# TECHNICAL NOTES

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## Native Shrubs As a Supplement to the Use of Willows as Live Stakes and Fascines in Western Oregon and Western Washington

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SUMMARY

In the Pacific Northwest USA, native **willows** (*Salix* spp.) are the primary species used for soil bioengineering and related streambank protection measures, including live stakes and fascines. Field trials have also demonstrated satisfactory application of **western redosier dogwood** (*Cornus sericea* var. *occidentalis*) and **Douglas spirea** (*Spiraea douglasii*). However, other native shrubs that root readily from dormant hardwood cuttings have not been well evaluated. The purpose of this work was to test additional species for their ability to root from older wood and perform as live stakes and fascines.

Greenhouse experiments indicated that **common snowberry** (*Symphoricarpos albus*), **Pacific ninebark** (*Physocarpus capitatus*), and **black twinberry** (*Lonicera involucrata*) can root as well or better from three year versus one (current year) or two year old wood. Results from previous greenhouse studies have corresponded well with outdoor trials under moist, weed free, well drained conditions (2). Based on this information, these species have potential as live stakes. In contrast, **salmonberry** (*Rubus spectabilis)* rooted well from first year wood but more poorly from older stems. It appears to have less potential. Secondary results indicated no apparent benefit from Wood's rooting compound (IBA+NAA) and detrimental effects from bottom heat (75°F) for all four species.

In addition to greenhouse trials, these and eight other native shrubs and trees were evaluated at four streambank sites, two in western Oregon and two in western Washington. To date, **common snowberry, salmonberry, Pacific ninebark,** and **black twinberry** are performing successfully as live stakes and/or fascines at one or more of these locations. It appears all four could be used as supplemental species for soil bioengineering, and may have special application to sites less suitable for **willows** (i.e. **salmonberry** in moist shaded environments or **common snowberry** in summer dry environments). Ecotype (genetics), site factors, quality of stock, installation technique, and handling can substantially affect results. While unlikely to outperform native **willows**, these species provide options for improving habitat diversity in restoration and revegetation projects that are designed to incorporate unrooted, dormant materials. Observations at the four test sites indicate that deer browse, summer moisture, and competition from other vegetation, alone or in combination, are probably the three most limiting factors for successful establishment. For any planting or soil bioengineering installation with these species, deer exclusion or repellents should be considered. Likewise, summer irrigation and weed suppression the first two to four years may be advisable.

Several other species, including **red flowering currant** (*Ribes sanguineum*), **Indian plum** (*Oemlaria cerasiformis*), **red elderberry** (*Sambucus racemosa*), and **mock orange** (*Philadelphus lewisii*) have been evaluated to a lesser extent and all but flowering currant merit further investigation. Fascines of **mock orange** performed the best along with those of salmonberry on a dry, sandy streambank where other species, including **western redosier dogwood**, failed completely. **Red elderberry** also failed at the one site where it was planted as live stakes and fascines, but the unrooted, harvested material had initiated bud break. It should be re-examined using earlier planting dates, as should **Indian plum**. Even the most promising native species need additional testing at different times of the year and under a variety of soil, moisture, hydrologic, and competitive plant conditions.

## INTRODUCTION

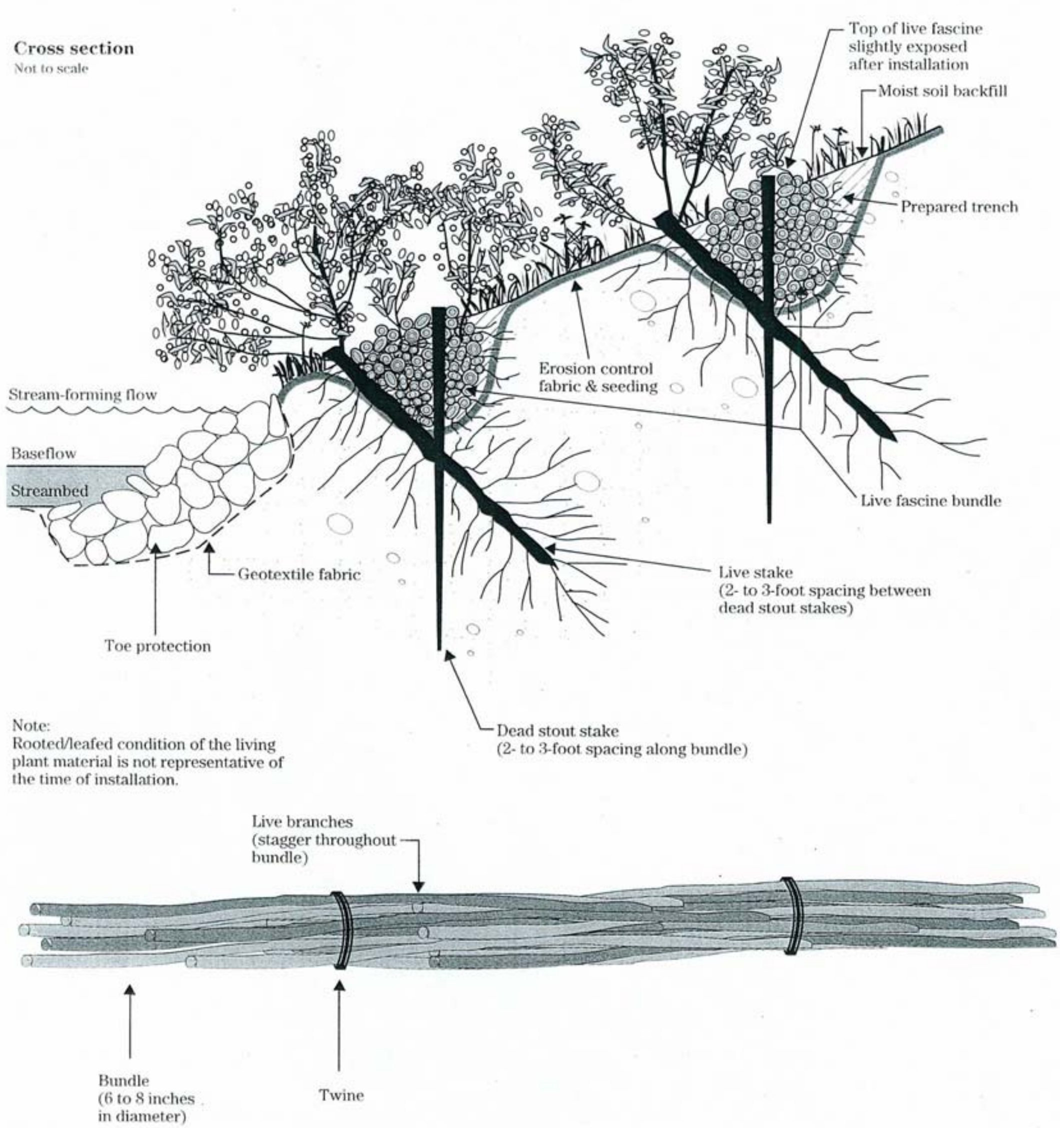
It is widely known that most native, riparian **willows** (*Salix* spp.) in the Pacific Northwest USA root easily from dormant hardwood stock, including older wood, allowing for their successful use in soil bioengineering practices such as live stakes, fascines, or brush mattresses. While willows are the mainstays of these stream and shoreline protection measures, native shrubs that root easily (from hardwood cuttings) may provide restoration alternatives, improve habitat diversity, and perform as well or better in shade or other conditions less suitable for willows.

True "live" stakes require that a species root easily from branches three years of age or older. The stem must be old and sturdy enough to withstand being tapped or "pounded" into the ground. In contrast, fascines work well even if most root development is confined to current year or juvenile wood. Results from previous greenhouse experiments have corresponded well with those from outdoor rooting trials indicating that **black twinberry** (*Lonicera involucrata*), **Pacific ninebark** (*Physocarpus capitatus*), **common snowberry** (*Symphoricarpos albus*), and **salmonberry** (*Rubus spectabilis*) are among those native Northwest shrubs with the highest potential for use in soil bioengineering (2). **Willows, western redosier dogwood** (*Cornus sericea* var. *occidentalis*), **black cottonwood** (*Populus balsamifera* var. *trichocarpa*) (5), and **Douglas spirea** (*Spiraea douglasii*) (3) have already proven to be fair to good candidates. While other potential species are found on national and regional lists (1,4,6,7) their actual performance is not always well tested or documented. The purpose of this work was to conduct studies and demonstrations that evaluate the ability of select western Oregon and western Washington native shrubs to root from older wood and perform as live stakes and fascines under actual streambank conditions.

Figure 1 [figure 16-7 (7)] illustrates the soil bioengineering practice of "live" fascines, the method used in the evaluations. In this example, two rows of fascines (wattles or bundles 6-8 inches in diameter) are buried in shallow trenches parallel to the stream. Only the very top layer of branches in the bundle remains partially exposed. Soil should also be worked into any gaps between the limbs. The fascines are anchored in the center by dead stout stakes and on the down slope side by dormant live stakes. The unrooted fascines help to hold the soil on the face of the slope and create mini "terraces" that reduce slope length. Root development soon reinforces the structure. Fascines can also be placed perpendicular to the stream in order to increase channel roughness, or are used in combination with other practices such as brush mattresses (1,4,6,7). Live stakes are simply 2 ½ to 3 feet segments of older wood installed perpendicular to the soil surface. Three fourths to $4/5^{th}$ of their length should be placed below the surface, while one or more nodes must remain above ground. Live stakes are also used alone to secure erosion mats or installed with other soil bioengineering and erosion control practices. Finally, they may offer a low cost alternative to container or bareroot nursery stock in some situations.

Figure 1.

**Figure 16–7** Live fascine details




(210-vi-EFH, December 1996) 16–17

## PART I: ROOTING TRIALS

### Methods and Materials

As a follow up to earlier studies, rooting experiments were conducted in a greenhouse mist bench in 2001 to test the ability of **common snowberry, Pacific ninebark, black twinberry**, and **salmonberry** to root from hardwood cuttings comprised of 1 (i.e. current year), 2, and 3-yr (plus) old wood (Factor C). Secondary objectives were to determine the effect of Wood's Rooting Compound (WRC: 1.03% IBA and 0.66% NAA diluted 5:1 with water)(Factor B) and bottom heat (75°F)(Factor A) on adventitious rooting. Minimum greenhouse temperature was 65°F and the day length was 16 hours. Rooting media consisted of 1 part peat moss to 4 parts perlite. Experimental design was a randomized complete block with four replications and five, 8 inch cuttings per replication. Analysis of variance (ANOVA) was conducted and Fisher's Protected Least Significant Difference test (FPLSD) was used to separate means at the P=0.05 level. Note that WRC, a mixture of two plant growth regulators (PGRs), is interchangeably referred to as "hormones" in this text.

### Results and Discussion

Results for the rooting experiments appear to Table 1. For **common snowberry**, as with all species tested, significant differences depended on the variable measured. However, cuttings from 3 year old wood generally rooted and grew as well or better than those from 1 year (current year) and 2 year old wood. The highest overall ranking was achieved by 3 year wood without hormones and no bottom heat. There were no significant factor interactions. Bottom heat (75°F) was detrimental to root formation and growth across all ages. WRC significantly improved shoot length and plant vigor for cuttings from 1 year old (current year) wood, but not for cuttings from 2 and 3 year old wood. Rooting was primarily nodal, but substantial amounts also formed at the basal ends and minor amounts at the internodes, regardless of age.

For **Pacific ninebark**, cuttings from 2 and 3 year old stems rooted and grew better than those from 1 year old (current year) shoots. Bottom heat appeared to diminish root development and WRC did not significantly change rooting for either 1 or 2 year old cuttings, regardless of the variable measured. Significant BxC factor interactions for some variables may be attributed in part to the poor rooting of 3 year wood with bottom heat in combination with WRC. The top overall ranking was achieved by 3 year old wood without hormones or bottom heat. Rooting occurred most regularly at the nodes, but additional amounts formed along the internodes, regardless of age.

In contrast to the other three species under identical conditions, **black twinberry** appeared to produce a greater abundance of roots. Performance was consistently good regardless of age or treatment. Bottom heat decreased basal rooting, but the overall affect was minor. This species rooted primarily along the internodes with some basal rooting. As with overall performance, internodal rooting did not diminish with age. Highest overall ranking was for 3 year old cuttings with hormones and without heat, but the results were not significantly higher than those without both hormones and heat.

**Salmonberry** rooted more poorly that the other three species, but achieved the most satisfactory results from cuttings of 1 year old (current year) wood, without hormones and without heat (top overall ranking). In general, WRC did not significantly change results regardless of age. Bottom heat in combination with the dilute hormone treatment was lethal for cuttings of 2 and 3 year old wood. There were no significant factor interactions. This species rooted randomly from nodes, internodes, and basal ends, but internodal rooting diminished with cuttings of 2 and 3 year old wood.

Table 1. Effect of bottom heat, rooting compound, and age of wood on rooting ability of common snowberry (SYALL), Pacific ninebark (PHCA11) black twinberry (LOIN5), and salmonberry (RUSP) from hardwood cuttings (in a greenhouse mist bench).

| Species | Bottom Heat (A) | Rooting Hormone(B) | Age of Wood(C) | Caliper(mm) Minimum | Percent Rooted | No. of Shoots | Shoot Length (cm) | Root Abundance | Root Length (cm) | Plant Vigor | Location of Roots | Overall Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYALL | No | No | 1 | 3.6 | 75abcd | 2.6 | 24.1bc | 5.5bc | 17.7 | 6.1bc | **N**,B,i | 6th |
| | No | No | 2 | 4.0 | 85ab | 2.6 | 33.7ab | 7.1ab | 20.0 | 7.6ab | **N**,B,i | 2nd |
| **S** | **No** | **No** | **3** | **5.6** | **90ab** | **3.1** | **35.7a** | **7.7a** | **22.1** | **8.3a** | **N**,b,i | **1st** |
| **N** | No | Yes | 1 | 4.2 | 85ab | 2.6 | 29.8abc | 5.4bc | 17.1 | 6.6abc | **N**,B,i | 5th |
| **O** | No | Yes | 2 | 4.6 | 100a | 2.6 | 30.1abc | 6.2abc | 17.6 | 7.2ab | **N**,B,i | 3rd |
| **W** | No | Yes | 3 | 5.9 | 85ab | 2.3 | 30.7abc | 6.0abc | 16.2 | 6.8abc | **N**,B,i | 4th |
| **B** | Yes | No | 1 | 4.8 | 50d | 2.4 | 21.5c | 4.6c | 13.5 | 5.4c | **N**,b,i | |
| **E** | Yes | No | 2 | 4.6 | 70bcd | 2.3 | 26.7abc | 4.9c | 16.0 | 5.8bc | **N**,B,i | |
| **R** | Yes | No | 3 | 5.1 | 53cd | 2.5 | 23.5bc | 4.7c | 17.2 | 6.0bc | **N**,i | |
| **R** | Yes | Yes | 1 | 3.9 | 80abc | 2.5 | 23.0c | 4.7c | 15.7 | 5.4c | **N**,b,i | |
| **Y** | Yes | Yes | 2 | 5.1 | 50d | 3.2 | 26.5abc | 5.0c | 18.1 | 6.2bc | **N**,b,i | |
| | Yes | Yes | 3 | 5.4 | 65bcd | 2.9 | 24.5bc | 5.0c | 15.7 | 6.0bc | **N**,b,i | |
| Mean | | | | | 74 | 2.6 | 27.5 | 5.6 | 17.2 | 6.4 | | |
| LSD | | | | | 30 | NS | 10.4 | 2.1 | NS | 1.8 | | |
| Significant Factor (ABC) Interactions: | | | | | none | None | none | none | none | none | | |
| | | | | | | | | | | | | |
| PHCA11 | No | No | 1 | 6.0 | 60abc | 1.3cde | 16.4bc | 5.6 | 16.8 | 6.0abc | **N**,I | 6th |
| | No | No | 2 | 5.2 | 90ab | 3.1ab | 20.6abc | 6.3 | 17.2 | 6.9abc | **N**,I | 2nd(tie) |
| | **No** | **No** | **3** | **6.9** | **89ab** | **3.9a** | **34.4a** | **7.4** | **19.8** | **8.9a** | **N**,i | **1st** |
| **N** | No | Yes | 1 | 5.1 | 50cde | 1.5cde | 21.5abc | 5.3 | 16.8 | 5.9abc | **N**,i | |
| **I** | No | Yes | 2 | 5.8 | 85ab | 2.0cd | 31.1ab | 6.8 | 18.6 | 7.5ab | **N**,I | 4th |
| **N** | No | Yes | 3 | 5.1 | 90ab | 1.8cd | 28.3ab | 6.0 | 14.3 | 6.4abc | **N**,I | 2nd(tie) |
| **E** | Yes | No | 1 | 5.6 | 25de | 1.1de | 14.5bc | 3.9 | 7.0 | 4.0cd | **N**,i | |
| **B** | Yes | No | 2 | 5.2 | 25de | 2.0cd | 18.4abc | 5.8 | 18.6 | 6.5abc | **N**,I | |
| **A** | Yes | No | 3 | 4.7 | 55dcd | 2.3bc | 25.1ab | 7.1 | 19.0 | 6.8abc | **N**,I | 5th |
| **R** | Yes | Yes | 1 | 7.3 | 25de | 1.6cde | 17.8abc | 4.9 | 11.0 | 4.8bcd | **N**,i | |
| **K** | Yes | Yes | 2 | 6.3 | 20e | 2.0cd | 26.6ab | 6.0 | 21.5 | 6.2abc | **N**,i | |
| | Yes | Yes | 3 | 5.5 | 30cde | 0.8e | 6.5c | 2.8 | 9.1 | 2.7d | **N**,I | |
| Mean | | | | | 54 | 1.9 | 21.8 | 5.6 | 15.8 | 6.0 | | |
| LSD | | | | | 35 | 1.1 | 16.7 | NS | NS | 3.1 | | |
| Significant Factor (ABC) Interactions: | | | | | None | BxC | BxC | none | none | BxC | | |

**Rooting Hormone** = Experimental Factor B, Wood's Rooting Compound (WRC) at 5:1 dilution. **Minimum caliper** is the minimum caliper which rooted.

**Root Abundance** and **Plant Vigor** based on scale of 10=best, 1=poorest. Means with the same letter are not significantly different at P=.05. **LSD**=Least Significant Difference.

**Root Location** refers to location of roots on the cutting: B(b) =basal. N(n) = nodal. I(i) = internodal. Bold, upper case letters indicate predominant position of roots.
Upper case letters (not in bold) indicate 2nd most common root position. Lower case letters indicate minor location of roots. **NS** = not signficant.

**Overall ranking** indicates summary of ability to root based on all parameters (dependent variables) measured. Top 6 of 12 treatments.

Table 1.
Continued.

| Species | Bottom Heat (A) | Rooting Hormone(B) | Age of Wood(C) | Caliper(mm) Minimum | Percent Rooted | No. of Shoots | Shoot Length (cm) | Root Abundance | Root Length (cm) | Plant Vigor | Location of Roots | Overall Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOIN5 | No | No | 1 | 4.3 | 100a | 2.2abc | 16.7cd | 6.8bcd | 21.5bc | 6.9bcd | **I**,B | |
| | No | No | 2 | 4.7 | 95a | 2.0bcde | 23.1abcd | 7.1bcd | 22.6abc | 7.2abcd | **I**,b | 3rd |
| **T** | No | No | 3 | 6.8 | 85ab | 2.4a | 29.0ab | 8.1ab | 27.9abc | 8.0ab | **I**,b | 2nd |
| **W** | No | Yes | 1 | 4.7 | 100a | 2.1abcd | 14.8d | 6.4cd | 24.3abc | 6.4cd | **I**,B | 6th |
| **I** | No | Yes | 2 | 4.7 | 95a | 1.8cde | 23.7abcd | 7.0bcd | 24.1abc | 7.1bcd | **I**,b | 5th |
| **N** | **No** | **Yes** | **3** | **6.6** | **90a** | **2.3ab** | **31.4a** | **8.6a** | **30.5a** | **8.6a** | **I**,b,n | **1st** |
| **B** | Yes | No | 1 | 4.7 | 60cd | 1.8cde | 19.1bcd | 5.9d | 21.1c | 6.3cd | **I**,B | |
| **E** | Yes | No | 2 | 5.3 | 65bcd | 1.6e | 24.6abcd | 6.7cd | 26.1abc | 6.9bcd | **I** | |
| **R** | Yes | No | 3 | 6.5 | 50d | 1.8cde | 17.0cd | 7.0bcd | 29.3ab | 6.1cd | **I** | |
| **R** | Yes | Yes | 1 | 4.6 | 80abc | 1.7de | 14.3d | 6.4cd | 24.4abc | 5.8d | **I**,b,n | |
| **Y** | Yes | Yes | 2 | 5.0 | 80abc | 1.9bcde | 22.0abcd | 6.4cd | 27.3abc | 6.8bcd | **I**,n | |
| | Yes | Yes | 3 | 5.9 | 80abc | 1.8cde | 26.7abc | 7.5abc | 27.9abc | 7.6abc | **I**,b,n | 4th |
| Mean | | | | | 82 | 1.9 | 21.8 | 7.0 | 25.6 | 7.0 | | |
| LSD | | | | | 24 | 0.4 | 11.2 | 1.4 | 8.0 | 1.4 | | |
| Significant Factor (ABC) Interactions: | | | | | AxB | None | none | none | none | none | | |
| | | | | | | | | | | | | |
| RUSP | **No** | **No** | **1** | **6.7** | **75a** | **1.8** | **21.5a** | **6.2a** | **19.6a** | **6.7a** | **I,N**,b | **1st** |
| **S** | No | No | 2 | 8.6 | 70a | 1.4 | 13.0ab | 4.4a | 11.9a | 4.9ab | **N**,i,b | 2nd(tie) |
| **A** | No | No | 3 | 12.4 | 40bc | 1.4 | 14.6ab | 6.1a | 19.6a | 4.9ab | **N**,i,b | 4th |
| **L** | No | Yes | 1 | 7.2 | 60ab | 1.2 | 12.0b | 5.3a | 13.4a | 5.5ab | I,N,B | 2nd(tie) |
| **M** | No | Yes | 2 | 10.0 | 10ef | 1.3 | 8.6bc | 4.3a | 10.8ab | 4.1abc | **N**,i,b | |
| **O** | No | Yes | 3 | 11.1 | 25cde | 1.7 | 7.6bc | 3.8ab | 16.6a | 3.3bc | **N**,i | 6th(tie) |
| **N** | Yes | No | 1 | 7.0 | 33cd | 1.3 | 12.6b | 6.3a | 17.5a | 4.9ab | **I**,B,n | 5th |
| **B** | Yes | No | 2 | 8.8 | 15def | 0.9 | 8.2bc | 3.6ab | 11.6a | 4.2abc | **N**,i | |
| **E** | Yes | No | 3 | 15.0 | 15def | 1.8 | 14.9ab | 4.5a | 13.8a | 6.4a | **N** | |
| **R** | Yes | Yes | 1 | 7.3 | 20cdef | 1.1 | 12.1b | 4.5a | 12.6a | 5.1ab | **I**,N | 6th(tie) |
| **R** | Yes | Yes | 2 | <> | 0f | 0.8 | 3.0c | 1.0b | 0b | 1.3c | <> | |
| **Y** | Yes | Yes | 3 | <> | 0f | 0.8 | 2.5c | 1.0b | 0b | 1.3c | <> | |
| Mean | | | | | 30 | 1.3 | 10.9 | 4.2 | 12.3 | 4.4 | | |
| LSD | | | | | 21 | NS | 8.9 | 3.1 | 11.2 | 3.1 | | |
| Significant Factor (ABC) Interactions: | | | | | none | None | none | none | none | none | | |

**Rooting Hormone** = Experimental Factor B, Wood's Rooting Compound (WRC) at 5:1 dilution. **Minimum caliper** is the minimum caliper which rooted.

**Root Abundance** and **Plant Vigor** based on scale of 10=best, 1=poorest. Means with the same letter are not significantly different at P=.05. **LSD**=Least Significant Difference.

**Root Location** refers to location of roots on the cutting: B(b) =basal. N(n) = nodal. I(i) = internodal. Bold, upper case letters indicate predominant position of roots.

Upper case letters (not in bold) indicate 2nd most common root position. Lower case letters indicate minor location of roots. **NS** = not significant.

**Overall ranking** indicates summary of ability to root based on all parameters (dependent variables) measured. Top 6 of 12 treatments.

In summary, **common snowberry, Pacific ninebark**, and **black twinberry** generally rooted as well or better from cuttings of 3 year old wood compared to 1 year old wood, suggesting that they have good to excellent potential as live stakes, and possibly for fascines. This improvement, especially in **Pacific ninebark**, may be the result of larger carbohydrate reserves in older, thicker cuttings. In contrast, **salmonberry** rooted more poorly from 3 year old cuttings and appears to have less potential for live stakes. However, it may work for fascines. This species, unlike the other three, may lose juvenile traits as it ages or the bark thickens, becoming less likely to root along the internodes. Finally, for all four species, there appeared to be little if any benefit in the use of Wood's rooting compound (WRC) and bottom heat (at 75°F) was generally detrimental under the conditions of this experiment.

PART II: STREAMBANK SOIL BIOENGINEERING TRIALS (live stakes and fascines)

Site 1: Schneider Creek

The purpose of this demonstration is to evaluate the ability of eight native shrubs to perform as parallel and perpendicular fascines along a streambank. The planting is located along Schneider Creek on the Wynne Farm in Thurston County, WA. Installed March 17, 1999, in a silty clay loam on a gentle slope, trenches were back filled with non-native top soil, fencing was used in 2000, and deer repellent was applied once in 1999. No fertilizer or supplemental water has been applied.

Third year (2001) mean data are shown in Table 2. Despite substantial deer browse and grass competition, sprouting and growth after three growing seasons has been fair to excellent for all species except **red elderberry** which failed to establish (1 shoot left alive). Perpendicular fascines are outperforming the parallel ones, possibly because of better moisture or soil quality. **Pacific ninebark, salmonberry, black twinberry**, and **western redosier dogwood** are roughly similar in performance.

Table 2. Schneider Creek fascines – 2001 results

| Species | Vigor1 | Ht.(cm) | Wth.(cm) | Deer Br.[1] | Stems/m |
|---|---|---|---|---|---|
| Sitka willow 'Plumas' | 9.0 | 150 | 150 | 3.0 | 33 |
| Sitka willow (local) | 9.0 | 154 | 147 | 1.5 | 40 |
| Redosier dogwood | 6.0 | 70 | 59 | 5.0 | 10 |
| Douglas spirea | 6.0 | 60 | 49 | 2.5 | 43 |
| Black twinberry[2] | 6.7 | 88 | 50 | 4.0 | 12 |
| Pacific ninebark[2] | 5.7 | 63 | 60 | 2.0 | 11 |
| Salmonberry | 6.5 | 70 | 58 | 3.5 | 16 |
| Red elderberry | 1.0 | 40 | 18 | -- | 0.5 |

[1]1=lowest, 10=highest. [2]Mean of 3 plots (fascines).

As expected, growth and vigor was the highest for both populations of **Sitka willow** (*Salix sitchensis*), although **Douglas spirea** produced more stems per meter than all other species. After three growing seasons, it appears deer browse is now the most limiting factor, not soil moisture. The willows have been vigorous enough to out grow the browse, but the other species have not. Shoots have the best growth where they manage to escape notice. This site demonstrates a case where the practitioner should consider the use of repellents or temporary fencing along with or above other establishment measures.

Site 2: Minnihaha Creek

At a streambank site on the Willamette National Forest (Minnihaha Creek, 2:1 side slopes, elev. 3100 ft.), fascines of nine different shrubs were installed in a droughty, cobbly sand on November 9, 1998. Each fascine was replicated twice, once on a lower tier and once on an upper tier. The lower tier was installed with coir fabric and the upper tier was fertilized at planting (14-14-14 slow release). Trenches were back filled with native soil. A single application of deer repellent was made in 1999. Supplemental water was applied once each summer. The area was sown to blue wildrye (*Elymus glaucus*) grass and mulched.

After three growing seasons, **mock orange** and **salmonberry** are unexpectedly the best performing species (Table 3.). Their potential on course soils merits further evaluation. **Common snowberry** is alive but in poor condition, as are single fascines of **Indian plum** and **Pacific ninebark**. **Red flowering current** failed to sprout and **western redosier dogwood**, and **Scoulers willow** (*Salix scouleriana*) died by August of the second growing season. The lower tier (rep. 2) is performing slightly better than the upper tier (rep. 1). Low fertility and poor soil moisture holding capacity are probably the major limiting factors at this site, not weed competition. Deer browse is also an important factor.

Table 3. Minnihaha Creek fascines – 2001 results

| Species | Vigor[1] | Ht.(cm) | Deer Browse1 | Stems/m |
|---|---|---|---|---|
| Mock orange[2] | 6.3 | 45 | 4.3 | 5.8 |
| Salmonberry | 6.5 | 42 | 4.0 | 3.5 |
| Redosier dogwood | 1.0 | -- | -- | -- |
| Sitka willow | 4.0 | 58 | 3.0 | 2.8 |
| Scouler willow | 1.0 | -- | -- | -- |
| Pacific ninebark[3] | 3.0 | 27 | 2.0 | 1.3 |
| Snowberry | 2.5 | 17 | 5.0 | 8.5 |
| Indian plum | 2.5 | 49 | 2.0 | 0.5 |
| Red flowering currant | 1.0 | -- | -- | -- |

[1]1=lowest, 10=highest. [2]Mean of 3 plots (fascines). [3]One plot.

Site 3: Frazier Creek

The objective of this study is to evaluate **salmonberry, common snowberry, western redosier dogwood**, and **Pacific ninebark** as both fascines and live stakes. Live stakes of **black twinberry** are also being evaluated. The plots were installed along Frazier Creek (PMC, Benton Co., OR, elev. 225 ft., 42 inch precip. zone) in a clay soil on February 9 and 12, 2001. Fascines were approximately 6 inches in diameter, 5 feet long, and replicated three times. Live stakes were 2 feet long and replicated twice (5 stakes per plot). Trenches were back filled with a non-native sandy loam. Slow release fertilizer (14-14-14) was used during installation and supplemental water was applied five times. The soil is a poorly drained Bashaw clay and has a high shrink-swell capacity.

First year results are shown in Table 4. Initial performance (June) was fair to good for all species except **Pacific ninebark**. Vigor, survival, and stems/meter substantially declined by October. At the end of one growing season, **common snowberry** fascines were performing the best. Because of their construction, they may have had better soil/stem contact and fewer air pockets compared to the other three species. Snowberry may also root more rapidly or is more drought tolerant. **Redosier dogwood** fascines ranked second in performance, followed by **salmonberry**. Both showed signs of severe drought stress by early October. Only one of three **Pacific ninebark** fascines produced an acceptable number of shoots (15/meter) in the spring. It completely died from drought by fall. While live stakes of **redosier dogwood** initially survived and grew the best (June), **black twinberry** had the highest survival by October, followed by **redosier dogwood**, and **common snowberry**. Soil "cracks" at the insertion points, soil compaction, and grass competition may have reduced survival during the dry summer. As the soil dried out, it pulled away from the sides of the fascines, further exacerbating the moisture limitations. Other than **snowberry**, chances for success on this site are poor.

Table 4. Frazier Creek fascines – 2001 results

| Species – fascines | Vigor[1] | | Ht.(cm) | | Wth.(cm) | | Stems/m | |
|---|---|---|---|---|---|---|---|---|
| | Jun | Oct | Jun | Oct | Jun | Oct | Jun | Oct |
| Snowberry | 8.0 | 5.3 | 42 | 36 | 31 | 36 | 37 | 34 |
| Redosier dogwood 'Mason' | 5.3 | 1.7 | 31 | 38 | 24 | 38 | 10 | 2 |
| Salmonberry | 4.7 | 2.3 | 33 | 10 | 21 | 10 | 6 | 1 |
| Pacific ninebark | 3.3 | 1.0 | 14 | -- | 19 | -- | 6 | -- |

| Species – live stakes | Vigor1 | | Ht.(cm) | | % Surviv | | Stems/ls | |
|---|---|---|---|---|---|---|---|---|
| Snowberry | 5.7 | 4.0 | 31 | 42 | 50 | 30 | 1.7 | 1.5 |
| Redosier dogwood 'Mason' | 6.8 | 5.0 | 34 | 37 | 100 | 40 | 5.1 | 4.7 |
| Salmonberry | 3.3 | 1.0 | 15 | -- | 50 | 0 | 1.0 | -- |
| Pacific ninebark | 5.6 | 3.0 | 26 | 24 | 50 | 10 | 3.4 | 3.0 |
| Black twinberry | 6.8 | 4.5 | 31 | 32 | 90 | 78 | 3.1 | 1.9 |

[1]1=lowest, 10=highest. ls=live stake. Wth.=width.

Site 4: Boyce Creek

A fourth installation consisting of **salmonberry** and **sikta willow** fascines was made along Boyce Creek in Kitsap Co., WA, in mid-September of 2000 (elev. <100 ft). The work was completed as part of WHIP project, coordinated and installed by the Kitsap County Soil and Water Conservation District and NRCS personnel. The site consists of two planting areas with silt loam soils and 2.5:1 or flatter slopes. Area 1 has both parallel and perpendicular fascines and is shaded. Area 2 contains over 30 feet of fascines. Leaves were stripped prior to planting. Trenches were back filled with native soil and no fertilizer or supplemental water has been used. At least initially, results suggest that **salmonberry** (vigor=7.4, ht= 79cm, stems/m= 24) may perform as well or better that **sitka willow** (vigor=6, stems/m= 21, ht=58cm), on moist, shady banks where, unlike willows, it often thrives. Deer browse played only a minor role the first year and moisture availability during the critical spring growing season appeared to be good. The site will be monitored several more years.

SUMMARY

- ✓ Under typical greenhouse conditions, it appears unnecessary to use bottom heat (at 75°F) or plant growth regulators similar to Wood's rooting compound (dilute IBA/NAA solution) to root hardwood cuttings of **common snowberry, Pacific ninebark, black twinberry** or **salmonberry.**
- ✓ **Common snowberry, black twinberry**, and especially **Pacific ninebark** can root as well or better from cuttings of 3 year old wood versus younger wood. Results suggests they have high potential as live stakes.
- ✓ **Salmonberry** roots best from hardwood cuttings of 1 year old (current year) stems and will probably not do well as live stakes.
- ✓ **Common snowberry, Pacific ninebark, black twinberry**, and **salmonberry** appear to have fair to good potential as fascines under favorable conditions, but will not root as fast or as predictably as willows.
- ✓ At least initially, it appears some species may have value over willows for soil bioengineering in certain environments (i.e. **salmonberry** on moist, shady sites or **common snowberry** on droughty soils).
- ✓ From observations made at four sites, it appears the most limiting factors for a successful planting of live stakes and fascines using easy to root native shrubs is summer moisture supply, deer browse, and competition from other vegetation.

- ✓ Supplemental use of **common snowberry**, **Pacific ninebark**, **black twinberry**, and **salmonberry** for soil bioengineering should provide further options for increasing habitat diversity, if limiting factors can be overcome. Consider supplemental irrigation, weed management, and deer fencing or repellent the first two to four growing seasons.
- ✓ Finally, it should be cautioned that field trial results are still preliminary and may change over time. Results will also be substantially affected by ecotype (plant genetics), site conditions, installation technique, stock quality, health of the donor plant, and handling methods.

## FUTURE WORK

Continued monitoring and additional studies are needed to further define how well these and other native shrubs perform over time under variable soil, moisture, and hydrologic conditions using live stakes and fascines, as well as other soil bioengineering practices such as brush mattresses and brush layering. For example, mock orange appears to merit further evaluation on appropriate sites. Furthermore, anecdotal information suggesting that fall installation of cuttings, live stakes, and fascines may perform as well or better than early spring planting, needs to be validated for select species.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## LITERATURE CITED


(1) Bentrup, G. and J.C. Hoag. 1998. The practical streambank bioengineering guide. USDA Natural Resources Conservation Service. Plant Materials Center. Aberdeen, ID. 165 p.

(2) Darris, D.C., et. al. 1998. Rooting ability of fifteen native shrubs using hardwood cuttings in the field and greenhouse. IN: Symposium proceedings. Native Plants Propagating and Planting. R. Rose and D.L. Haase (editors). OSU, Nursery Technology Cooperative, Corvallis, OR. P. 60-67.

(3) Darris, D.C. and T.R. Flessner. 2000. Corvallis Plant Materials Center annual technical report. USDA Natural Resources Conservation Service, Corvallis, OR. 203 p.

(4) Georgia Soil and Water Conservation Commission. 1994. Guidelines for streambank restoration. Atlanta, GA. 52 p.

(5) King County Dept. of Natural Resources. (undated). Live stake cutting and planting tips. Water and Land Resources Division. Accessed at: http://dnr.metrokc.gov/wlr/pi/cutting.htm. 2 p.

(6) King County Dept. of Public Works. 1993. Chapter 6. Role and use of vegetation. IN: Guidelines for bank stabilization projects. Surface Water Management Division. Seattle, WA.

(7) USDA-NRCS. 1996. Chapter 16. Streambank and shoreline protection. IN: Engineering Field Handbook. USDA NaturalResources Conservation Service. Washington D.C.