ACER GRANDIDENTATUM AND ITS PROPAGATION

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Abstract: Acer grandidentatum is practically a diminutive of *Acer saccharum* to which it is closely related. Widely distributed throughout the Intermountain region of the United States, its attributes include outstanding foliage coloration in the fall and tolerance of drought and alkaline soil conditions. There was highly significant variation in number of seed-filled samaras harvested from 86 plants in 1972; also from plants at different elevations. Empty samaras resulted from aborted embryos and infestation by larvae of a *Euclyptus* weevil. By March 9, 1973, 36 seed lots had germinated out of 76 that had been stratified. The radicle length means of these germinated seed lots ranged between 2.6 and 25.4 mm. The mean height of the seedlings grown from seven representative seed lots ranged between 4.34 and 5.98 cm at 1-year age and 16.35 and 29.10 cm at 2-year age.

The dazzling spectacle of scarlets and oranges imparted by the bigtooth or canyon maple, *Acer grandidentatum* Nutt., is a major component of the autumn scene in many parts of Utah. Yet few people elsewhere seem to know about it or its nobility. Apparently Li (5), who mentioned it in his comprehensive paper on the cultivated maples, was unaware of its attributes.

Discovering its fall coloration is a dramatic experience. Gene Bauer, an artist living in southern California, who, with her husband, first saw canyon maples while traveling through Utah in October 1970, described the experience in a letter:

"I couldn't wait to jump out of the car and run over to them. I was spellbound by their beauty . . . They were the exact same gorgeous color of the sugar maples of the eastern United States, the very trees we were journeying across the country to see . . . The leaves were basically the same shape but smaller and the trees themselves were very much like the eastern tree but again smaller. They were dwarf sugar maples. The brilliant color of their leaves could not be surpassed. These particular trees had retained their lower branches so the lower leaves barely skirted the ground. What a thrill to step under the canopy of leaves and see the sun rays streaming through them . . .. The sides of the mountains looked like a marvelous patchwork quilt . . .. The ravines especially were covered with [them], some yellow, some yellow-orange, some apricot colored, some scarlet, some blazing red and some still green."

Taxonomy. Experimental evidence of a number of workers, based almost entirely on leaf characters, suggests that *Acer grandidentatum* Nutt. is one of several subspecies of *Acer saccharum* Marshall (4).

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Distribution. Besides occurring in solid stands along a north-south axis through central Utah, the continuous range of *A. grandidentatum* includes southeastern Idaho and southwestern Wyoming, Arizona, New Mexico, and the Guadalupe, Davis, and Chisos Mountains of southwestern Texas (7). It is also a disjunct species in the Wichita Mountains of southwestern Oklahoma, its easternmost limit (6), and in the northwestern corner of Montana, its northernmost limit.

A. grandidentatum occurs on a wide range of both moist and dry sites, and from limestone-talus slopes where the pH is alkaline to sites where the soil is a fertile loam of moderately acid pH. Soil pH at 10 canyon maple sites in the mountains surrounding Cache Valley, Utah, ranged from 6.2 to 7.5 with a mean of 7.17 in 1975. The species is hardy at sustained winter temperatures of −35° C (−25° F) and tolerates summer temperatures well above 38° C (100° F).

One of its principal ecological niches is the sides and bottoms of canyons, hence my preference for the name "canyon maple," a name as western as the plant itself.

Form and Size. This maple is typically a 2- to 6-meter (6- to 20-foot) multistemmed shrub, but single-trunk trees as high as 12 meters (40 feet) exist. The widespread variations in form and size are believed to reflect genetic differences evolving from site selection pressures.

Current Research. My study of the canyon maple, which began in 1970, has centered in northern Utah near the northern limits of the maple's continuous range (1, 2). The objectives of this research were to assess the pattern of the fall foliage coloration, select and eventually cross superior individuals (phenotypes), and develop propagation and other silvicultural information about the canyon maple. This paper describes results of studies relating to its propagation.

PROPAGATION BY SEED

Procedures. Fruit yield in *A. grandidentatum* in northern Utah is frequently meager, but in 1972 it was unusually heavy; likewise in 1975 in Logan Canyon and other canyons east of Logan, Utah. We harvested the 1972 crop from late August through early October from 86 plants that had unique form, unusually brilliant fall foliage coloration, or both.[2] These seed-source plants and about half as many nonfruiting ones were permanently tagged for future observation and as sources of seeds in succeeding years. All are located at elevations between 1,550 and 2,280 meters (5,100 and 7,500 feet), primarily in canyons draining into Cache Valley of northern Utah and southeastern Idaho in which Logan, Utah, is the principal city.

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We handpicked the fruit, bagged it separately in polyethylene bags for each of the selected plants, and delivered it daily to the laboratory where it was immediately stored at 1° C (34° F). Within a few days after collection, the number of samaras filled and empty of seeds was estimated by the usual cutting test. We drew two 25-samara samples from each seed lot (tree source) for this purpose. In late November each of 76 seed lots was mixed with an equal volume of moist sand or a moist 50-50 v/v peat-perlite medium, either repackaged in polyethylene bags or sealed in glass jars and stored at 1° C until planting time the following spring. With both kinds of media, there was adequate moisture for after-ripening and the samaras remained free of fungi.

Filled samaras were not sorted from empty ones before storage, but radicle elongation in some of the seed lots by early March 1973 made sorting possible. This also made it practical to use Jiffy-7 peat pellets[3] planted with only filled samaras. This was done by inserting the radicle of the seed into a hole made into the expanded pellet and then gently pressing the hole closed. Seed of some of the germinated lots was planted in "1-quart" plastic pots, also in early March.

Following planting, all of the planted pellets and pots were held in a greenhouse for several weeks at 18° C (65° F) during the day and 14° C (57° F) at night. The seedlings started in both the pellets and the "1-quart" pots were shifted into "1-gallon" plastic containers at age 6 weeks and into "1½-gallon" metal containers at the beginning of the second growing season. Each shift was into a medium of equal volumes of Canadian peat, fine sand, and a fine sandy loam soil. Seedlings were fertilized with a water-soluble, 20-20-20 fertilizer three times during each of the two growing seasons. Iron chelate also was applied once each season.

RESULTS AND DISCUSSION

Seed Quality. An analysis of variance mean squares (table 1) showed significant differences in the amount of filled samaras harvested in 1972 from different plants and from different elevations. Filled samaras from the 86 plants ranged between 92.0 and 2.0 percent with mean and standard deviation percentages of 43.2 and 23.8, respectively. Samaras with the most seeds came from plants growing at elevations between 1,800 and 1,900 meters (5,900 and 6,200 feet). Samaras with the fewest seeds were from plants located below 1,600 and above 2,000 meters (5,300 and 6,500 feet).

[3] Use of trade or firm names is for reader information only, and does not constitute endorsement by the U.S. Department of Agriculture of any commercial product or service.

Table 1. Analysis of variance mean squares for effects of elevation (Analysis A) and plants (Analysis B) on quality of samaras of *Acer grandidentatum* growing in northern Utah that were collected in 1972 from plants located within 30-meter (100 foot) elevational zones (54 plants in three nearby canyons) for Analysis A and from an additional 32 plants (N=86) for Analysis B.

		Mean square for condition indicated		
		Empty samaras		
Source of variation	Degrees of freedom	Aborted ovary	Insect infested	Filled samaras
		(Analysis A)		
Elevation	17	56.8**	194.6**	107.2**
Error	90	10.3	28.6	17.0
		(Analysis B)		
Plants	85	39.9**	98.8**	64.8**
Error	86	3.1	6.1	2.8

**Statistically significant at the 1 percent probability level.

Ordinarily, when only a few of the trees in a stand bear fruit, most of the seeds are consumed by late August by tiny larvae of a *Euclyptus* weevil (1) and occasional moth larvae. But in 1972, with weather presumably favorable for pollination of the flowers followed by the development of an abundance of fruit, there were proportionately more filled samaras than usual because insect infestation lagged behind the abrupt rise in host populations. Insect infestations were present in 37.0 percent of all samaras in the 86 seed lots.

Failure in propagating *A. grandidentatum* from seed has not been an uncommon experience among the few nurserymen and others who have tried to grow it. These failures are apparently due in part to planting empty samaras that had been infested by insects or had aborted ovaries, even when the presence of a heavy fruit crop may have suggested otherwise.

Seed Germination. By March 9, 1973, 36 of the 76 seed lots that were in stratification storage had germinated. A seed was considered germinated if the radicle was visible. The radicle length mean for these 36 seed lots was 10.42 mm (standard deviation 5.62 mm). The seed lots with the longest radicles probably germinated the earliest (3).

The absence of germination in more than half of the seed lots and the different magnitude of radicle elongation in the seed lots that did germinate support the idea that changes in endogenous hormones during stratification proceeded at different rates in seeds from the different plants. A particular rate of such change could be a desirable selection criterion for genetic improvement work with this maple. Differential radicle elongation also suggests the possibility of using seed from an array of these plants in assessing the presence and differential levels of endogenous germination inhibitors and promoters (8, 9).

Seedling Development. Several lots of the germinated and ungerminated samaras that had been in stratification storage were sown in seed flats and the bare-root seedlings were shifted into 1-quart plastic pots at age 4 weeks. There was high mortality among these seedlings after shifting and the survivors had no further growth that year. This problem corresponds to that described by Kenneth Taylor for this maple taxon and by Ed Wood for some other maples in personal communications (1975). The reason for it is not apparent, although Wood reported that some of the maples require an overwintering before they are bare-rooted.

Seven of the seed lots that germinated in storage were used in an experiment to assess seedling survival and growth when planted in Jiffy-7 peat pellets. The experiment comprised five 20-germinant plots per seed lot. Results are shown in table 2. The germinants from seed lot 10 (tree 10) lacked vigor and had high mortality. The reason for this is not apparent. The few germinants in this seed lot that did survive grew as well as the others.

There was very little internode elongation in these seedlings during the first growing season. This is attributed to the presence of a survival mechanism that favors root elongation at the expense of shoot elongation in first-year seedlings of this species. On dry sites, where canyon maple often grows, this may be a desirable attribute. But under more favorable moisture conditions, such as in nursery cultivation, it could be a liability in terms of production time requirements. Therefore, the use of an exogenous phytohormone to promote shoot elongation in first-year seedlings of canyon maple should be explored.

Height growth of the seedlings at the end of the second growing season averaged 23.84 cm (9.39 inches).

The pattern of growth of the seedlings in the foregoing experiment typifies that of the seedlings produced from the other seed lots collected in 1972.

Table 2. Size of *Acer grandidentatum* seedlings at 1 and 2 yeais and other growth indices at 1 year[1].

Seed lot (plant No.)	Age 1 year					Age 2 years	
	Germinant survival rate, %	Pairs of leaves	Height cm	Height inches	Growth index	Height cm	Height inches
	(A)	(B)	(C)		(A×B×C)		
61	92	6.76	5.44	(2.14)	3.45	26.77	(10.54)
140	99	5.00	5.82	(2.29)	2.91	25.43	(10.01)
38	72	7.22	4.86	(1.91)	2.52	24.83	(9.78)
7	88	5.18	4.48	(1.76)	2.15	23.30	(9.17)
64	90	5.24	4.34	(1.71)	2.03	16.35	(6.44)
29	91	4.72	4.27	(1.68)	1.94	21.10	(8.31)
10	12	7.48	5.98	(2.35)	0.48	29.10	(11.46)
Mean	77.7	5.94	5.03	(1.98)	2.21	23.84	(9.39)

[1] Each seed lot value is a mean of 100 observations × the germinant survival rate ÷ 100.

LITERATURE CITED

1. Barker, Philip A. 1974. The spectacular canyon maple. *Utah Sci.* 35(1):7-10.
2. Barker, Philip A. and D.K. Salunkhe. 1974. Syrup production from canyon maple. *Utah Sci.* 35(1):13-16.
3. Carl, Clayton M. Jr. and Harry W. Yawney. 1966. Four stratification media equally effective in conditioning sugar maple seed for germination. *Tree Planters' Notes* 77:24-28.
4. Kriebel, H.B. and W.J. Gabriel. 1969. Genetics of sugar maple. *USDA For. Serv. Res. Pap.* WO-7, 17 p. Washington, D.C.
5. Li, Hui-Lin. 1960. The cultivated maples. *Morris Arboretum Bull.* 11(3):41-47.
6. Little, Elbert L. Jr. 1944. *Acer grandidentatum* in Oklahoma. *Rhodora* 46:445-450.
7. Sargent, Charles Sprague. 1933. Manual of North American trees. 910 p. Houghton Mifflin Co., Boston.
8. Vogt, Albert R. 1974. Physiological importance of changes in endogenous hormones during red oak acorn stratification. *For. Sci.* 20(2):187-191.
9. Wareing, P.F. 1965. Endogenous inhibitors of seed germination and dormancy. Encyclopedia of Plant Physiology Nos. 15/2:909-922.