# The Watershed Revegetation Program: Lessons Learned From Large Scale Native Plant Propagation

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## Introduction

The Watershed Revegation Program (WRP) has been working to restore native plant communities in the Portland area since 1996. The program covers the entire Portland metropolitan area working with public agencies and private landowners to revegetate riparian and upland areas which impact City of Portland Watersheds. During the past five years, the WRP has developed a large scale propagation program for more than 75 native woody and herbaceous species. As a consequence of propagating and installing a large number of bareroot plants and native seed, we have gained knowledge about working with native plants in the context of urban environments. This paper will attempt to share knowledge we've gained in establishing these plants in marginal environments.

## Program History

Since 1996, the WRP has planted over 1.5 million trees and shrubs and managed over 1000 acres on more than 250 sites. The program has four main objectives: to improve water quality, increase biodiversity, enhance wildlife habitat and promote community livability. The WRP has developed a propagation program for more

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than 75 native woody and herbaceous species. This program includes seed collection, processing and mixing; grow-out contracts; plant handling and allocation; and reference site data collection. All woody seed and the majority of herbaceous seed is collected within 50 miles of Portland in the lowlands of the Willamette Valley.

Managing project sites involves site preparation, herbaceous seeding, planting, site maintenance, and monitoring. For most projects, five year agreements are established with each landowner to insure consistency in site monitoring, management prescriptions and implementation. Site preparation or weed management generally includes cutting or mowing followed by herbicide application. Native seed is broadcast using manual spreaders. Seed mixes have been formulated based on commercial availability, site conditions and reference site data. Tree and shrub planting is implemented from late winter to early spring using bareroot material. Plant allocation and design is based on current and projected site conditions as well as historical plant communities. Planting is followed by maintenance and in depth monitoring to assess plant survival and weed conditions.

## Woody Plant Production

We currently have 28 native species of trees and shrubs which are contract-grown by local nurseries. We use primarily bareroot material because it is the least expensive form of woody plant material to grow and install. Most species are sown in the field in the fall with no seed pre-treatment. These include *Acer circinatum, Acer macrophyllum, Amelanchier alnifolia, Mahonia aquifolium, Mahonia nervosa, Cornus nuttallii, Crataegus suksdorfii, Fraxinus latifolia, Holodiscus discolor, Lonicera involucrata, Malus fusca, Oemlaria cerasiformis, Physocarpus capitatus, Quercus garryaua, Ribes sanguineum, Rosa pisocarpa, Rosa gymnocarpa, Rosa nutkana, Rubus parviflorus, Rubus spectabilis, Sambucus racemosa, Sambucus cerulea,* and *Rhamnus purshiana.* Spring sown species without seed pre-treatment include *Populus trichocarpa ssp. balsamifera, Spiraea douglasii,* and *Alnus rubra.* We cold stratify *Cornus sericea,* and sometimes *Fraxinus latifolia. Symphoricarpos albus* requires a warm-cold stratification before spring sown.

There are a few species we have grown in containers. These are species which are unavailable in bareroot form. *Arbutus meniesii* and *Gaultheria shallon* are grown in Ray Leach Cell plugs. A. *menziesii* requires a cold stratification. Most are ready the first year while others require two growing seasons.

Conifers are grown and purchased from established conifer nurseries. *Pseudotsuga menziesii* and *Thuja plicata* are grown on contract. *P. menesii* is grown as I-I and *T plicata* as a Plug-I. *Abies grandis* is purchased as a 2-0, Ts*uga heterophylla* as a Plug-1 and Willamette Valley *Pints ponderosa* as a I-I or Plug-I. These stock types offer the best quality trees because they have a large root mass, thick caliper, and are easy to handle. Tracking genetics of conifers is easier than most other bareroot plants because the conifer industry consistently keeps detailed records of seed source by seed zone and elevation.

In grow-out contracts, the grower has the majority of the say in maintenance of the crop. Many are undercut, sprayed with fungicide and pre-emergent. Failures have included *Prunus emarginata, S. albus, A. rubra,* and *Philadelphus lewisii.* These have failed due to herbicides, poor seed quality or incomplete stratification. Most are fertilized, watered, and weeded frequently to improve growth. Packing is done in large seedling bags ranging from 100-1000 trees/bag and are stored in a cooler before planting.

### Hybridization threats

A threat to our native plants is hybridization between introduced and native species. We have seen this to occur between the native Black Hawthorn *(Crataegus suksdorfii)* and the English Hawthorn *(C. mouogyna)* and between the native Nootka *Rose (Rosa nutkana)* and Sweet Briar Rose *(Rosa euglanteria).* We have avoided propagating hybrids of Hawthorn by hiring private seed collectors to collect in populations that are void of *C. monogyua.* For Rose, we planted a row of identified *Rosa nutkaua* at our research plot at North Willamette Research Center. This is maintained as a "seed orchard" for *R. nutkana.* The native Black Cottonwood *(Populus basalmifera* var. *trichocarpa)* may be under threat from hybrid Cottonwood plantations.

### Planting and protection

The Portland Metro region has experienced intensive development and urbanization. Establishing native plants in this setting has many challenges. First, the project size is usually small, increasing the edge effect and consequently susceptibility to exotic plant introductions, increased pollution, and other human impacts. Many project sites have compacted soils and are dominated by invasive species- including both plants and nuisance wildlife such as nutria. Establishing pre-settlement vegetation or restoring a "reference" native plant community is not always a feasible goal because of the cost involved. Our program goal is to establish a native tree and shrub canopy layer as well as a dominant native graminoid and forb component. Completion of this goal involves intensive weed management to prepare and maintain the native plant installment at each site.

Planting is implemented using reforestation contractors. Trees are planted in a grid to maximize plant dispersal and to allow for repeated maintenance. Trees are then protected with Vexar tubes and bamboo stakes for support in animal damage prone areas. Tubes have been only marginally successful against Deer and Beaver on favored species, but are good barriers for mice, voles and nutria. Deer seem to prefer T *plicata, M. fusca, and* C. *suksdorfii* and will avoid *P ponderosa, Q. garryana* and *E latifolia.* Mice and voles will target most trees, but seem to avoid *C. suksdorfii, S. racemosa, S. douglasii, P. capitatus,* and *S. albus.* Beaver will avoid F *latifolia* as well. A combination of high plant densities and planting unfavorable plant species increases successful establishment of trees and shrubs.

### Tree and shrub establishment

Over the years, we have seen trends in species survival on different site conditions. Species which have great success in dry and compact conditions include *Quercus garryana, Fraxinus latifolia, Pinus ponderosa, P. meniesii, S. albus, Rosa pisocarpa, R. purshiana, P. capitatus, S. douglasii,* C. *suksdorfii,* and *B. aquifolium.* Species that must be planted under certain site conditions are *Sambucus racemosa* and *cerulea, Populus trichocarpa, Ants rubra, Cornus sericea,* and *Tsuga heterophylla.* The above species will have excellent performance if they are handled properly and placed in appropriate conditions. Species that have shown preliminary success are *Arbutus menziesii* and *Malus fusca. Acer macrophyllum , Gaultheria shallop, Rubus parviflorus, Rubus spectabilis, Acer circinatum,* and *Philidelphus lewisii* have only shown marginal results. These may need to be grown in a different stock type (in containers) or on more favorable sites.

Plant establishment is dependent on many variables. Soil conditions, weed competition, maintenance treatments, animal damage, and hydrology greatly influence the establishment of each species. Five year old sites have shown to average 59% overall tree survival rate. This has varied from 97% to 26% depending on site conditions. After one growing season in 2000, our average survival rate was 70% for trees and 56% for shrubs. This is mitigated for in our high plant densities (around 2500 trees and shrubs per acre).

## Herbaceous Seed Production

Traditional production of native seed has been primarily grasses. Native grasses have been used successfully for some time in revegetation and erosion control projects. They are comparable to traditional grass seed crops in that they can be sown, managed and harvested with traditional methods. In the past several years, public land managers in the Willamette Valley have recognized the need for re-introduction or enhancement of native forbs, sedges and rushes onto restoration/revegetation sites. This has led to smaller agencies such as the City of Portland to follow leads put forth by the US Forest Service and the Bureau of Land Management to produce native seed themselves or contract out to local seed farmers.

The Watershed Revegetation Program has had seed grow-out contracts with local farmers for the past four years. Through these contracts, the following species were successfully produced between 1998 and 2000: *Alisma triviale (plantago-aquatica), Collomia grandiflora, Eleocharis ovata,* and *Gilia capitata.*

These species have been successfully broadcast seeded onto a variety of site

conditions. During 2001, farmers were able to successfully produce seed for an additional 13 species of native herbaceous plants. This seed produced will be used for Fall 2001 and Spring 2002 seeding. The remainder of the 16 species (Table 1) are those which are perennial crops in their first year of production, or those which have failed due to lack of germination, chemical exposure or expense.

**Table 1. Species in Contract Grow-out**

| | |
|---|---|
| *Achillea millefolium* | Western Yarrow |
| *Aquilegia formosa* | Red Columbine |
| *Bromus vulgaris* | Columbia Brome |
| *Carex aperta* | Columbia Sedge |
| *Carex deweyana* | Dewey's Sedge |
| *Carex scoparia* | Pointed-Broom Sedge |
| *Carex tumulicola* | Foothill Sedge |
| *Clarkia amoena* | Clarkia |
| *Collomia grandiflora* | Large-Flowered Collomia |
| *Coreopsis atkinsoniana* | Columbia Tickseed |
| *Danthonia californica* | California Oatgrass |
| *Deschampsia cespitosa* | Tufted Hairgrass |
| *Deschampsia elongata* | Slender Hairgrass |
| *Elymus glaucus* | Blue Wildrye |
| *Eriophyllum lanatum* | Wooly Sunshine |
| *Festuca occidentalis* | Western Fescue |
| *Gilia capitata* | Globe Gilia |
| *Glyceria elata* | Tall Mannagrass |
| *Grindelia integrifolia* | Gumweed |
| *Hypericum formosum* | Western St. John's Wort |
| *Iris tenax* | Oregon Iris |
| *Juncus patens* | Spreading Rush |
| *Koeleria cristata* | Junegrass |
| *Lupinus polyphyllus* | Broad-leaved Lupine |
| *Phacelia nemoralis* | Shade Phacelia |
| *Potentilla gracilis* | Slender Cinquefoil |
| *Ranunculus alismifolius* | Water-Plantain Buttercup |
| *Sidalcea campestris* | Meadow Sidalcea |
| *Sisyrinchium angustifolium* | Blue-Eyed Grass |
| *Tellima grandiflora* | Fringecup |
| *Tolmiea menziesii* | Piggy-back |
| *Wyethia angustifolia* | Narrow-Leaved Wyethia |

## Challenges of native herbaceous seed production

One challenge of native herbaceous seed production is that many native non-graminoids are not easily produced using standard farming methods. This results in a high price that must be paid for the production of native seed. The first challenge is that plot sizes for native species are generally small (.125-10 acres) in contrast with traditional non-native grass crops which range in size from 40 through several thousand acres. In most restoration or habitat enhancement projects, the goal is to re-introduce or enhance the native forb component by seeding a comparatively small amount of a diverse number of species. In addition, a lack of consolidated demand for native seed in the Willamette Valley limits the amount of seed which is produced and stored.

Traditional farming methods such as seed drilling and combine harvest don't work well with many natives because of the desire to retain genetic diversity during production. Unlike cultivars, native (orbs generally produce seed which varies greatly within a species in size, shape and timing for harvest. Many of the pioneering species which compete well in disturbed conditions produce light, fluffy, wind-dispersed seed which are extremely difficult to sow, harvest and clean. In addition to difficulties with traditional farming equipment, chemicals used for maintenance of non-native grass crops are also problematic for native forb and some grass species. Some crops are completely intolerant of chemical applications and must be managed entirely through cultural means.

The size of the crop is also problematic in producing clean seed. Most commercial seed cleaners are set up to clean thousands of pounds of seed at a time. It takes on average a full day to change cleaning equipment between species. For most small crops, this is not a cost-efficient option and crops must be cleaned by hand or by using small, make-shift cleaners.

## Challenges in forb re-introduction

The greatest challenge in seeding project sites is adequate site preparation. As discussed earlier, the majority of Watershed Revegetation Program sites are fragmented riparian areas, comprised of fill soils and dominated by well-established exotic and noxious weeds. On larger restoration or enhancement projects with exhaustive seed banks, the optimal site preparation method would be to remove the top portion of the soil including the seed bank. This is not a viable option on many of our sites. The primary

reason is cost and the secondary reason is that most of these fragmented sites don't have the potential to stay "clean" for long.

Rather than reconstruct herbaceous plant communities, it is our goal to create a community of native plants which are able to sustain themselves with competition from non-natives such as reed-canary grass *(Phalaris arundaceae),* exotic thistles *(Cirsium spp),* teasel *(Dipsaucus sylvestris),* creeping clover *(Trifolium repeus),* bird's foot trefoil *(Lotus corniculatus),* etc. Many of the species we work with are those most would classify as native weeds. Most are ubiquitous, have high germination rates or produce millions of seeds per plant. They can be broadcast seeded as opposed to drilled and will germinate even with competition from the seed bank or existing plants.

During the past four years, staff at the Watershed Revegetation Program has taken great care in observing which native herbs may fit this criteria. Fall of 2001 marks the first time we will be able to direct sow a wide variety of native broadleaf and sedge species as well as grasses onto project sites. Although we have collected data on sites where we've sown a variety of native grasses, we have yet to assess the success of broadcast seeding for forbs and sedges.

## Conclusion

Restoration and native plant reforestation are relatively new endeavors in urban, degraded environments. In order for our efforts to be successful, it is important that we share both failures and successes in plant propagation and establishment. We hope that this information shared will benefit restoration practitioners throughout the Willamette Valley.

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