Propagation of Twelve Alaska Native Plants by Summer Stem Cuttings

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Abstract

Twelve Alaska native plants were propagated from softwood and semi-hardwood stem cuttings collected from late June through August. Cuttings of new growth were treated with 0.3% indole-3-butyric acid powder and propagated in horticultural grade perlite and vermiculite (1:1 by vol) under intermittent mist with bottom heat [26°C (79°F)] in a greenhouse with a minimum night temperature of 15°C (59°F). After 6 weeks, cuttings were harvested and evaluated for rooting percentage and root quantity. Four species rooted poorly (< 25%) regardless of collection date: Siberian alder (Alnus viridis ssp. fruticosa), silverberry (Elaeagnus commutata), Bebb willow (Salix bebbiana) and shrub birch (Betula glandulosa). Best rooting (> 80%) occurred June 20 for: Beauverd spiraea (Spiraea stevenii), sweetgale (Myrica gale), and thimble alder (Alnus incana ssp. tenuifolia). Peak rooting for dwarf birch (Betula nana), feltleaf willow (Salix alaxensis), balsam poplar (Populus balsamifera), Labrador tea (Ledum groenlandicum) and littletree willow (Salix arbusculoides) was early to mid July. During peak rooting times, all successful species developed adequate root quantities for survival following transplanting.

Index words: softwood stem cuttings, semi-hardwood stem cuttings, intermittent mist propagation.

Species used in this study: thimble alder (Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung); Siberian alder (Alnus viridis (Chaix) DC. ssp. fruticosa (Rupr.) Nyman); dwarf birch (Betula nana L. ssp. exilis (Sukaczew) Hult.); shrub birch (Betula glandulosa Michx.); silverberry (Elaeagnus commutata Bernh. Ex Rydb); Labrador tea (Ledum groenlandicum Oeder); sweetgale (Myrica gale L.); feltleaf willow (Salix alaxensis (Anderss.) Coville var. longistylis (Ryd.) C.K. Schneid.); littletree willow (Salix arbusculoides Anders); balsam poplar (Populus balsamifera L. ssp. balsamifera); Bebb willow (Salix bebbiana Sarg); and Beauverd spiraea (Spiraea stevenii (C.K. Schneid.) Rydb.).

Significance to the Nursery Industry

Eight Alaska native shrubs and shrubby trees showed sufficient rooting percentages and root quantity rating for possible commercial greenhouse propagation by new growth, softwood or semi-hardwood stem cuttings: balsam poplar, Beauverd spiraea, dwarf birch, feltleaf willow, Labrador tea, littletree willow, sweetgale and thimble alder. With the exception of dwarf birch (57%), all cuttings rooted more than 80% under mist in perlite/vermiculite (1:1 by vol) with bottom heat and 0.3% IBA powder. Best rooting percentages were obtained from June 20 through July 29. In Alaska's short growing season, greenhouse propagation is possible between the end of the spring bedding plant season and the closure of greenhouses in late September. Rooting is sufficiently fast so that rooting may be completed by greenhouse closure in autumn. Four shrubs rooted poorly and cannot be recommended at this time: silverberry, shrub birch, Bebb willow and Siberian alder.

Labrador tea, Beauverd spiraea, silverberry, dwarf and shrub birch and sweetgale are recommended for use in home and commercial landscapes (1, 10), but they are available through nurseries only in limited quantities (2).

Less than one percent of Alaska's lands are privately owned. The remainder is managed by a variety of state and federal agencies, all of which have reclamation/vegetation plans for Alaska's wild lands (e.g. 4, 27) Most plans emphasize seed-propagated plants especially grasses, but there is an unfulfilled need for species such as willow, alder, poplar and a variety of other native shrubs for streambank stabilization, mine and oil field reclamation, roadside stabilization and more (Joyner, P. Alaska Urban and Community Forestry Program, Anchorage, AK. Pers. Comm. 2008; Densmore, R. U.S. Geological Survey, Anchorage, AK. Pers. Comm. 2007). The greenhouse/nursery industry has not addressed that need, in part because other segments of the industry such as bedding plants and woody ornamentals are more lucrative than native plants, but there is also a lack of knowledge by growers of commercial propagation techniques.

With the exception of some willow species (3, 26, 28), few Alaska native plants are propagated clonally by stem cuttings and not in quantities useful for landscape contractors and resource managers. Despite reports of propagation success for many species growing over wide geographic areas including Alaska (6, 7, 8, 12, 13, 16, 17, 18, 19, 21, 22, 24), it is not known how applicable this research is to Alaska genotypes and growing conditions. For instance, silverberry is characterized as a relatively easy-to-root species (16, 21, 22), yet an Alaska study did not support those findings (11). Additionally, no information is available on methods that fit well with the existing Alaska commercial landscape/nursery industry with an effective three-month propagation season. The objectives of this project were to identify easy-to-root native species and

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optimum stem cutting collection times for clonal propagation during the short Alaska summer season.

Materials and Methods
Cuttings of current year stem growth of 12 species selected for study were collected from wild stands near Fairbanks, Alaska or the University of Alaska Fairbanks Experiment Farm and Georgeson Botanical Garden (64°51'N, 147°52'W) (Table 1). Four replicates of 25 cuttings for each species were stuck at approximately two-week intervals from June 20 through August and remained in the mist bench for 6 weeks. Design was completely randomized with individual cutting flats re-randomize on the bench when new cuttings were added. Cuttings were treated with 0.3% indole-3-butyric acid powder and propagated in perlite/vermiculite (1:1 by vol) under intermittent mist with bottom heat [26°C (78°F)] in a greenhouse with a minimum night greenhouse temperature of 15°C (59°F). From September 17th to the end of the experiment, supplemental air heat was added to the greenhouse to maintain the minimum night temperature. Light consisted of natural daylight ranging from 21:52 hr to 9:46 hr. No attempt was made to equalize light among treatments to emulate commercial greenhouse conditions since few businesses use supplemental lights. Data consisted of number of rooted cuttings and percent rooting per treatment, and rooted cuttings were rated for root quantity. The final rating was conducted on October 15th. The three root quantity classes were: 1 = few roots (1–3 roots per cutting) the propagation medium falling off of the roots with a gentle shake of the cutting; 2 = moderate number of roots (4–8 roots per cutting), the propagation medium clinging to roots but most removeable with vigorous shaking; and 3 = abundant roots (> 8 roots per cutting), the propagation medium difficult to remove without washing roots. roots. Because Labrador tea produces few individual roots that eventually become finely branched clumps, the root quantity rating for this species was: few = 1–2 roots; moderate = 3–4 roots; and abundant = > 4 roots per cutting. Based upon past experience in our research greenhouse, this rating system allows for quick, non-destructive inspection of cuttings and rapid separation into classes by minimally trained personnel. For species grown in our greenhouse over the past 20 years, a minimum rating of 2 was considered necessary for optimum survival of cuttings upon transplanting although in this study transplant survival was not evaluated. Percentage data were analyzed for each species individually using regression analysis and curve fitting using arctan-transformed data to create predictive models for optimum percent rooting throughout the season. Root quantity ratings were compared among dates using the non-parametric Kruskal-Wallis test, P < 0.05 (9).

Results and Discussion
Four species rooted poorly (< 25%) regardless of collection date: Siberian alder, silverberry, Bebb willow and shrub birch. Best rooting (≥ 80%) occurred at the earliest collection date, June 20th, for sweetgale, Beauverd spiraea and thinleaf alder (Fig. 1, Table 2). Peak rooting for dwarf birch, feltleaf and littletree willows, balsam poplar and Labrador tea was later in the season in early or mid July. Rooting percentages declined rapidly through the season for sweetgale, and thinleaf alder, and a similar decline occurred later in the season for fettelfelay willow, balsam poplar, littletree willow and dwarf birch. Only two species, Beauverd spiraea and Labrador tea, showed rooting percentages > 60% at the end of August. At least for summer cuttings, the collection window for cuttings is shorter for all plants except Beauverd spiraea and Labrador tea.

Species with the highest rooting percentages on June 20th (sweetgale, Beauverd spiraea, thinleaf alder) showed high root quantity ratings on that date (Fig. 1, Table 2) and for spiraea and thinleaf alder, ratings did not differ significantly among collection dates through mid July. The two willows that rooted best in mid July showed high root quantity ratings through June and July, and for littletree willow, into August. Even with pre-formed root initials, these species showed a seasonal pattern of rooting, but once roots were initiated, development was rapid and abundant. All species showed average root quantity ratings near the optimum 2.0 or higher during the time of greatest rooting percentages (Table 2). Labrador tea did not follow the pattern of large masses of roots but produced tiny branching strands of thin, nearly translucent roots that may require additional time to establish transplantable rooted cuttings.

Our results for summer cuttings agree with previous research for Labrador tea (7), sweetgale (7, 20, 23), and dwarf birch (4, 24). Others have reported success with spring hardwood, softwood stem tip and mid-summer cuttings of silverberry (8, 16, 19, 20, 21, 22), but we did not have

Table 1. Collection location for 11 Alaska native plants.

| Cutting source                                      | Plant                                      |
|-----------------------------------------------------|--------------------------------------------|
| Cultivated, agricultural fields, Fairbanks Experiment Farm, elev. 137 m (450 ft) | Balsam poplar, *Populus balsamifera* L. ssp. *balsamifera* |
|                                                      | Bebb willow, *Salix bebbiana* Sarg.        |
|                                                      | Feltleaf willow, *Salix alaxensis* (Anders.) Coville |
|                                                      | *var. longistylis* (Rydby) C.K. Schneid.   |
|                                                      | Littletree willow, *Salix arbusculoides* Anderss. |
| Cultivated, constructed wetland, Georgeson Botanical Garden, elev. 138 m (454 ft) | Sweetgale, *Myrica gale* L. |
| Wild collected, black spruce ( *Picea mariana* ) bog, elev. 137 m (450 ft) | Silverberry, *Elaeagnus commutata* Bernh. Ex Rydb. |
| Wild collected, dry roadside, elev. 609 m (2000 ft) | Labrador tea, *Ledum groenlandicum* Oeder |
| Wild collected, subalpine ridge, elev. 625 m (2050 ft) | Thinline alder, *Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung |
|                                                      | Beauverd spiraea, *Spiraea stevenii* (C.K. Schneid.) Rydb. |
|                                                      | Shrub birch, *Betula glandulosa* Michx.    |
|                                                      | Siberian alder, *Alnus viridis* (Chaix) DC. ssp. *fruticosa* (Rupr.) Nyman |

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similar success. Sciannia (21) noted it took 12–16 weeks for silverberry cuttings to root fully. Our six-week project may not have been long enough to get results, but longer rooting times would not work well commercially for the short Alaska summer season.

Hardwood cuttings are the most common type used for our species of poplar and willows (3, 4, 5, 11, 12, 18) primarily because cuttings may be direct stuck in the field. However, we show that midsummer cuttings are also successful for greenhouse propagation for littletree and feltleaf willow but not Bebb willow.

Thinleaf alder rooted from midsummer cuttings, whereas the Siberian alder did not. In past research (11) neither species of alder rooted well under mist from either hardwood or softwood cuttings. Because all plant materials from these species were wild-collected, germplasm differences or plant growing conditions could explain the discrepancies. Huss-Daniel (13) found that eight of nine tested clones of thinleaf alder from a variety of geographic locations rooted easily from leafy stem cuttings, but one consistently rooted poorly indicating a genetic component to rooting. Other research has shown that softwood cuttings of thinleaf alder are very easy to propagate (17).

Densmore and Zasada (5) suggested that riparian species of willow have adapted the ability to produce roots on stem cuttings more easily and rapidly than non-riparian species in order to colonize and survive in floodplain habitats. Their study and ours showed that the riparian species, feltleaf willow, rooted easily, while the non-riparian Bebb willow, did not. Littletree willow, commonly found along streambanks and rivers in interior Alaska fits the profile of an easily rooting riparian species, as does balsam poplar in our study and others (14, 15). A similar generalization cannot be made with other species such as poorly rooting shrub birch and

![Fig. 1. Rooting percentages and predicted response curves for eight Alaska native plants from June 20th through August.](https://example.com/fig1.png)

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Table 2. Predictive models, maximum rooting percentages and root rankings for 8 species of Alaska native plants.

| Species              | Maximum rooting (%) + SD | Predicted optimum rooting date | Model for predicting rooting percentages | Maximum root quantity rating + SD | Date(s) of maximum root quantity rating |
|----------------------|--------------------------|-------------------------------|------------------------------------------|----------------------------------|----------------------------------------|
| Balsam poplar        | 87.5 ± 8.7               | July 17                       | y = 4.727 + 3.727x - 0.0395x² + 0.68    | 2.1 ± 0.2                        | June 20–July 29                         |
| Beauverd spirea       | 95.0 ± 4.0               | June 20                       | y = -0.1895x + 95.21, R² = 0.78          | 2.4 ± 0.4                        | June 20–July 19                         |
| Dwarf birch          | 57.5 ± 10.4              | July 6                        | y = -78.36 + 8.509x - 0.1653x + 0.000894x², R² = 0.80 | 1.8 ± 0.4                        | June 20–July 29                         |
| Feltleaf willow      | 93.7 ± 7.5               | July 11                       | y = 41.64 + 2.268x - 0.03149x², R² = 0.73 | 2.1 ± 0.3                        | June 20–July 29                         |
| Labrador tea         | 88.7 ± 2.4               | July 18                       | y = -106.9 + 9.505x - 0.1576x + 0.00008156x², R² = 0.75 | 1.6 ± 0.4                        | June 20–August 22                       |
| Littletree willow    | 92.5 ± 8.6               | July 15                       | y = 21.13 + 3.423x - 0.03671x², R² = 0.74 | 1.8 ± 0.3                        | June 20–August 22                       |
| Sweetgale            | 95.0 ± 5.8               | June 20                       | y = 90.01 + 0.2614x - 0.01129x², R² = 0.88 | 2.7 ± 0.3                        | June 20                                 |
| Thinline alder       | 80.0 ± 10.8              | June 20                       | y = -1.184x + 100.2, R² = 0.97           | 1.8 ± 0.4                        | June 20–July 29                         |

*All species except Labrador tea: 1 = 1–3 roots per cutting, transplant success questionable; 2 = 4–8 roots per cutting, transplant success possible; 3 = > 8 roots per cutting, transplant success possible. Labrador tea: evaluations the same except 1 = 1–2 roots per cutting; 2 = 3–4 roots per cutting; and 3 = > 4 roots per cutting.

†Maximum root ratings between the dates listed did not differ significantly, Kruskal-Wallis test, P < 0.05.

| Species              | Maximum rooting (%) + SD | Predicted optimum rooting date | Model for predicting rooting percentages | Maximum root quantity rating + SD | Date(s) of maximum root quantity rating |
|----------------------|--------------------------|-------------------------------|------------------------------------------|----------------------------------|----------------------------------------|

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