New Stock Types and Species from Stooling Beds
by Thomas D. Landis and Tara Luna

Stooling beds are hedge-like rows of mother plants that are established in bareroot nurseries or in vacant fields adjacent to container nurseries. They have been a traditional way of propagating poplars, cottonwoods, and willows in forest and conservation nurseries for well over a century (Figure 1). The term "stool beds" or "stooling beds" is unique to forestry; in horticulture, they are known as "stock hedges" (Macdonald 1986). Regardless, the concept is the same - to establish a ready source of cuttings of known genetic quality for propagation or other purposes.

Stooling beds take advantage of the ability of many broadleaved woody plants to sprout profusely from the base after being cut-off just above the root crown. This happens because the plants are still in the juvenile state which means that they have a higher tendency to sprout and produces roots. Once stooling beds are established, annual cutting ensures that juvenility can be prolonged indefinitely.

Advantages of Stooling Beds

Stooling beds allow the efficient collection of dormant hardwood cuttings during the winter when it may be difficult or impossible to make field collections. Because they are located at nurseries, the beds can be irrigated and cultured; processing and storing the cuttings is also much more efficient and cost-effective. Stooling beds have several advantages over wild collected cuttings:

Figure 1—Stooling beds, like this one of black cottonwood (A), are a traditional way of producing rooted cuttings in bareroot and container nurseries (B).

1. Maintaining genetic and sexual diversity. It is much easier to correctly identify different species and ecotypes from labeled stooling beds compared to wild collections. For example, willows often grow together along streams and can be difficult to identify during the winter dormant season. Stooling beds offer the ability to bulk-up unique species or ecotypes quickly and easily.

Many government nurseries have established stooling beds of the species and ecotypes that are adapted to their local area and thus can be a potential source of cutting material for private growers or restorationists. In addition, private native plant nurseries are also establishing stooling beds of desirable species for their local areas and several are specializing in riparian and wetland species. For specific restoration projects, however, the odds of a nursery having existing stooling beds of the proper species and local ecotype is problematic. Therefore, collecting cuttings and establishing stooling beds should be done early in the planning process so that a good supply of cuttings will be available when needed.

For dioecious species like willows and cottonwoods, there is also the issue of proper representation of male and female plants. If a balanced mixture of male and female plants are not collected at the start, the resultant stooling beds will not produce both male and female cuttings. So, when working with dioecious plants, the sexual identify of potential mother plants must be made ahead of time. This is easiest when plants are flowering. Depending on species, willow catkins may appear before, during, or after new leaves appear in spring. Identifying anthers in male catkins and pistils in females with a hand lens is relatively easy, especially with a little practice. During the winter dormant season, it is possible to identify the sex of dormant cottonwoods by dissecting floral buds although this is more difficult with willows. Detailed instructions on how to "sex" willows and cottonwoods can be found in Landis and others (2003).

2. Producing healthy and vigorous cuttings. Cuttings from stooling beds are usually healthier and more vigorous than those from wildland collections. Willows are host to many insect and fungal pests such as galls and cankers (Figure 2) that lower the quality of wild-collected cuttings. For example, on a riparian restoration project in Idaho, cuttings were collect from heavily browsed willows on the project site and then planted in nursery beds to produce rooted cuttings. However, the yield of shippable plants was low and these

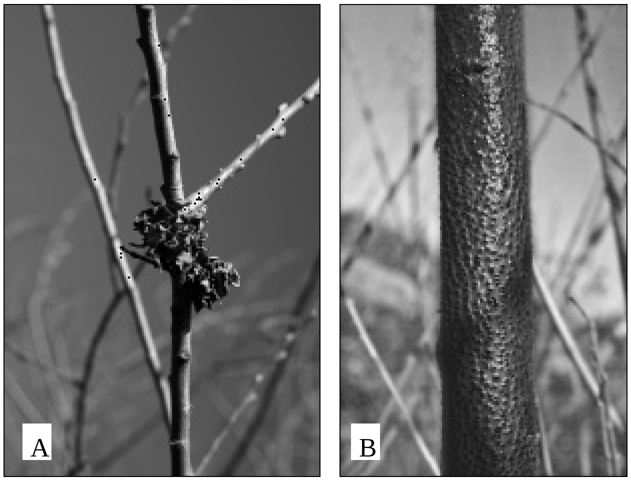

Figure 2—Stooling beds can be cultured to prevent the occurrence of insect galls (A) and fungus cankers, such as Cytospora *(B)*

wild-collected cuttings rooted poorly (> 50%) when outplanted. These failures increased production costs and threatened the project's replanting schedule. So, about 150 rooted cuttings from the first nursery crop were used to start a stooling bed. The following year, harvesting just half of the stooling bed yielded more than 6,000 healthy cuttings. Cuttings from the stooling beds rooted at over 99%, thereby lowering establishment costs and keeping the project on-schedule (Dumroese and others 1998).

So, to summarize, a well-planned stooling bed will produce health, vigorous cuttings of the proper plant species. A known mixture of male and female plants to ensure that the resulting plant materials will be able to produce viable seeds soon after outplanting, and achieve the ultimate goal of a diverse, sustainable plant community.

Types of Plant Materials from Stooling Beds

Nurseries can harvest several different plant materials from stooling beds. They can use propagation cuttings to start their own bareroot or container plants, or can sell other types of plant materials to clients for use on restoration sites (Figure 3). These plant materials can be collected during winter or very early spring that are usually "slow times" at many nurseries.

Hardwood cuttings for nursery propagation. Historically, the main purpose of stooling beds was to provide a ready and reliable source of propagation cuttings (Figure 3) for use at the nursery. Cuttings were collected during the winter dormant season, processed, stored, and then stuck into bareroot beds or containers to produce rooted cuttings (Mathers 2003). These stock types take only one growing season.

Hardwood cuttings for restorations sites. Stooling beds can also be sources of several types of nonrooted cuttings:

Live stakes - Live stakes are so-named because, in addition to providing stability on restoration sites, they are expected to root and sprout after installation. Because they will be pounded into the ground, live stakes are cut from relatively straight sections of second or third year wood. Live stakes are typically 18 to 24 in (46 to 61 cm) in length and at from 1 to 3 in (2.5 to 7.6 cm) in diameter (Figure 3). However, because dimensions will vary with each application, specifications should be negotiated with individual customers. Depending on the plant species, it can take 2 to 4 years for a stooling bed to produce large enough branches for live stakes. Some of the smaller willow species will never grow large enough.

Branched cuttings - Fascines, vertical bundles, and other bioengineering structures (Hoag and Landis 2001) require a large number of dormant, nonrooted, branched, hardwood cuttings (Figure 3). Usually, these are gathered on-site but, for restoration projects that will require a large amount of plant material over several years, cuttings of a variety of species can be brought back to a nursery to start stooling beds. Stooling beds

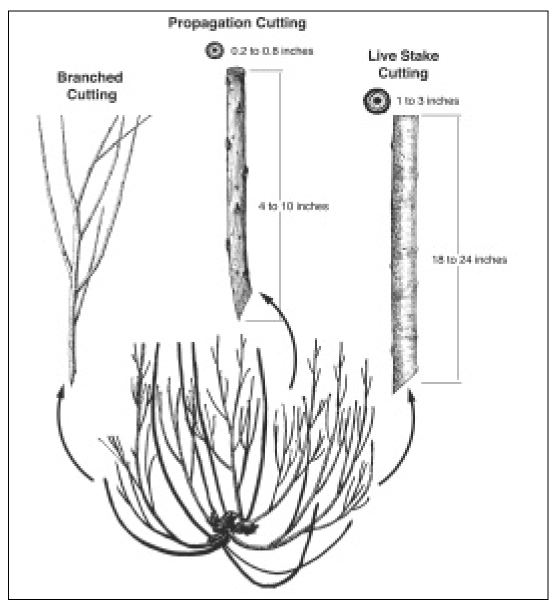

Figure 3—Several types of hardwood cuttings can be obtained from stooling beds, including cuttings for propagation at the nursery or live stakes and branches cuttiings for restoration projects. Note that large plant materials require extra time to produce.

may take 2 or more years to produce significant numbers of harvestable cuttings.

Pole cuttings - Pole cuttings (Figure 4) are large diameter main stems that have all side branches and the top 30 to 60 cm (1 to 2 ft) removed. They have primarily been used in riparian restoration projects where normal-sized cuttings fail, such as riparian systems where high water velocities can rip cuttings out before they have a chance to establish. Poles should also have applications in roadside revegetation and other restoration projects where stability is a main concern. Because of the large size of the plant material necessary for pole cuttings, nursery stooling beds are ideal. Cottonwoods have been the main species used for poles but the larger tree-sized willows such as Goodding's willow *(S. gooddingii*) also have potential.

Dreesen and Harrington (1997) were able to produce large Fremont cottonwood poles from stooling beds at the Los Lunas Plant Materials Center in New Mexico in as little as 3 years. They also tested other southwestern riparian species in pole plantings, and found that New Mexico olive (*Forestiera neomexicana*), seepwillow (*Baccharis glutinosa*), and false indigo bush (*Amorpha fruticosa*) had potential.

Stooling beds can remain productive for many years, depending on species, ecotype, and nursery cultural practices, especially pest management. For cottonwood, stooling beds typically remain productive for 4 to 8 years after which vigor and productivity start to decline; however, other nurseries have maintained stooling beds of willow and cottonwood for 12 to 15 years without decreases in vigor. Cytospora canker, caused by fungi of the genus *Cytospora* spp. (Figure 2B) is a particularly serious pest of all Salicaceae and, because it is transmitted and thrives in wounded stem tissue, can ruin a productive stooling bed. The productivity and longevity of a stooling bed is a direct function of the amount of care given them.

Plant Species Suitable for Stooling Beds

As mentioned, most stooling beds have been of poplars, cottonwoods, and willows. However, it should not be assumed that all species of the willow family are good candidates for stooling beds. Some species have growth characteristics which reduces their potential. For example, trials at the Colorado State Forest Service Nursery in Ft Collins have shown that narrowleaf cottonwood (*Populus angustifolia*) and coyote willow (*Salix exigua*) do not "stool" well and must be propagated by other methods (Grubb 2007).

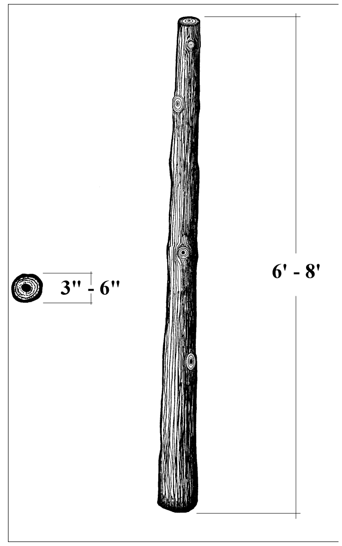

Figure 4—Pole cuttings of cottonwood and larger willows can also be produced in stooling beds, and have application in restoration outplanting where stability is a concern.

On the other hand, there is great potential for using other woody species that have the propensity to sprout and form roots easily. For example, redstem dogwood (*Cornus sericea*) is commonly grown in stooling blocks and used as a source of cuttings for restoration sites. Outplanting success is higher than with native collections on site and have ranged from 50 to 90% (Hoag 2007). In North Dakota, black twinberry honeysuckle (*Lonicera involucrata*) is being investigated (Morgenson 2007).

Clearly, native species that root easily from hardwood cuttings have the potential to be grown in stooling beds to generate cuttings. This is especially true for those species whose seed have inherent deep seed dormancy characteristics, such as snowberry, honeysuckle, elderberry, and some species of currants. Other species such as mock orange and ninebark (*Physocarpus* spp.), that often have consistent low seed viability, may also be produced more economically by stooling beds.

The Plant Materials Centers of the USDA Natural Resources Conservation Service have done an good job of identifying the potential of a wide variety of woody native plants that would be suitable for stooling beds (Table 1). For example, Crowder and Darris (1999) do an excellent job of discussing which plants are suitable in the Pacific Northwest and then provide a wealth of information on the installation and culture of stooling beds.

Table 1—Native woody plants of the Pacific Northwest with potential for propagation in stooling beds

Plant Species		**Rooting Ability**	**Growth Rate**	**Field Success** (1=Poor, 5=Good)
Scientific Name	**Common Name**			
Baccharis pilularis	Coyote brush	Fair to good	Moderate	3
Cornus sericea	Red-osier dogwood	Good	Fast	3
Oemleria cerastiformis	Indian plum	Poor to Good	Moderate	1
Physocarpus capitatus	Pacific ninebark	Good to Very Good	Moderate to Fast	4
Philadelphus lewisii	Lewis mockorange	Fair	Moderate	1
Populus trichocarpa	Black cottonwood	Fair to Very Good	Very Fast	3
Rosa woodsii	Woods' rose	Poor to Fair	Moderate to Fast	1
Salix amygdaloides	Peachleaf willow	Excellent	Very Fast	5
Salix exigua	Coyote willow	Very Good	Fast	4
Salix lasiolepis	Arroyo willow	Excellent	Very Fast	5
Salix scouleriana	Scouler's willow	Good to Very Good	Very Fast	4
Spirea douglasii	Douglas spirea	Very Good	Fast	4
Symphoricarpos albus	Snowberry	Very Good	Fast	4

* = modified from Crowder and Darris (1999)

Darris (2002) performed extensive greenhouse and field trials to test the potential of several woody plants for live stake applications. Common snowberry (*Symphoricarpus albus*), salmonberry (*Rubus spectabilis*), Pacific ninebark (*Physocarpus capitatus*) and black twinberry (*Lonicera involucrata*) have all proved effective as live stakes for soil bioengineering in the Pacific Northwest. Notably, several have proven superior to willow on some sites such as salmonberry in wet, shaded environments and snowberry on drier, exposed locations.

Summary

Stooling beds have been producing cuttings of willows, cottonwood, and poplars for many years but also have the potential for supplying other plant materials for restoration projects. Because of their proven application, nursery managers should work with their customers to establish stooling beds of woody plant species.

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