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# VEGETATIVE PROPAGATION OF 11 COMMON ALASKA WOODY PLANTS

by

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## ABSTRACT

Vegetative propagation trials were conducted with stem, root, and rhizome cuttings of *Alnus*, *Arctostaphylos*, *Ledum*, *Populus*, *Salix*, *Shepherdia*, *Vaccinium*, and *Viburnum*. With the exception of *Alnus incana* and *Shepherdia canadensis*, stem cuttings of all species produced some roots. Softwood stem cuttings of *Salix bebbiana* and *Viburnum edule* rooted much better than hardwood cuttings of the same species; hardwood and softwood stem cuttings of other species were about equal in performance. Rooting media, wounding, and hormone treatments did not affect rooting of stem cuttings in the majority of cases. Root or rhizome cuttings of *Vaccinium uliginosum* and *Shepherdia canadensis* appeared more promising for vegetative propagation of these species than stem cuttings.

KEYWORDS: Vegetative propagation, stem cuttings, root cuttings, rhizome cuttings, woody plants, Alaska .

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## INTRODUCTION

Restoration and/or rehabilitation of sites severely disturbed by pipeline, highway or similar construction, and mining is often mandated by law. Although the most common practices used to replace vegetation are best described as agronomic (grass seeding and fertilization), there is increasing interest in the use of native plants (Johnson and Van Cleve 1976, Freeman et al. 1977). Since woody plants are a major component of forested and nonforested Alaska ecosystems, there is a need to determine methods for obtaining adequate quantities of suitable plant materials for revegetation purposes.

Woody plant materials can be propagated by seed or by various vegetative methods. There is a great deal of information available on ways to propagate woody plants (Hartmann and Kester 1975, U.S. Department of Agriculture, Forest Service, 1974); however, its general applicability to Alaska species is not known. For example, it was generally believed that North America willow seed was nondormant and could not be stored. Research with Alaska willows identified species with dormant seed and revealed that seed of at least five species (dormant and nondormant seeded species) could be stored for up to 3 yrs without a significant reduction in viability[2/] (Brinkman 1974, Zasada and Viereck 1975, Zasada and Densmore 1977). Results of this type suggest that surveys of reproductive characteristics may be necessary to determine the full potential of each species for revegetation programs.

This report summarizes the results of a study designed to examine the rooting response of stem cuttings of 11 native Alaska shrub and tree species in a controlled environment:

| Scientific name[3/] | Common name |
|---|---|
| *Alnus crispa* (Ait.) Pursh ssp. *crispa* | American green alder |
| *Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung | Thinleaf alder |
| *Arctostaphylos uva-ursi* (L.) Spreng. var. *uva-ursi* | Bearberry |
| *Ledum palustre* L. subsp. *groenlandicum* (Oeder) Hult. | Labrador tea |
| *Populus balsamifera* L. | Balsam poplar |
| *Salix alaxensis* var. *longistylis* (Rydb.) Schneid. | Feltleaf willow |
| *Salix bebbiana* Sarg. | Bebb willow |
| *Salix scouleriana* Barratt. | Scouler willow |
| *Shepherdia canadensis* (L.) Nutt. | Buffaloberry |
| *Vaccinium uliginosum* L. ssp. *alpinum* (Bigel.) Hult. | Bog blueberry |
| *Viburnum edule* (Michx.) Raf. | Highbush cranberry |

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2/ Unpublished data on file at Institute of Northern Forestry, USDA Forest Service, Fairbanks, Alaska.

3/ Nomenclature follows Hultén (1968).

Smaller studies were also undertaken to test these species in the field and to examine shoot production potential of underground parts of these species.

## METHODS

### Hardwood and Softwood Stem Cuttings

Hardwood stem cuttings were collected between September 17 and October 15, 1976, from sites near Fairbanks, Alaska. All material was moistened, wrapped in polyethylene bags, and placed in cold storage at 4.5°C for approximately 2 wk after which it was trimmed for further treatment.

Cuttings of *Salix* spp., *Alnus* spp., and *Populus balsamifera* consisted entirely of new growth with the proximal cut not greater than 1 cm below a node, and with a minimum of three viable buds. The cuttings of the remaining shrub species consisted of all available new growth plus a heel of 1-yr-old tissue.

The stems of each *Salix* species were further separated into base and tip cuttings. The base cutting contained the oldest of the newly hardened tissue immediately above the 1-yr-old stem tissue. The tip cuttings contained stem tissue from the apex of the newest growth.

The cuttings were divided into two groups. One group was buried in flats of sterilized native peat which were wrapped in opaque polyethylene bags and placed in cold storage for later planting in the field. The remaining group of cuttings was planted immediately and placed on an intermittent mist propagation bench in the greenhouse (22°C average air temperature, 26.7°C bottom heat). The mist cycle was approximately 5 sec of mist every 15 min.

The propagation bench was divided into 5 randomized blocks with 20 treatments per block and 82 cuttings per treatment. Supplemental lighting was provided by two 40-watt cool-white fluorescent bulbs suspended 1 m above the bench.

Cuttings of each species were divided between two propagation media, horticultural grade perlite and sand. Further treatments within these media included:

1. Control.
2. Powdered auxin treatment. The proximal portion of each stem cutting was dipped into a powdered formulation of Indole-3-butyric acid (IBA), Hormodin #3.
3. Wounding treatment. The bark of the proximal end of each cutting was severed with the pointed tip of a knife for approximately 2-3 cm upward from the base.
4. Powdered auxin-wounding treatment. A combination of treatments 2 and 3 above.
5. Liquid auxin-wounding treatment. Following wounding as in treatment 3 above, cuttings were soaked for 5 min in a concentrated, 2,000 ppm liquid formulation of IBA.

Cuttings of all treatments were checked three times weekly for successful rooting, which was defined as the first indication of root emergence

from the cutting surfaces. The data recorded for each treatment included the percentage of successfully rooted cuttings for each species and the average time it took for roots to emerge. The rooted cuttings were planted in flats of moist peat for possible transplanting into the field sites.

Rooting percentages were treated statistically with the analysis of variance for randomized complete block design and, where applicable, with Duncan's New Multiple Range Test at the 5-percent level (Steel and Torrie 1960).

With slight variations, this experimental design was repeated for the study of softwood cuttings. Cuttings were collected from sites near Fairbanks, Alaska, between July 5 and July 19, 1977, and immediately trimmed to cutting length for further treatment:

| Species | Average length (cm) |
|---|---|
| *Alnus crispa* | 17 |
| *Alnus incana* | 20 |
| *Arctostaphylos uva-ursi* | 10 |
| *Ledum palustre* | 15 |
| *Populus balsamifera* | 20 |
| *Salix alaxensis* | 20 |
| *Salix bebbiana* | 20 |
| *Salix scouleriana* | 20 |
| *Shepherdia canadensis* | 16 |
| *Vaccinium uliginosum* | 10 |
| *Viburnum edule* | 6 |

Leaves were removed from the lower 2-4 cm of each cutting. All other leaves were trimmed to approximately three-quarters of their original size to reduce water loss. The softwood cuttings were planted in the greenhouse in sand or perlite media after undergoing identical treatments as the hardwood cuttings. The propagation bench design was identical except for the elimination of supplemental lighting and a slightly shorter mist cycle averaging 5 sec every 12 min.

## Root and Rhizome Cuttings

Root and rhizome cuttings were collected from *Salix* spp., *Alnus* spp., *Shepherdia canadensis*, *Arctostaphylos uva-ursi*, *Viburnum edule*, *Vaccinium uliginosum*, *Ledum palustre*, and *Populus balsamifera* from sites near Fairbanks, Alaska, between September 17 and October 15, 1976. Sections 5 to 10 cm long were buried horizontally in wooden flats containing sterilized native peat: 25 cuttings per flat and 2 flats per species. One flat of each species was moistened and placed immediately in the greenhouse. The flats were enclosed in individual, clear polyethylene bags to increase moisture retention. Data recorded included the percentage of cuttings producing shoots, the number of days to maximum shoot emergence, percent survival, and new root production following a 2-mo growing period.

The remaining group of flats was enclosed in individual, opaque polyethylene bags and placed in cold storage for 6 mo. Following this period, 15 of the 25 cuttings of each species were planted in flats of

peat in the greenhouse and handled identically to the first group of flats. The remaining 10 cuttings of each species were returned to cold storage for the duration of winter, after which they were planted in the field.

Data were recorded for three groups of cuttings: cuttings of each species planted directly in the greenhouse after collection, cuttings planted in the greenhouse after a 6-mo cold storage period, and cuttings planted in the field site after an approximate 9-mo cold storage period.

## Field Study

One of the two field sites was located at the Agricultural Experiment Station farm at the University of Alaska, Fairbanks. The soil at this site is classified as Tanana silt loam (Rieger et al. 1963). The land had been cleared more than 10 yr ago. Cultivation in the study area during the past 5 yr was limited to mechanical weed control. The field site was nearly level, and soil moisture content at the time of planting was 19 percent.

Cuttings planted at this site included half of the hardwood stem cuttings which had been maintained in flats of peat in cold storage during the winter and the rooted cutting transplants from the greenhouse hardwood cutting study.

The unrooted hardwood stem cuttings were planted on June 6, 1977, and subsequent care of experimental plots consisted of hand weeding. Cuttings were directly inserted into the soil to three-quarters their length after being treated as follows:

1. Control.
2. Liquid auxin treatment. The proximal end of the cuttings was soaked for 5 min in a 2,000 ppm liquid formulation of IBA.
3. Powdered auxin treatment. The proximal portion of each cutting was dipped into a powdered formulation (Hormodin #3) of IBA.
4. Repetition of treatments 1, 2, and 3 with the addition of soaking the distal portion of the stem cuttings in a commercially prepared antitranspirant.

A randomized complete block design was used with four blocks of 6 treatments and 65 cuttings per treatment. Successful rooting and establishment within each treatment were recorded as the percentage of cuttings that survived after 3 mo. Cuttings which survived produced leaves and new buds. Results were treated statistically with an analysis of variance for randomized complete block design and where applicable, with Duncan's New Multiple Range Test at the 5-percent level of significance (Steel and Torrie 1960).

The rooted cutting transplants were removed from the greenhouse on June 10, 1977, and hardened in a coldframe for 2 wk prior to planting. Cuttings were planted with a ball of saturated peat surrounding the roots. No treatments were administered after planting. Results were recorded as the percent survival following a 3-mo growing season.

The second field site was located in the Bonanza Creek Experimental Forest approximately 21 miles south of Fairbanks, Alaska. The soil at this site is classified as Steese silt loam (Furbush and Schoephorster

1977). The experimental site was located on an east-facing, 49-percent roadside slope with soil moisture content of 12 percent at the time of planting. Limited natural regeneration of white spruce, birch, and willow was evident, but cover from these plants was minimal. The site was not prepared prior to planting nor were any treatments administered during the growing season.

Cuttings planted at Bonanza Creek included the remaining unrooted hardwood stem cuttings and the cold storage treated root, rhizome, and sucker cuttings. Both were planted on June 13, 1977. Treatments, experimental design, data collection, and analysis for the unrooted hardwood cuttings were identical to those for Experiment Station farm site. The root cuttings were planted horizontally, approximately 2 cm below the soil surface, and the percent shoot production was recorded for each species.

## RESULTS

### Rooting in a Controlled Environment

*Alnus* spp. Only 3 of a total of 1,000 *A. crispa* hardwood cuttings formed roots. All softwood cuttings failed to produce roots. Neither hardwood nor softwood cuttings of *A. incana* produced roots.

*Arctostaphylos uva-ursi.* Both hardwood and softwood stem cuttings initiated roots (table 1). Treatment and media differences were not significant for either type of cutting. Thin, fibrous clusters of roots formed randomly along the buried portion of the stems within approximately 6 wk of bench planting.

*Ledum palustre.* Few roots were initiated on either hardwood or softwood stem cuttings (table 1). The number of cuttings rooting successfully was not sufficient to show any real differences between treatments. Diffuse clusters of very thin, branching roots formed along the buried stems, mostly within the heel or 1-yr-old tissue. Rooting generally occurred within 3 mo of planting.

*Populus balsamifera.* Both hardwood and softwood stem cuttings had relatively high rooting percentages (table 1). Root initiation generally occurred within 3 wk after planting in the greenhouse. Initial root formation occurred near a viable bud; however, further rooting occurred randomly along the buried stem. Some callus tissue was formed on the base of the cuttings which were treated with the powdered formulation of IBA.

Roots were preceded by the formation of protrusions of cells which subsequently split the bark and through which the roots emerged. The formation of these protrusions occurred very quickly after bench planting, even on the cuttings which eventually failed to produce roots.

Treatment differences were significant for both softwood and hardwood stem cuttings. Wounding seemed to enhance root production in hardwood cuttings, but roots did not emerge solely from the severed region. Wounds which were subsequently treated with powdered IBA tended to form callus tissue in the severed region rather than roots.

Table 1--Rooting percentages of hardwood and softwood stem cuttings of selected Alaska woody plants

| Species | Type of cutting[1] | Treatment | | | | | | | | | | Average performance | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sand | | | | | Perlite | | | | | | | | |
| | | Control | Wound-liquid IBA[2] | Wound-powdered IBA | Wound only | Powdered IBA only | Control | Wound liquid IBA | Wound-powdered IBA | Wound only | Powdered IBA only | Sand | Perlite | Hardwood cutting | Softwood cutting |
| *Arctostaphylos uva-ursi* | H | 40 | 56 | 65 | 48 | 60 | 44 | 32 | 48 | 52 | 36 | 54 | 42 | 48 | -- |
| | S | 36 | 36 | 40 | 32 | 40 | 32 | 24 | 44 | 32 | 36 | 37 | 34 | -- | 36 |
| *Ledum palustre* | H | 8 | 0 | 0 | 0 | 8 | 16 | 12 | 12 | 12 | 8 | 3 | 12 | 8 | -- |
| | S | 16 | 8 | 12 | 16 | 16 | 12 | 12 | 8 | 8 | 8 | 14 | 10 | -- | 12 |
| *Populus balsamifera* | H | [3]60abc | 46a | 50ab | 69bc | 56ab | 63abc | 53ab | 60abc | 76c | 79c | 56 | 66 | 61 | -- |
| | S | 53b | 53b | 63b | 49b | 61b | 23a | 50b | 40ab | 23a | 47ab | 56 | 37 | -- | 47 |
| *Salix alaxensis* | Hb | 60 | 56 | 62 | 64 | 64 | 54 | 68 | 74 | 64 | 70 | 61 | 66 | 64 | -- |
| | Ht | 54 | 48 | 42 | 56 | 50 | 50 | 50 | 40 | 58 | 54 | 50 | 50 | 50 | -- |
| | Sb | 62 | 54 | 62 | 50 | 54 | 54 | 68 | 62 | 62 | 54 | 56 | 60 | -- | 58 |
| | St | 44 | 40 | 44 | 32 | 28 | 36 | 40 | 36 | 48 | 44 | 38 | 41 | -- | 40 |
| *Salix scouleriana* | Hb | 62 | 50 | 58 | 56 | 56 | 64 | 60 | 64 | 64 | 66 | 56 | 64 | 60 | -- |
| | Ht | 60 | 56 | 78 | 66 | 68 | 66 | 58 | 72 | 50 | 68 | 66 | 63 | 65 | -- |
| | Sb | 60 | 58 | 64 | 60 | 64 | 48 | 50 | 60 | 54 | 64 | 61 | 55 | -- | 58 |
| | St | 55 | 45 | 58 | 50 | 48 | 50 | 55 | 58 | 56 | 58 | 51 | 55 | -- | 53 |
| *Salix bebbiana* | Hb | Less than 1 percent rooted | | | | | | | | | | | | | |
| | Ht | Less than 1 percent rooted | | | | | | | | | | | | | |
| | Sb | 54 | 62 | 46 | 46 | 54 | 50 | 54 | 30 | 42 | 72 | 52 | 50 | -- | 51 |
| | St | 44 | 46 | 40 | 30 | 66 | 50 | 38 | 34 | 34 | 42 | 45 | 40 | -- | 42 |
| *Vaccinium uliginosum* | H | 7 | 13 | 13 | 13 | 7 | 10 | 7 | 17 | 17 | 13 | 11 | 13 | 12 | -- |
| | S | 3 | 17 | 0 | 3 | 3 | 0 | 17 | 3 | 0 | 17 | 5 | 7 | -- | 6 |
| *Viburnum edule* | H | 1 of 250 cutting produced roots | | | | | | | | | | | | | |
| | S | 48ab | 32a | 92c | 32a | 80c | 44b | 28b | 84c | 24b | 92c | 57 | 54 | -- | 56 |
| *Alnus crispa* | H | 3 of 1,000 cuttings produced roots | | | | | | | | | | | | | |
| | S | 3 of 1,000 cuttings produced roots | | | | | | | | | | | | | |
| *Alnus incana* | H | No cuttings produced roots | | | | | | | | | | | | | |
| | S | No cuttings produced roots | | | | | | | | | | | | | |
| *Shepherdia canadensis* | H | No cuttings produced roots | | | | | | | | | | | | | |
| | S | No cuttings produced roots | | | | | | | | | | | | | |

[1] H = hardwood cutting
S = softwood cutting
Hb = hardwood cutting from base of annual growth
Ht = hardwood cutting from tip (apical section) of annual growth
Sb = softwood cutting from base of annual growth
St = softwood cutting from tip (apical section) of annual growth.

[2] IBA = Indole-3-butyric acid.

[3] Treatments with same letter in a row were not significantly different at $P \leq 0.05$. The absence of letters indicate no significant difference.

*Salix* spp. *S. alaxensis* stem cuttings produced numerous roots from both hardwood and softwood cuttings with most root formation occurring within 2 wk of planting (table 1). Treatment differences were not statistically significant within either tip or base cuttings or between the sand and perlite media. *S. alaxensis* exhibited the diffuse pattern of rooting (Chmelar 1974), with roots arising near viable buds showing the best growth.

Results were similar for *S. scouleriana* cuttings which rooted within 4 wk of planting (table 1). Treatment differences were not statistically significant for either base or tip cuttings nor between propagation media. Unlike *S. alaxensis* cuttings, initial rooting occurred at the base (basal pattern (Chmelar 1974)) near the proximal cut of the stem. Rooting progressed sporadically upward from the base along the buried stem surfaces.

Few hardwood stem cuttings of *S. bebbiana* rooted; rooting percentages were significantly higher for the softwood cuttings (table 1). The great difference between hardwood and softwood cuttings may not be characteristic of the species but possibly a favorable response to heavy pruning. The stem cuttings collected in the fall were noticeably very thin and short. The fall pruning of growing tips appeared to stimulate prolific shoot growth which was both thicker and longer than on the hardwood cuttings. These provided the bulk of the softwood cuttings for the summer experiments. Treatment differences were negligible for *S. bebbiana* softwood stem cuttings of both tip and base types. Rooting was random (Chmelar 1974) and was most prolific on the part of the stem section located immediately below the surface of the propagation medium.

*Shepherdia canadensis*. This species failed to produce roots from stem cuttings under the prescribed experimental greenhouse conditions. Both hardwood and softwood stem cuttings became soft and black shortly after planting. No evidence of callus formation at the proximal cut or along wound surfaces was apparent.

*Vaccinium uliginosum*. Rooting percentages from both hardwood and softwood stem cuttings of blueberry were poor, and the number of rooted cuttings was not sufficient to reveal any significant differences between treatments (table 1). Rooting generally occurred within two mo after planting, with thin, fibrous roots forming indiscriminately along the buried portion of the stem.

*Viburnum edule*. From a total of 300 highbush cranberry hardwood cuttings, 1 produced roots. In contrast, softwood cuttings initiated numerous roots (table 1). Cuttings rooted equally well in the sand and perlite media, but rooting was more prolific and averaged 2 wk earlier in sand. Rooting was significantly increased by treating cuttings with powdered IBA.

Roots generally formed within 6 wk after planting. They were in large clusters near the base of each cutting, primarily in the heel (1-year-old tissue). Root emergence was preceded by the development of cell protrusions along the buried portion of the stem as much as 1 wk before root emergence. Callus formation was minimal at the base of these cuttings. Softwood cuttings whose leaves had fallen or had been removed did not produce roots.

## Root and Rhizome Changes

*Alnus crispa*, *Arctostaphylos uva-ursi*, *Ledum palustre*, *Populus balsamifera*, *Shepherdia canadensis*, *Vaccinium uliginosum*, and *Viburnum edule* were successfully propagated from root or rhizome cuttings when planted in the greenhouse immediately after fall collection. Following cold treatment, only *L. palustre*, *Populus balsamifera*, *Vaccinium uliginosum*, and *Viburnum edule* survived to regenerate from this type of material (table 2).

Table 2--Results of propagation with root, rhizome, or sucker cuttings

| Species | Type of cutting | Immediately planted | | Cold treated | | Average no. days to maximum shoot emergence |
|---|---|---|---|---|---|---|
| | | Percent success, shoot production | Percent survival and root production | Percent success, shoot production | Percent survival and root production | |
| *Alnus crispa* | root | 4 | 100 | 0 | 0 | 7 |
| *Arctostaphylos uva-ursi* | root | 60 | 100 | 0 | 0 | 46 |
| *Ledum palustre* | rhizome | 64 | 31 | 100 | 53 | 49 |
| *Populus balsamifera* | root | 100 | 0 | 73 | 100 | 14 |
| *Shepherdia canadensis* | root | 24 | 100 | 0 | 0 | 46 |
| *Vaccinium uliginosum* | rhizome | 52 | 100 | 53 | 100 | 56 |
| *Viburnum edule* | rhizome | 100 | 28 | 100 | 100 | 28 |

## Field Trials

Unrooted hardwood cuttings of *Populus balsamifera* exhibited varying degrees of rooting at the two field sites (table 3). At the Agricultural Experiment Station field site, rooting was observed for all treatments within each block, but treatment differences were not statistically significant. Shoot growth at the termination of the experimental growing

Table 3-- Average rooting and survival percentages of hardwood stem cuttings of *Populus balsamifera* L. ssp. *balsamifera* which were directly inserted into the ground at field sites

| Treatment | Bonanza Creek Experimental Forest | Agricultural Experiment Station |
|---|---|---|
| Control | 0 | 25 |
| Powdered IBA[1/] | 8 | 58 |
| Liquid IBA | 17 | 33 |
| Antitranspirant (AT) | 0 | 25 |
| Powdered IBA-(AT) | 0 | 41 |
| Liquid IBA-(AT) | 25 | 25 |
| Average performance, all treatments | 8 | 35 |

[1/] IBA = Indole-3-butyric acid.

averaged 7 cm in length for all treatments. Rooting and survival of cuttings at the Bonanza Creek field site appeared to be confined to the treated cuttings and predominately to the liquid IBA treatment. The number of cuttings rooting successfully was not sufficient to show any differences between treatments. New shoot lengths averaged 5 cm, and considerable insect damage was noted on the new growth on several of the cuttings.

With the exception of *S. alaxensis*, none of the species survived one growing season in the field.

More than 50 percent of the rooted hardwood cuttings of *Salix alaxensis*, *S. scouleriana*, and *Populus balsamifera* survived transplanting into flats of peat from the greenhouse propagation bench. Subsequently fifty cuttings of each species were planted at the Agricultural Experiment Station field site. At the conclusion of the growing season 38 percent of the *S. scouleriana*, 44 percent of the *S. alaxensis*, and 82 percent of *Populus balsamifera* transplants remained alive. None of the root or rhizome cuttings planted at Bonanza Creek produced new shoots during the growing season.

## DISCUSSION AND CONCLUSION

The results reported here for hardwood and softwood cuttings indicate a variety of responses for these species under controlled temperature and moisture conditions. With the exception of *Alnus incana* and *Shepherdia canadensis*, all species exhibited some root production. With few exceptions there was little difference between the two rooting media and the wounding and hormone treatments used. The rooting potential of the various species, excluding *Alnus* spp. and *S. canadensis*, are similar to those reported earlier for the same or similar species (Bailey and Bailey 1934, Bogdanov 1968, Hartmann and Kester 1975, Holden 1975). Lepisto (1970) reported rooting percentages of up to 74 percent with *Alnus incana* and 33 percent with *A. glutinosa*. Average success with *A. incana* was 43 percent and *A. glutinosa*, 16 percent.

Although limited in scope, propagation trials with roots and rhizomes indicated that this approach should be investigated in more detail. These plant parts are more difficult to collect; however, our results suggest that propagation of species such as *Vaccinium uliginosum* and *Shepherdia canadensis* could be more successful using these materials rather than stem cuttings.

With the exception of *Populus balsamifera*, direct planting of unrooted cuttings was not successful. Based on work with similar *Populus* species (e.g., McKnight 1970) and other Alaskan observations, the results with balsam poplar were expected. The almost total failure of *Salix alaxensis* to survive, however, was unexpected. Previous work with this species had resulted in 2-yr survival of 55-60 percent (Zasada et al. 1977). These previous trials were with material collected and planted in early May on a coarser textured soil. These differences in success with *Salix alaxensis* are an example of the range in success that may occur when unrooted cuttings are planted in the field. Factors such as soil water content, season of planting, and methods of collecting and handling cuttings are critical to success and must be considered for each planting site.

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