Seed Propagation of *Acer diabolicum*

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INTRODUCTION

The devil maple, *Acer diabolicum*, a species native to Japan, is rarely found in botanic gardens and arboreta in the United States. This rarity is due to its flowering and fruiting characteristics, as well as difficulty in propagation. Since it is a dioecious species, viable seed is usually not available. Devil maple is a member of the rather obscure *Lithocarpa* section in the *Acer* genus, and as a result, cannot be readily propagated via grafting or budding due to a lack of closely related, compatible rootstock species (van Gelderen et al, 1994).

The common name for the species refers to the two horn-like styles that attach to the inner sides of the nutlets between the seed wings (Vertrees, 1978a). The species is perfectly hardy in central Kentucky (Zone 6a) and should be considered for use as a small-sized tree for the homeowner. It has smooth, gray bark reminiscent of beech, and a broad spreading crown profile. The foliage is an appealing deep green in summer; fall foliage coloration is a muted brown. Besides its overall dimensions and apparent hardiness, the greatest ornamental feature of the devil maple are the terminal inflorescences that appear prior to the leaves on male trees. These flowers are a striking red color and are quite noticeable in early May in Kentucky.

In 1964, three trees of *A. diabolicum* were planted at the Bernheim Arboretum and Research Forest. They now average 20 ft tall and 25 to 35 ft wide. Fortunately, the two female and one male trees were planted in close proximity, but only one female produces viable seed. The other female tree flowers approximately 10 days later and, as a result, is out of phase with the male tree. Interestingly, this tree will produce an abundance of parthenocarpic seeds.

Literature indicated that species in the section *Lithocarpa* can require up to 2 or 3 years to germinate (van Gelderen, 1994). A study to investigate the seed germination requirements of this species was initiated in Fall 1998. Results from this study should lead to the development of protocols for producing seedlings that will be screened for fall color potential and/or used as a source of potentially compatible understocks for the male selections.

MATERIALS AND METHODS

A total of 600 seeds were collected on each of three different dates beginning in early September. An additional 150 seeds for each collection date were cut to determine the percentage of filled seed in each lot. Each collection was subsequently divided into a series of five stratification treatments: 3 months cold or 4 months cold, 2 months warm/2 months cold, 2 months warm/3 months cold, and 2 months warm/ 4 months cold. The experimental design for this study was a split-plot arranged in a randomized complete block design with 6 replications, with the stratification treatments considered to be the whole units, and dates of collection as the sub-units.

All seeds were stratified by placing them in polyethylene bags containing moist Canadian peat and sand medium (1 : 1, v/v) for the duration of each treatment period. Warm stratification temperature was approximately 68°F and cold stratification temperature was 40°F. Seeds were subsequently sown at a depth no greater than the width of the seed in flats filled with Metro-Mix® 360. Each flat contained a total of 60 seeds, with 20 seeds sown per collection date for each stratification treatment. Each flat was assigned a random position within each of the 6 replications (blocks) on the greenhouse bench. Temperatures within the greenhouse ranged from 60 to 95°F. Flats were hand watered as needed.

The total number of germinated seedlings was noted at the end of a 30-day period following each sowing date. A germinated seedling was counted based on the presence of true leaves. Percent germination data for each date × treatment × replication combination, was transformed using the arcsin-transformed percent procedure and subjected to analysis of variance (Steele and Torrie, 1960). Treatment mean seperations were tested for significance at $P<0.05$ level following the procedures outlined by Cochoran and Cox (1957).

RESULTS AND DISCUSSION

The percent filled seed, as determined by a cut test of 150 seeds for each collection date, averaged 78%. Despite this potential, the actual germination rate over all collection dates and stratification treatments averaged only 8.6%. Such a minimal result should not be unexpected, however, since species in the *Lithocarpa* section are reported to have the longest dormancy requirements in the *Acer* genus, and may take up to 3 years to germinate (van Gelderen et al., 1994).

The germination rate of devil maple was significantly affected by stratification treatment (T) (Table 1) and date of seed collection (D) (Table 2). In addition, a significant D × T interaction was detected. In general, germination rates decreased for later collection dates for the 3 or 4 month cold stratification treatments. The opposite trend was noticed for the warm/cold stratification treatment data, where germination rates increased with the later collection dates (Table 3). A maximum germination rate of 36% was obtained in this study by collecting seeds in mid-October and placing them in a 2 months warm/ 3 months cold stratification treatment.

Table 1. *Effect of stratification treatments on seed germination of Acer diabolicum*[z].

Treatment	Months warm stratification (no.)	Months cold stratification (no.)	Germination arcsin %[y]
T1		3	13.8 b
T2		4	9.9 b
T3	2	2	10.8 b
T4	2	3	28.1 a
T5	2	4	22.6 a

[y] Values followed by the same letter do not differ at $P< 0.05$.
[z] Germination assessed 30 days after sowing.

Table 2. Effects of seed collection date on germination of *Acer diabolicum*[z].

Date	Collection date	Germination arcsin %[y]
D1	09/3/98	10.8 b
D2	10/22/98	21.1 a
D3	11/17/98	19.2 a

[y] Values followed by the same letter do not differ at $P< 0.05$.
[z] Germination assessed 30 days after sowing.

Table 3. Effects of seed collection date and stratification treatment on seed germination of *Acer diabolicum*[z].

Date	Treatment	Germination arcsin %[y]
D1	T1	14.5 cde
D2		18.5 cd
D3		8.6 e
D1	T2	4.3 f
D2		17.3 cde
D3		8.3 ef
D1	T3	4.4 f
D2		11.2 def
D3		16.7 cde
D1	T4	15.6 cde
D2		36.0 a
D3		32.7 a
D1	T5	15.1 cde
D2		22.8 bc
D3		29.8 ab

[y] Values followed by the same letter do not differ at $P< 0.05$
[z] Germination assessed 30 days after sowing.

Seed Collection Date. Seeds were collected for the study on three different dates beginning in early September. Normal seed fall did not occur until late November in 1998. Early harvest of maple seeds has been cited as one technique to improve germination in some *Acer* species, especially in the Series *Palmata* (Vertrees, 1978b). Early seed collection has also been suggested as a method to overcome dormancy in maples imposed by hard seed coats (Wiegrefe, 1994). In this study, early seed collection in fact resulted in the poorest germination rate (Table 2). Germination was maximized when the seed was collected approximately 1 month before normal seed fall.

Stratification Treatments. The length of stratification, along with temperature, had a significant impact on germination (Table 1). Devil maple apparently requires a combination of warm and cold stratification temperatures to maximize germination, which indicates that the mechanism of seed dormancy in this species may be imposed by both the testa and embryo. Wiegrefe (1994) suggests that testa-imposed dormancy in *Acer* is cold temperature dependent, whereas embryo dormancy is overcome by longerstratification periods when compared to testa-imposed dormant species. In this study, a 2 month warm/3month cold treatment provided the best results over all three seed collection dates.

Devil maple is an obscure species with great potential for surburban landscapes of the MidWest. Its characteristic growth rate, size, and shape, appealing foliage and bark, as well as the spectacular flower display on male trees, are just some of the reasons to justify growing this species. Seed propagation information for the species is lacking, due to scarcity of seed supply. While the present study is by no means conclusive, it does provide some insight into the seed dormancy requirements for the species. It appears that devil maple exhibits a characteristic double dormancy which can be partially overcome by means of combining a warm/cold stratification schedule with a seed harvest date approximately 1 month prior to normal seed fall. Such a prescription may allow the grower to produce a meaningful number of seedlings (35%) within 6 months of seed harvest. It is anticipated that the germination percentage might increase significantly as the stratification schedule is lengthened.

LITERATURE CITED

Cochran, W.G., and **G.M. Cox.** 1957. Experimental designs. 2nd ed. John Wiley & Sons, Inc., New York.

Steele, R.G.D., and **J.H.Torrie.** 1960. Principles and procedures of statistics. McGraw-Hill Book Co. New York.

van Gelderen, D.M., P.C. de Jong, and **H.J. Oterdoom.** 1994. Maples of the world. Timber Press. Portland, Oregon.

Vertrees, J.D. 1978a. Japanese maples. Timber Press, Portland, Oregon.

Vertrees, J.D. 1978b. Notes on propagating certain *Acers*. Comb. Proc. Plant Prop. Soc. 28:93-97.

Wiegrefe, S.J. 1994. Overcoming dormancy in maple seeds without stratification. N. Amer. Region Plant Propagator. 6(3):8-11.