

Propagating Woody Riparian Plants in Nurseries^{1,4}

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Abstract-We provide basic information for nursery production of ten genera of riparian plants. These plants can easily be grown as a one-year crop in an enclosed or open-sided greenhouse using many of the same basic cultural practices developed for reforestation species.

Key Words-propagation, riparian, container-grown, fertilization

RIPARIAN PLANTS

Just what does that title mean? Well, speaking for most nursery managers, we know about "propagating," and "nurseries" is self-explanatory. It's not much of a stretch to define "woody" -- for traditional forest nursery managers that means none of that grassy stuff (i.e., *Carex*, *Scirpus*). But what does "riparian" mean? According to the dictionary, a riparian plant is any plant growing along a natural water course. Well, using a broad definition like that includes many plants, probably many that we already grow but don't think of as "riparian." For example, in central Washington *Artemisia* spp. (sagebrush) is often considered a riparian plant. For the scope of this paper, we'll focus on what many view as more traditional riparian plants: *Alnus*, *Amelanchier*, *Betula*, *Crataegus*, *Populus*, *Prunus*, *Rosa*, *Salix*, *Sambucus*, and *Symphoricarpos*.

SEED PROCESSING & BARERoot CULTURE

A review of seed processing techniques and bareroot culture for many of these plants was published by Shaw (1984) and will not be repeated here. Readers interested in bareroot production may also wish to read Morgensen's (1992) paper on *Salix* and *Populus* production, and nutrition considerations provided by Davey (1984). If you're planning hardwood production, you may also wish to read Finnerty and Hutton (1993) for things to consider before venturing further.

PROPAGATION TECHNIQUES

Four propagation methods are used for riparian plants in container nurseries: root cuttings, hardwood cuttings, softwood cuttings, and seed. **Root cuttings** are a special technique and usually only used on *Populus tremuloides*. A review of asexual reproduction of *P. tremuloides*, including root cuttings, is found in Campbell (1984) and specific instructions for collecting and growing root cuttings are provided by Schier (1978). This technique is very labor intensive, both in the field and in the nursery, and is therefore very expensive and seldom used in production nurseries. However, it may be the only propagation technique available, especially if a particular male clone is needed.

Cuttings from dormant tissue, usually woody stems with well-formed lateral buds, are called

hardwood cuttings. This technique is the most-used method because most *Populus* and *Salix* species are propagated this way.

Species propagated via hardwood cuttings include *Cornus stolonifera* (*C. sericea*), *Populus* spp. (except *P. tremuloides*), *Salix* spp., and *Symphoricarpus albus*. Cuttings are usually made from stooling beds in late winter or early spring (December- February) and kept dormant by refrigerated storage. For container production, typical cuttings are 4-8 inches long (10-20 cm) with many lateral buds (Fig. 1). Cuttings may or may not be dipped in rooting hormone and/or fungicides, and are usually stuck directly into 1: 1 peat: vermiculite in containers in which they'll be grown. Stuck cuttings are often misted until roots form.

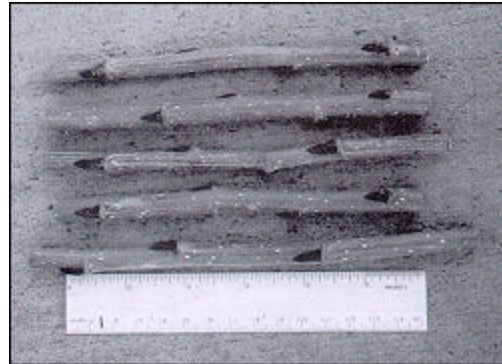


Figure 1. Hardwood cuttings of *Populus* ready to be planted.

Cuttings made from actively growing tissue, often terminal tips, are called **softwood cuttings**. *Amelanchier alnifolia*, *Cornus stolonifera*, *Crataegus* spp., *Populus* spp. (except *P. tremuloides*), *Prunus* spp., *Salix* spp., and *Symphoricarpus albus* are species propagated this way. Usually, cuttings 3 to 5 inches long (8- 10 cm) are clipped, and leaves are removed from the bottom half to two-thirds of the cutting (Fig. 2). The severed end of the cutting may or may not be dipped in a rooting hormone and/or fungicide. Cuttings are stuck into a well-drained mix, but occasionally right into 1: 1 peat: vermiculite. Usually, retained leaves are clipped in half and shoot tips are removed to reduce transpirational losses, and cuttings are kept under high humidity to maintain turgor. Although softwood propagation can be done later in the crop year so a second crop of softwood cuttings could be planted after a hardwood cutting crop is stuck, it is seldom used in production facilities.



Figure 2. A *Salix* softwood cutting ready to be planted (left) and after growing three months (right).

The most common method of producing riparian plants, including some *Populus* and *Salix* species, is **seed** propagation. This technique is easiest for most nursery managers because

we're familiar with seed and have automated equipment for planting it. Common plants grown from seed include *Alnus* spp., *Amelanchier alnifolia*, *Betula* spp., *Cornus stolonifera*, *Crataegus* spp., *Populus* spp. (including *P tremuloides*), *Prunus* spp., *Rosa* spp., *Salix* spp., and *Symphoricarpos albus*. Although we may be accustomed to using seed, we may not be as accustomed to growing riparian, nontraditional, species. Other problems can include unavailability of good seed in sufficient quantities, poor seed quality, a lack of proven stratification techniques, and difficulty in obtaining year-to-year consistency with seedling establishment.

NURSERY & SPECIES DESCRIPTIONS

Below we describe some techniques currently used at our nurseries. Most of these have developed through trial and error, and work reasonably well at our facilities. These descriptions are intended to give you some insight as to where to begin your production process.

Nursery Protocols-Plants of the Wild

Plants of the Wild (POTW) grows one crop each year within an enclosed greenhouse. Seeds requiring stratification are placed into mesh bags and buried in moist vermiculite for the necessary duration at 35°F (1 -2°C). Seeds and cuttings are planted between March and June (depending on plant growth rates) into Ray Leach Super Cells (10 in³ and 49 seedlings per ft²; 90 ml and 527 seedlings per m²) filled with 1: 1 peat:vermiculite. Perlite is used as a top mulch. Seedlings receive periodic fertilization. All plants receive one application of Peters' Plant Starter (N:P:K = 9:45:15) at 90 ppm N immediately after thinning or about 3 weeks after cuttings are stuck. Plants are then given 200 ppm N of Peters' Peat Lite Special (N:P:K - 20:20:20) at three different frequencies depending on their growth rate. "Low" frequency plants grow rapidly and are fertilized once every two weeks. "Medium" plants are fertilized once each week and "high" frequency plants, because they grow slowly, receive fertilizer twice each week. All other irrigations are plain water. Once target heights are met, plants are fertilized with 9:45:15 at 90 ppm N continuing the same frequencies (low, medium, high) as those established with the 20:20:20 applications.

Nursery Protocols-University of Idaho

The University of Idaho (UI) grows one crop per year in an open-sided, lexan-covered structure. Most seeds requiring stratification are placed in mesh bags, soaked in running water for 48 hours, and then suspended within a plastic bag hung inside a cooler at 33-34°F (1°C) for the necessary duration. Some species are sown directly into their containers (described below) during late October or early November to simulate more natural conditions and allow nursery workers to do some planting work during the fall slow period, rather than the hectic spring months. For fall sowing, containers are filled with 1: 1 peat:vermiculite, seeds are planted, top-coated with a 0.5-cm-deep layer of silica grit, the medium is watered to saturation, and the entire container placed into cold storage (33-34°F (1°C). Fall sown containers are removed from storage in late May (unless they begin growing sooner). Seeds stratified in mesh bags and cuttings are planted between late May and early June into the Ventblock 45/340 (615A; 20 in³ and 20 seedlings per ft² ; 340 ml and 215 seedlings per m²) filled with 1: 1 peat:vermiculite medium. Plants receive constant fertilization. Usually, plants are watered and fertilized twice each week. After thinning (about 3 weeks after sticking

cuttings), all plants receive Peters' Conifer Starter (N:P:K = 7:40:17) at a rate of 42 ppm N twice each week for one month (8 applications). Then plants receive Peters' Conifer Grower (N:P:K = 20:7:19) at either 120 or 192 ppm N the first irrigation each week, and CAN-17 (liquid calcium ammonium nitrate; N:P:K:Ca = 17:0:0:8.8) at either 102 or 162 ppm N during the second irrigation each week. Plants receiving low rates of 20:7:19 receive low rates of CAN-17, and vice versa. Applications of Grower/CAN-17 continue for about two months (about 8 applications of Grower and 8 applications of CAN-17), then all plants receive Peters' Conifer Finisher (N:P:K = 4:25:35) at 24 ppm N alternated with CAN-17 at 102 ppm N until seedlings are extracted from their containers (about 3 months) and placed into cold storage.

***Alnus* spp.**

POTW grows three species of alder (*rubra*, *sinuata*, *incana* (*tenuifolia*)) while the UI produces only *A. sinuata*. At both nurseries, plants are started from stratified seed (at least 90 days) and target height is 10 inches (25 cm). Seedlings at POTW are given the "medium" fertilizer frequency. At the UI, seedlings receive 20:7:19 at the 192 ppm N rate alternated with CAN-17 at 162 ppm N. Top-pruning is avoided.

Although neither nursery uses cuttings, *A. incana* can be successfully grown from hardwood cuttings. Jave and Everett (1992) achieved 76% rooting with a combination of cold treatment and rooting hormones.

Growth of these species may also be increased by inoculating with *Frankia* (a nitrogen-fixing, soil-inhabiting microorganism) four weeks after germination (Subramaniam and others 1991). Root collar diameters and heights of inoculated plants were 2 and 4 times greater, respectively, than non-inoculated plants 13 weeks after sowing.

Amelanchier alnifolia

Both nurseries grow this plant from seed. Seeds are cold-moist stratified at POTW for at least 120 days; seeds are fall sown at the UI. Target height is around 16 inches (40 cm). *Amelanchier* is given the "medium" fertilizer frequency at POTW, while at the UI they receive 20:7:19 at 120 ppm N alternated with 102 ppm N CAN-17. At the UI, when plants are 8 inches (20 cm) tall the first time, they're top-pruned to 6 inches (15 cm) to make a fuller plant and increase root collar diameter. POTW top prunes only when seedlings exceed target height.

***Betula* spp.**

Betula papyrifera and *B. occidentalis* are both grown from seed. Seeds are cold-moist stratified for 60 days at UI and 90 days at POTW. At POTW, seeds are just barely covered with perlite after sowing, but at the UI grit is not applied until after seedlings have emerged since they germinate better in the light. Target height is 16 inches (40 cm) and top pruning is avoided. Seedlings are given "medium" fertilizer frequencies at POTW; at the UI they receive 120 ppm N via 20:7:19 alternated with CAN-17 at 102 ppm N.

Cornus stolonifera

This species can be propagated from hardwood or softwood



cuttings and seed (Fig 3). Collection of hardwood cuttings generally follows the same protocol as that for *Populus trichocarpa* (see below). However, our experience is that customers prefer the appearance of seed-propagated material, and it's easier to grow from seed (Fig. 4). At POTW, seeds are acid-scarified (30-60 minutes in sulfuric acid) before 90 days of stratification. At the UI, seeds are fall sown directly into containers. Target height is around 16 inches (40 cm). *Cornus* is considered a "low" fertilizer frequency plant at POTW, while at the UI they receive 20:7:19 at 192 ppm N alternated with 162 ppm N via CAN-17. At the UI, when plants first reach a height of 8 inches (20 cm), we top prune them to 6 inches (15 cm) to make a fuller seedling and increase root collar diameter. At POTW plants are pruned only when they exceed target height.



Figure 3. A crop of *Cornus stolonifera* growing in Ray Leach Super Cells.



Figure 4. Four-month-old *Cornus stolonifera* plants growing in a Ventblock 45.340 (615A)(left) and an individual seedling (right).

Crataegus douglasii

Currently grown at POTW, this species exhibits extremely variable seed germination. Seed gathered by the same collector, from the same stands, cleaned the same way, and stratified with the same method (90-120 days in moist vermiculite) may vary in germination between 20 and 80%. If it germinates, target height is around 10 inches (25 cm). Seedlings are fertilized at the "medium" frequency. Pruning is avoided.

***Populus* spp.**

POTW grows both *Populus tremuloides* and *P trichocarpa*, while only *P tremuloides* is grown at the UI. *Populus trichocarpa* is grown from hardwood cuttings. Cuttings are

collected during winter and refrigerated until planting. Ideal cuttings are 8 inches (20 cm) long, about 0.25 inch (5 mm) in diameter, and have visible buds along the length (Fig. 1). Cuttings are dipped in 1: 10 Dip-N-Grow: water immediately before planting. On warm, sunny days, cuttings are misted for 3 minutes once every 90 minutes but only once every 3 hours on cool, cloudy days. Cuttings receive one application of 9:45:15 at 90 ppm N, but receive 20:20:20 only sparingly (about once a month) in an attempt to keep height growth in check. Target height is 16-20 inches (40-50 cm). Once terminal buds have formed, seedlings receive 9:45:15 at 90 ppm N once every two weeks.

Populus tremuloides seeds must be freshly harvested (no more than one year old) and can be sown without stratification. At the UI, sown containers are placed into a fog house (90+% relative humidity and 80°F (27°C)) until germination is complete (usually less than one week). At POTW, sown containers are placed directly into the greenhouse. Seedlings at POTW receive one application of 9:45:15 at 90 ppm N, and one application of 20:20:20 at 200 ppm N when seedlings are about 2 inches (5 cm) tall. Until terminal buds are set, seedlings receive 20:20:20 sparingly (once each month) in an attempt to keep height growth in check. At the UI, seedlings receive 20:7:19 at 120 ppm N alternated with CAN- 17 at 102 ppm N. Pruning is avoided at POTW while seedlings may be pruned at the UI to maintain the target height of 16-20 inches (40-50 cm).

Prunus virginiana

This species is grown from seed at both nurseries. Seeds are given at least 180 days stratification at POTW; seeds are fall sown at UI. Target height is around 16 inches (40 cm). When *P. virginiana* plants at the UI first reach 8 inches (20 cm) in height, they are pruned to 6 inches (15 cm) to enhance root collar diameter. Seedlings receive fertilizer at the "medium" frequency at POTW; at the UI seedlings receive 120 ppm N via 20:7:19 and CAN- 17 at 102 ppm N.

***Rosa* spp.**

Rosa nutkana and *R. woodsii* are grown at POTW from seed stratified 120 days. Target height for both species is around 10 inches (25 cm). The first time seedlings are 8 inches (20 cm) tall, they are top-pruned to 6 inches (15 cm) to make them fuller and increase root collar diameter. Seedlings receive fertilizer at the "medium" frequency.

***Salix* spp.**

POTW grows around ten species of willow, with *Salix rigida* "Mackenziana," *S. scouleriana*, *S. exigua*, *S. lassianra*, and *S. sitchensis* being produced in the largest quantities. All plants are grown from hardwood cuttings following the same cutting and fertilization protocols as that for *Populus trichocarpa* (see previous). Target height is around 16 inches (40 cm). Pruning is avoided as cut stems tend to turn black and die back to the first viable bud. Usually, rooting is 80% or better, the exception being *S. scouleriana*, an upland willow, which often roots in the 40-80% range. Edson and others (1995) increased the rooting of 3- to 5-inch-long (8-10 cm) hardwood and softwood cuttings by treating them with 0.3% IBA; hardwood cuttings rooted at 73% and softwood cuttings at 87%.

***Sambucus* spp.**

Three species (*cerulea*, *racemosa*, and *racemosa* var. *melanocarpa*) are grown at POTW from seed stratified 120 days. When given the "medium" frequency of fertilizer, *Sambucus* grows rampant in the greenhouse (24-30 inches (60-75 cm)), but a target height is rather irrelevant as the shoot dies back to the ground the first winter. The robust height growth is a trade off necessary to accumulate sufficient roots to hold the plug together.

Symphoricarpus albus

At POTW *Symphoricarpus* is grown from hardwood cuttings following the protocol described for *Populus trichocarpa*, except that cuttings are dipped in 1:5 Dip-N-Gro:water. The best success ideally, is by rooting one-year-old suckers from plants in recently logged areas. Target height is 16 inches (40 cm) and can be reached only by using "high" frequency fertilization.

CONCLUSIONS

The more common woody riparian plants are relatively easy to grow using techniques, fertilizers, and growing medium used in traditional conifer production programs. As with all cultural programs, keep detailed records to help refine and define the evolution of the propagation technique that works at your specific facility.

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