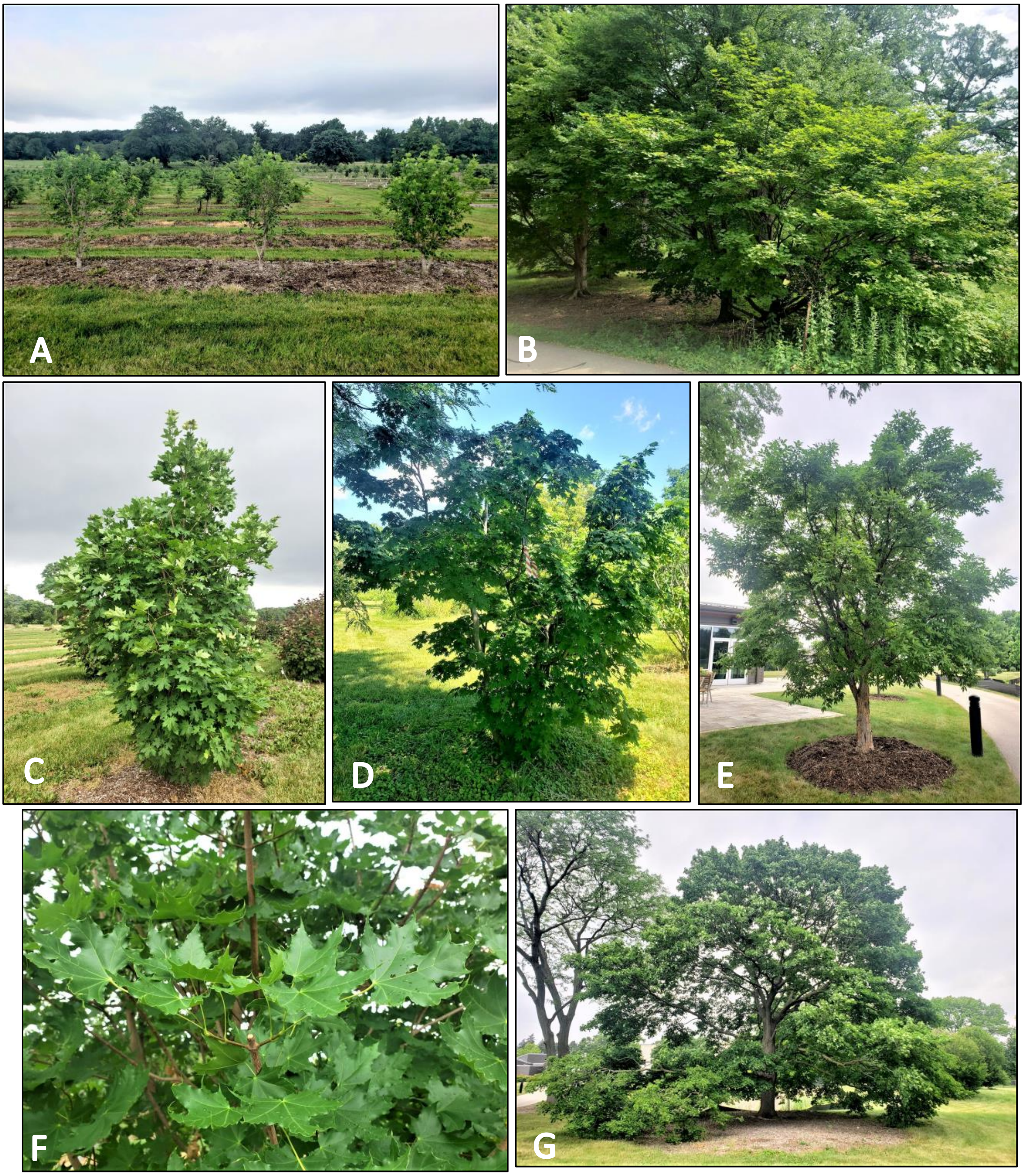

Figure 1. (A) *A. miyabei* 'Morton' State Street® , stock block in tree breeding nursery; (B) *A. circinatum* × *A. pseudosieboldianum* 'Morton UW' Morning Starburst™ , 644-81*1 (C) *A. platanoides* × *A. truncatum* TBN 14.121; (D) *A. pseudosieboldianum* 263-99*1 (E) A. triflorum, 269-2017*1 (F) *A. platanoides* × *A. truncatum* TBN 13.128 (G) *A. platanoides*, 919-61*1; identification numbers preceded by "TBN" are identification numbers associated with individual plants in the Morton Arboretum tree breeding nursery, and other numbers are Morton Arboretum plant identification numbers associated with individuals from the living collections used in this experiment.

Samples were processed June 24, 2022. Cuttings from each individual were treated with varying concentrations of the water-soluble auxin Indole-3-butyric acid potassium salt (K-IBA). Treatment 1 (control) consisted of deionized water. Treatment 2 consisted of 5000 ppm of K-IBA (5 mg/mL). Treatment 3 consisted of 10,000 ppm K-IBA (10 mg/mL). Each treatment was replicated three times in separate 15.75 in. × 15.75 in. × 5 in. Anderson Deep Propagation Flats (Anderson Pots, Portland, Oregon). Each experimental unit was composed of eight cuttings taken from a with the exception of the *A. platanoides* × *A. truncatum* hybrids. For these genotypes, we only had six cuttings per experimental unit available.

Cuttings were stripped of all but 2 or 3 of the topmost leaves to limit evapotranspiration. Wounds were made by scraping the base of each stem with pruners deep enough to expose the cambium layer. Terminal leaves were dipped and swirled in fungicide for ~10 sec. The proximal end of each wounded stem was dipped into a K-IBA treatment for ~10 sec. Cuttings were air dried on newspaper for ~5 min before being inserted at a depth of 2 inches into the propagation substrate (**Fig. 2A**). Propagation substrate was composed of 1 peat: 2 perlite. Cuttings were placed 3 to 4 inches apart in rows of eight according to taxon, and six for both *A. platanoides* × *A. truncatum* hybrids (**Fig. 2B, 2D**). Flats were placed in an overhead fog room at random locations on greenhouse benches (**Fig. 2C**). Continuous fog maintained humidity during the day. Average temperature of the propagation house was ~73.4 °F (Average Max: ~77 °F; Average Min: ~53.6°F). Humidity was close to 100%. Fog was programmed to operate from 60 minutes after sunrise until 90 minutes prior to sunset.

Figure 2. (A) Cuttings being processed, (B) one replication, (C) flats placed in fog room, (D) overhead view of propagation flat.

Rooting results were evaluated 42–50 days after cuttings were initiated (**Fig. 3**). Samples were arranged in randomized block design. Data recorded included percentage of rooting, callusing, and no change/death.

Data on percent rooting, and callusing were subjected to a two-way ANOVA. Fisher's LSD was used for mean separation among taxa. Number of roots and individual root lengths were recorded for each cutting and averaged per treatment.

Figure 3. Rooting 60 days after initiation. One sample from each taxon for each treatment. Left to right: a) *A. miyabei* 'Morton', b) *A. platanoides* 919-61*1, c) *A. triflorum* 269-2017*1, d) *A. platanoides* × *A. truncatum* 14.121, e) A. 'Morton UW', f) *A. pseudosieboldianum* 263-99*1, g) *A. platanoides* × *A. truncatum* 13.128.

RESULTS AND DISCUSSION

Blocking had no significant effect on rooting or callusing percentages based on the two-way ANOVA (**Table 2**). It can be assumed that position in the fog room had no significant effect on rooting success. There was no significant difference in percent rooting or percent callusing between treatments. However, there was a significant difference in percent rooting and percent callusing when comparing between taxa ($p < 0.001$, α=0.0.5).

Our results indicate that water-soluble K-IBA concentrations used in this study do not have a significant effect on rooting success in these seven maple selections after 6 to 7 weeks (**Fig. 4**).

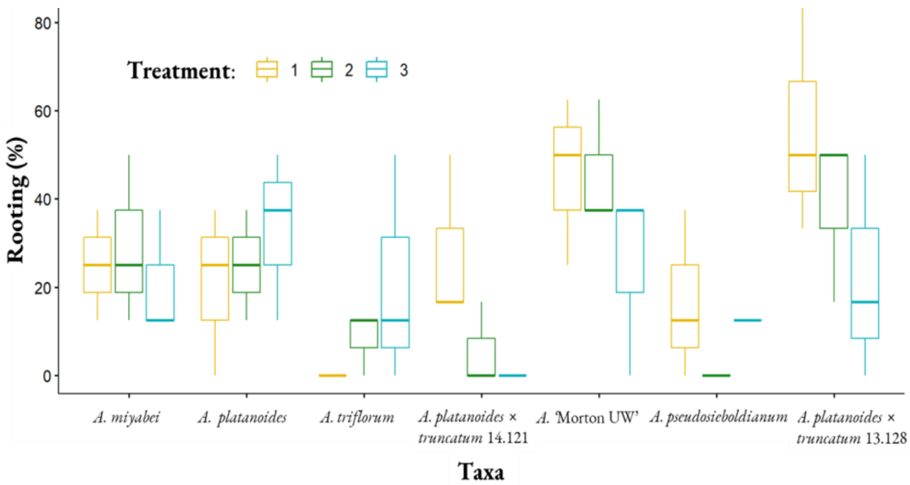

Figure 4. Percent rooting after 42-50 days for maple cuttings treated with 0 ppm (Treatment 1), 5000 ppm (Treatment 2), and 10,000 ppm (Treatment 3) of K-IBA depicted in box plots.

Table 2. Non-significant results after 6-7 weeks for percent rooting, percent callousing, mean root number, and mean root length of maple cuttings treated with varying concentrations of K-IBA.

Taxa	Treatment 1 (Control)				Treatment 2 (5000 ppm)				Treatment 3 (10,000 ppm)			
	Rooting (%)	Callusing (%)	Root No.	Root Length (cm)	Rooting (%)	Callusing (%)	Root No.	Root Length (cm)	Rooting (%)	Callusing (%)	Root No.	Root Length (cm)
A. miyabei **abc***	25.0	33.3	0.29	3.91	29.2	20.8	0.38	3.67	20.8	29.2	1	2.29
A. platanoides **ab***	20.8	79.2	0.67	5.13	25.0	70.8	2.25	4.01	33.3	62.5	1.25	3.76
A. triflorum **c***	0	0	0	N/A	8.33	0	1.08	3.12	20.8	4.2	0.58	7.41
A. platanoides × *truncatum* 14.121 **bc***	2.78	33.3	0.72	5.19	5.56	11.1	0.17	2.27	0	27.8	0	N/A
A. 'Morton UW' **a***	45.8	45.8	1	0.58	45.8	37.5	1	0.82	25.0	50.8	0.46	0.77
A. pseudosieboldianum **c***	16.7	8.33	0.54	4.23	0	8.33	0	N/A	12.5	4.2	0.42	5.32
A. platanoides × *truncatum* 13.128 **a***	55.6	27.8	2.22	7.38	38.9	44.4	0.61	2.12	22.2	72.2	0.33	2.93

* Mean Separation Results from Fisher's LSD Test. Treatments with the same letter are not significantly different.

Results confirmed that different maple genotypes have varying responses to rooted cutting propagation. Selections with the greatest response to rooted cutting propagation after 6 to 7 weeks were *A. platanoides*, *A. platanoides* × *truncatum* 13.128, and *A.* 'Morton UW'.

Further rooting in all seven maple selections was observed 90 days after initiation, suggesting that greater rooting success could potentially be achieved with extended time in the propagation flats before transplanting. Future research could consider data collection at least 90 days or more after initiation (**Fig. 5**).

Figure 5. Rooting of *A. platanoides* × *A. truncatum* 13.128 after 60 days compared to 90 days post-transplanting.

Results from previous scientific studies about the impact of auxins on rooting are varied and inconclusive. As reported by Brock (2014), variation in rooting success can often be attributed to genetic differences among trees. The difference in rooting success between the two *A. platanoides* × *A. truncatum* individuals supports this idea. Additional research could explore concentrations of K-IBA both lower and higher than those used in this study or evaluate various auxin application techniques.

According to Coggeshall (1957), Bachtell and Breslauer (1985), Gabriel (1961), and Brock (2014), it is relatively certain that the age of a tree is a huge determinant of rooting success. Cuttings from mature trees tend to be less successful, while those taken from juvenile stock trees are more likely to produce commercially acceptable percentages of root growth. Future research could consider comparing propagation results of cuttings taken from clonally reproduced and coppiced stock plants (ramets) to the parent tree (ortet).

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