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Development of vegetative solutions for conservation problems is a primary function of the USDA NRCS Plant Materials (PM) program. The Corvallis (Oregon) Plant Materials Center (PMC) is one of 26 centers nationally and serves western Oregon, western Washington, and northwestern California. The PMC's primary mission is to develop new technology in plant propagation and establishment, seed production, revegetation, restoration and erosion control, and to test and release new plant sources for use in riparian areas, wetlands, and uplands. Most of the focus is on native grasses, forbs, and shrubs.



Removing crop residue and older foliage of California fescue after seed harvest using a Brady field chopper.

The principal program customers include:

- ✓ NRCS field offices, who in turn serve both rural and urban land owners, farmers, ranchers and other land managers;
- ✓ Public agencies, universities, Tribes, and private conservation organizations that utilize technology and plants selected or produced by the program; and
- ✓ Commercial seed producers and nurseries who receive information on production technology as well as seed and plants of selected species for further increase.

PLANT EVALUATIONS AND RELEASE

Wild populations of plants are collected, propagated, and selected for their physical attributes, area of adaptation, potential performance, or documented capabilities from a series of evaluations aimed at addressing conservation needs. Purposeful selection can be important for farm or related pragmatic uses such as erosion control, forage, seed production, windbreaks, or water quality improvement. However, species are not bred or hybridized and genetic changes are intentionally minimized if ecological restoration is the primary goal.

Studies may begin with assemblies of numerous ecotypes and the establishment of an initial evaluation planting or common garden. After populations are chosen from

Contents	
	Page
Plant Evaluations and Release_____	1
Plant Technology and Increases_____	3
Partnerships with Other Agencies_____	5
Special Assistance and Demonstrations_____	8
Technology Transfer_____	9

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comparative evaluations, propagation and increase methods are determined and field tests are conducted. The material may then be released and made available to commercial growers. They in turn produce the seed or plants on a much larger scale and make it available to the public for conservation, reclamation, or restoration purposes. Currently, the Corvallis Plant Materials Center maintains and promotes 14 plant cultivars and pre-varietal releases. A 15th release, Skamania Germplasm Sitka alder, is pending final approval.

Pre-varietal Native Plants to Address Resource Needs

Commercial sources of native plants of “local” genetic origin are needed for wetland, upland, and riparian revegetation and other resource needs on an ecoregion or Major Land Resource Area (MLRA) basis. The PMC addresses this need by providing pre-varietal releases of species from specific areas for use in the same or similar area. Pre-varietal release is a process whereby a plant (individual, group, or whole population) from a specific location is identified and studied (by the PMC), increased (by the PMC or private grower), and certified (by the official seed certification agency in the state it was collected or grown). Pre-varietal releases may be “source identified”, “selected”, or “tested class”, depending on the degree of testing and evaluation they undergo.

Future Plant Releases: Oceanspray

Pre-varietal releases targeted for completion within several years include five ecotypes of oceanspray (*Holodiscus discolor*) which will be ecoregion specific. It is an important native shrub for riparian revegetation and wildlife habitat in western Oregon, western Washington, and northwestern California. The PMC is establishing isolated seed orchards for each selected population. Seed harvest may begin as early as next growing season.

Progress Continues on Common Garden Study of Roemers Fescue

Roemers fescue (*Festuca roemerii*) is a native fine leaf fescue found exclusively west of the Cascade Mountains in Washington and Oregon as well as northwestern California. It was once a dominant bunchgrass of oak savannas and prairies throughout the region. Because of extensive agriculture and urbanization, there remain only small, isolated remnant populations. For these reasons there is considerable interest in this species for ecosystem restoration as well as revegetation and erosion control.

To address the need, a common garden study of Roemers fescue was initiated in 2001 in cooperation with Institute for Applied Ecology in Corvallis, and the Bureau of Land Management. By collecting seed from throughout its geographic range and growing out plants in a common garden, it is possible to identify patterns of genetic variation that correlate to the environment. The study contains 14 populations from Washington, 30 from Oregon, and 3 from California. The results will be used to define seed transfer guidelines or seed transfer zones. Other outcomes may include several selected class releases.



Hand harvest of seed from individuals in the Roemers fescue common garden study.

This year (2005) was the second full growing season for the common garden of Roemers fescue. Survival, foliage abundance, vigor,

and seed production were scored. Despite the moist spring, stem and leaf rust infections caused by fungi were unusually low. Mortality within the nursery reached approximately 25 percent by June and nearly 40 percent of the remaining individuals did not flower in 2005.



Specimens of Roemers fescue show high genetic diversity within and between populations

PLANT TECHNOLOGY and INCREASES

The NRCS is a USDA agency with the responsibility of administering technically based conservation programs. Many of these programs, such as CRP, CReP, GRP, WRP, and WHIP directly involve the use of plant materials and plant technology. The primary responsibility for developing new plants and technology lies with the PM program.

- Portions of the plant technology developed by the program are incorporated into the Field Office Technical Guide (FOTG) or supporting handbooks and become standards for conservation practices implemented on public and private lands.
- The National PM program maintains a web site, which contains useful information such as plant fact sheets and guides, publications developed by the PM program, sources of plant materials, and related websites. The website address is <http://plant-materials.nrcs.usda.gov>.

- The PM program supports other NRCS computer applications such as the PLANTS database and VEGSPEC.

Current technology studies at the Corvallis PMC to address priority resource needs involve:

- ✓ determining vegetative propagation, seed production, and establishment methods of plant materials (native forbs, shrubs, and grasses) for rehabilitating, stabilizing or restoring riparian areas, wetlands, and uplands, primarily at low elevations;
- ✓ studying and increasing plant materials for use in soil bioengineering;
- ✓ evaluating progress and monitoring maintenance needs of sites restored or revegetated through direct seeding, planting, and soil bioengineering;
- ✓ assessing flood inundation tolerance and other adaptive qualities of select grass, forb, and woody species;
- ✓ increasing and testing seed and plant materials for revegetation at low to high elevation areas in National Parks;
- ✓ increasing and determining seed propagation methods of wetland and upland species for the Bureau of Land Management; and
- ✓ installing demonstration plantings and providing materials to illustrate and promote the use of native species for windbreaks, landscaping, and wildlife.

Overall, about 30 new or ongoing studies and increases were conducted in 2004-2005. In terms of production, over 15,500 container plants, 4000 cuttings, and an estimated 337 pounds of seed were produced in 2004.

Seed Production, Germination and Establishment Studies Benefit Commercial Growers

The major challenges facing the widespread increase and availability of native grasses and forbs are unknown seed production techniques and inherent low seed yields for many species.

To address this bottleneck, the Center conducts studies and demonstrations to evaluate seed production and establishment techniques. The most universal research needs concern basic agronomic practices to maximize yields, including post harvest residue management, broadleaf weed and annual grass control, harvest techniques, row spacing (some), seed dormancy and establishment (some), and irrigation management (some). The following is a list of native grasses currently under production at the PMC and the priority technological issues to be addressed.

NATIVE GRASSES UNDER INCREASE AND STUDY¹

Common name	Scientific name	Priority Technology Issues
Lemmon's needlegrass	<i>Achnatherum lemmonii</i>	Seed yields, harvesting, indeterminate flowering
Hall's bentgrass	<i>Agrostis hallii</i>	Establishment, harvest technology, seed yields
California brome	<i>Bromus carinatus</i>	Volunteer seedlings, weediness, control
Columbia brome	<i>Bromus vulgaris</i>	Establishment, longevity
Bluejoint	<i>Calamagrostis canadensis</i>	Seed fill, establishment from seed, stand mgt.
California oatgrass	<i>Danthonia californica</i>	Establishment, seed dormancy, adaptation
Tufted hairgrass	<i>Deschampsia caespitosa</i>	Adaptation (inundation, salinity) ecotypic variation
Annual hairgrass	<i>Deschampsia danthonioides</i>	Soil moisture mgt., weed management
Slender hairgrass	<i>Deschampsia elongata</i>	Soil moisture management, longevity
Blue wildrye	<i>Elymus glaucus</i>	Seed shattering
Slender wheatgrass	<i>Elymus trachycaulus</i>	Stand longevity, management
California fescue	<i>Festuca californica</i>	Establishment, seed germination/dormancy
Roemers fescue	<i>Festuca roemeri</i>	Seed fill, longevity, low yields, row spacing
Tall mannagrass	<i>Glyceria elata</i> (<i>G. striata</i>)	Soil moisture mgt, seed dormancy, establishment
Meadow barley	<i>Hordeum brachyantherum</i>	Seed retention, harvest techniques
Rice cutgrass	<i>Leersia oryzoides</i>	Harvest techniques, stand rejuvenation, seed dormancy, establishment
Harford's melic	<i>Melica harfordi</i>	Seed fill, variable seed dormancy, stand mgt., harvesting methods
Pine bluegrass	<i>Poa secunda</i> (<i>P. scabrella</i>)	Stand longevity, harvesting, row spacing

1. Post harvest residue management and weed control are universal priority needs for all species listed with possible exception of *Elymus*.

Recent work conducted at the Center has included studies on seed dormancy of several species, residue management (burning vs. baling/mowing) and herbicide trials for annual bluegrass (*Poa annua*) control.

Finally, significant amounts of time and funds have been put into obtaining and evaluating seed harvesting, cleaning and conditioning equipment. A new mini-combine, windrower, and a three screen fanning mill were added in 2004. The goal is to define and perfect production and processing methods for PMC releases and other species in order to maximize seed quality and ease of planting.

Adaptation: Flood (Inundation) Tolerance of Wetland Plants

Evaluating the water depth and the length or season of flooding that native grasses and shrubs can tolerate helps determine where these species perform best in the landscape. The results become part of the planting or seeding prescriptions for wetland enhancement and riparian area rehabilitation work. The PMC has conducted several related trials since 1998 using water tanks as well as sloped ponds that create a water depth gradient.



Cattle trough used to evaluate water depth tolerance of several grasses grown in pots and anchored at different elevations.

In 2005, a new study was undertaken to evaluate several native grasses for their ability to grow and reproduce in summer under five constant hydrologic conditions. Potted plants were held in small pools or tanks and subjected to five treatments over a six month period (April-September): subirrigation, soil saturation, and inundation at depths of 3.5 inches, 7 inches, and 16 inches.

Results suggest that western mangrass (*Glyceria occidentalis*) is the most summer flood tolerant of the grasses tested, thriving nearly as well at all three inundation depths, and under saturated “soil” conditions. Western sloughgrass (*Beckmannia syzigachne*) and meadow barley also persisted and produced abundant seed under all but the deepest condition where they became weak or died. Weak alkaligrass (*Torreyochloa pallida* var. *pauciflora*) grew prolifically and matured seed under all conditions except the 16 inch depth where vigor was low and mortality imminent. This species spreads readily by rhizomes and nodal root and shoot development while producing an abundance of fibrous roots. It may be an excellent candidate for stabilizing ditch bottoms, wetter grassed waterways, and the shorelines of lakes and streams, as well vegetating bioswales.

Additionally, water foxtail (*Alopecurus geniculatus*) grew luxuriantly and produced seed under all conditions except the 16 inch depth where mortality was 100%. Tufted hairgrass and slender hairgrass did well under subirrigation and saturation, but did not survive any of the three inundation treatments. Annual hairgrass was unable to complete its flowering and produce seed when inundated. Finally, western panicgrass (*Dichanthelium acuminatum* var. *fasciculatum*) was able to survive and develop seed when grown during summer under subirrigation, soil saturation, and an inundation depth of 3.5 inches.

PARTNERSHIPS WITH OTHER AGENCIES

Upland Plants and Technology for the National Park Service

Since 1988 the Corvallis Plant Materials Center has developed and implemented numerous cooperative agreements with Olympic National Park, Mount Rainier National Park, and Crater Lake National Park of the National Park Service. These collaborative projects were created to share technical expertise, develop propagation or establishment technology, and produce indigenous plant materials for use in park revegetation programs.



Careful hand collections of wild seed are performed to obtain enough material for establishing increase fields that produce genetically appropriate seed for National Park Service revegetation projects.

Over the past 15 years, the Corvallis PMC has collected, increased, and tested more than 50 native species, grown hundred pounds of native grass and forb seed, produced tens of thousands of containerized plants, and investigated revegetation techniques onsite (Crater Lake and Mount Rainier in the 1990s). High standards of seed quality and genetic integrity are maintained by isolating fields for each species and ecotype. Information on collection, field establishment and management, seed increase and processing for grasses and forbs, propagation and container production of herbaceous and woody species, and results of tests or trials are compiled and published in annual reports and presented at meetings. These species are continuously added as protocols to the Native Plant Network website: (www.nativeplantnetwork.org).

Increases for Mt. Rainier National Park

In 2005, the Corvallis PMC entered its second year of an agreement with Mount Rainier National Park. The goal is to produce 100 pounds of pure live seed of three native grasses for roadside planting after construction is complete along SR123 inside the Park. Phase I was completed this year and the PMC easily produced over 250 pounds of grass seed. It will be delivered to the Park this fall

and hydroseeded. Phase II begins in 2006 and will continue through 2007.



Swathing a vigorous blue wildrye seed field (Mt. Rainier seed origin) at the Corvallis PMC, July 7, 2005.

Revegetation of Lake Drawdown Slopes and Roadsides within Olympic National Park

Two agreements with Olympic National Park continued in 2005. One is for revegetation of shorelines and exposed lakebed slopes. Two dams on the Elwah River are scheduled to be removed in 2007 in order to restore salmon habitat. This will leave 500 acres of land in need of restoration under what is now Lake Mills and Lake Aldwell. The Park is relying on the Corvallis PMC for about one third of the plant material required for the entire project. The Center has agreed to produce plants and seed of 15 trees and shrubs, 11 forbs, six grasses, and four sedges and rushes. Several of the species needed for this work are forbs that require creative harvesting and handling procedures, such as fireweed (*Epilobium* spp. or *Chamerion* spp.).

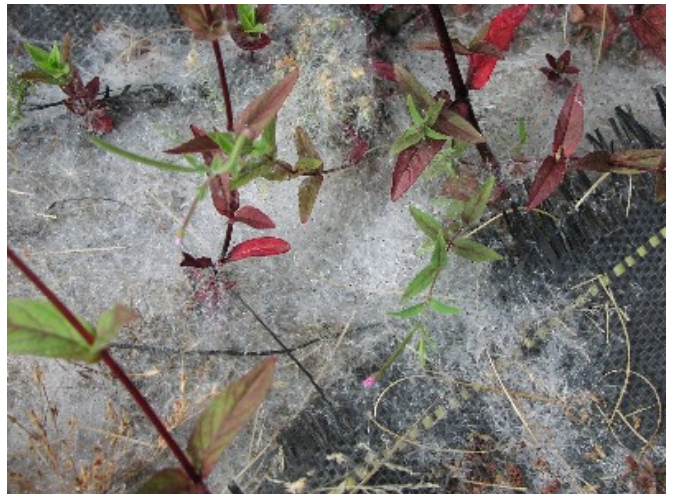
PMC employees continued native seed collections this summer with the help of numerous volunteers and Park staff. Over 200 volunteer hours were recorded for these seed collections. Seed increase fields will be expanded using wild collected seed. These fields were harvested in 2005 producing approximately 175 pounds. Slender hairgrass (*Deschampsia elongata*) was an impressive producer. Starting with less than a half pound

of seed collected in 2004, a ¼ acre increase field sown in October 2004 yielded 100 pounds in 2005! This agreement is scheduled to continue through 2012 when dam removal should be complete.



PMC team of employees and volunteers who collected seeds on Hurricane Ridge in 2005.

In addition to restoration of the lower Elwah River, a second agreement involves materials for revegetation of the Park's Hurricane Ridge road project. Beginning in 2004 and continuing through 2007, work includes the increase of three native grasses and seven forbs. Wild collections continued this year and approximately 37 pounds of seed were harvested from fields planted in the fall 2004.



Seed increase field of fireweed (*Epilobium ciliatum*). As capsules split, seeds land on weed fabric that has been tacked down in between rows of plants. They are then vacuumed from the surface using a reversed leaf blower.

The PMC has agreed to produce 400 pounds of Pure Live Seed (PLS) on the farm and

directly collect an additional 3.5 pounds of wild seed for roadside planting.

Wetland and Wet Prairie Species for the Bureau of Land Management

In 2002, The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Eugene district of the Bureau of Land Management (BLM) to perform seed germination trials and conduct small scale increases of native wetland and wet prairie species. Many of these species have proven difficult to establish in restored wetlands or have very high labor costs associated with collection (as high as \$2000 an ounce!). The PMC agreed to investigate and document propagation techniques from seed for these species and to evaluate their potential for agronomic seed increase. In four years, the Center has successfully propagated over 50 species, most of which have little if any published data on germination or production. New harvesting techniques, such as hand-made seed catchers, have been developed for small scale seed increase.



Rose checker-mallow seed increase field. Seeds shatter onto weed fabric and are harvested by vacuuming or sweeping the surface.

These new techniques have increased yields by 400 percent while cutting collection time in half for difficult species such as slender phlox (*Microsteris gracilis*). Other species, such as Rose checker-mallow (*Sidalcea malviflora* ssp. *virgata*) are heavily predated in the wild by seed weevils. Wild collections only amount to

a couple grams per year. In 2005, a PMC seed increase field of this species produced two pounds.

Native Grasses and Legumes for Fire Rehabilitation in Southern Oregon

Another agreement with the BLM began in 2004. Its Medford, Oregon, district is regularly in need of native seed for fire rehabilitation projects. The PMC agreed to work with four native grasses that are seldom grown by large-scale seed producers. In 2005, one acre of grasses and three small plots of legumes were in production. Approximately 50 pounds of seed were harvested in 2005. Also this year, the contract included germination research and containerized production of species listed as BLM Special Status species such as Umpqua green gentian (*Frasera umpquaensis*) and tall bugbane (*Cimicifuga elata*). Over 2000 plants were produced in 2005 and will be delivered for transplanting this fall. Both BLM contracts are renewed on a yearly basis.

Common Garden Studies with the US Forest Service and Bureau of Land Management

The PMC has cooperated with David Doede and other staff and volunteers of the US Forest Service (USFS) on two common garden studies. The first was with broadleaf lupine (*Lupinus latifolius*) and the second with big deervetch (*Lotus crassifolius*). The latter effort also involved the Bureau of Land Management (BLM). The purpose of both projects is to evaluate genetic diversity within each species in relation to the environment and use the data to develop preliminary seed zones and seed transfer guidelines for ecological restoration. Broadleaf lupine and big deervetch are important native legumes that help fix nitrogen in the soil and act as early successional species on infertile or newly disturbed sites.

The broadleaf lupine study (1997-1999) included seed collected from 81 locations on the Mt. Hood National Forest. The PMC propagated all the materials, maintained one of two common garden sites, and participated in

data collection. Final results were recently published (*Doede, DL. 2005. Genetic variation in broadleaf lupine on the Mt. Hood National Forest and implications for seed collection and deployment. Native Plants Journal 6(1): 37-48.*) This marks the completion of this cooperative study.

The big deervetch common garden study comprised material assembled from 141 locations across two National Forests (Siuslaw and Willamette) as well as BLM lands in western Oregon. All the seedlings were produced at the PMC and staff collected greenhouse data. Plants were then turned over to the USFS for planting, maintenance, and data collection/processing. Survival at both common garden study sites has been low making analysis difficult. Results will be summarized in a Forest Service technical paper next year.

SPECIAL ASSISTANCE AND DEMONSTRATIONS

Blue violet Propagation for Oregon Silverspot Butterfly Recovery

The PMC has been provided the opportunity to assist with the recovery of Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*) The Silverspot was declared a federally threatened species in 1980 and is classified as endangered in Oregon and Washington. It occurs in small, isolated populations on grassland habitats within its range from coastal Washington, south to coastal northern California.

The adult butterflies feed on flower nectar of yarrow (*Achillea millefolium*), pearly everlasting (*Anaphalis margaritacea*), Canada goldenrod (*Solidago canadensis*), and Douglas aster (*Aster subspicatus*), all of which occur in the plant community of the coastal meadows, which the butterfly inhabits. The larvae of the silverspot butterfly prefer to feed on the leaves of the early **blue violet** (*Viola adunca*), where the females lays her eggs in order to provide close proximity of the larvae food source.

This is where the PMC comes in. Early this year we were contacted by Anne Walker of the U.S. Fish and Wildlife Service, who is coordinating the restoration efforts for the species. Working with the U.S. Forest Service, Oregon Department of Transportation and Oregon Parks, Anne has identified a number of sites suited to reintroduction of the violets. The all-too-common disruptions of habitat conversion for various human uses, elimination of fire, introduction of exotic species, and increase of invasive species have all contributed to a decline of the violets and subsequently, rearing habitat for the larvae. In an attempt to reverse this decline, and learn something about propagating the violets for future production, we salvaged 185 violets from a patch that was destined to be destroyed for the construction of a home. We have cultivated these plants in individual pots and dramatically increased both their size and vigor. We have also been able to harvest and clean approximately 235 grams of seed from these potted violets. Later this fall, 100 of the violets will be planted out on four restoration sites identified and coordinated by Anne.



Blue violet did very well in pots. They continued to flower all summer and produced approximately 1/2 pounds of seed.

We will also begin germination and propagation trials in order to determine the most effective method for increasing the violets by seed, as well as conduct vegetative increase trials with the remainder of the violets from our collection. We expect to have a significant quantity of the violets for additional planting next season as Anne secures

additional sites for restoration. We could also provide violets to others who may have access to coastal grassland and would like to implement a silverspot rearing habitat restoration of your own. If you are interested in this project please contact us and we will see that you get some violets and an introduction with Anne.

Native Grass and Threatened and Endangered Species Gardens

In 2002 the PMC established a native grass demonstration garden. The garden includes between 26 and 32 species of native upland prairie, woodland, wet prairie, and marsh-bog grasses, organized by habitat type. It is used for training NRCS field office, Soil and Water Conservation District, and other personnel on native grass identification and use. The staff also designed and installed an endangered species garden in 2003 for similar purposes. The Berry Botanic Garden donated seeds of seven endangered species of the Corvallis PMC service area: Willamette valley daisy (*Erigeron decumbens* var. *decumbens*), Bradshaw's lomatium (*Lomatium bradshawii*), Nelson's checkermallow (*Sidalcea nelsoniana*), Kincaid's lupine (*Lupinus sulphureus* spp. *kincaidii*), peacock larkspur (*Delphinium pavonaceum*), shaggy horkelia (*Horkelia congesta*), and Curtus's aster (*Aster curtus*).

TECHNOLOGY TRANSFER

The PMC regularly produces publications and makes technical and popular presentations in order to disseminate technology to NRCS, SWCD, and other partners, as well as the general public. Thirteen oral presentations were given in 2004 on various PMC activities and technology development topics. Customers were directly assisted 131 times. Papers include technical reports, technical notes, brochures, plant guides, and fact sheets summarizing work and plant releases. Major publications in 2004 were:

- "Considerations for Establishing Native Grasses from Seed for Restoration, Revegetation, and Erosion

Control in Western Oregon and Western Washington" (PM Technical Note No. 36).

- "*Festuca roemerii* Common Garden Study: Interim Report for the Bureau of Land Management" (multiple authors, paper published by the Institute for Applied Ecology).
- "Progress Report of Activities, Corvallis Plant Materials Center 2003-2004".
- "The 2003 Crater Lake National Park Annual Report: Mazama Dorm".
- "The 2003 Crater Lake National Park Annual Report: Highway 62 Revegetation Project".
- "The 2003 Bureau of Land Management Annual Report: West Eugene Wetlands".
- "Common Garden Study on the Genecology of Roemers Fescue" (abstract summary).
- "Aspects of Seed Production and Establishment of Native Grasses" (1 page conference abstract)
- In addition to these, the PMC documented the addition of 11 new plant propagation protocols written and entered in the Native Plant Network.



Students learning native grass ID. The PMC provided training to new NRCS employees during the six week "Boot Camp" held in the Corvallis, Oregon, area in July-August of 2005. (photo by Sara Magenheimer)

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