Report of the Intermountain Native Plants Cooperative

Volume 3 *December 2011*

An annual report of research and extension activities for members of WERA-1013, Intermountain Regional Evaluation and Introduction of Native Plants

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Forward

The Intermountain Native Plants Cooperative, initiated in 2007, is a group of researchers who share an interest in utilizing native plants in arid urban landscapes, sharing research-based information, and exchanging superior germplasm. All are members of WERA-1013, Intermountain Regional Evaluation and Introduction of Native Plants, an officially recognized Western Education/Extension and Research Activity. The Report of the Intermountain Native Plants Cooperative is published annually and contains announcements of studies in progress by members and updates of germplasm evaluations. Some of the various research reports include work on such diverse topics as the selection criteria of native plants for urban landscapes, sexual and asexual propagation techniques of unique plants, native plant breeding techniques, native plant genetic diversity studies, evaluations on weediness of native plants in the urban landscapes and many other native plant related studies.

Cover: The photo on the cover was taken by Mikel R. Stevens and is of *Penstemon watsonii* found along USDA Forest Service road 154 out of Loa, Wayne Co., Utah.

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Announcements

2012 American Penstemon Society Annual Meeting will be in Laramie, Wyoming, June 22-24, 2012. For details visit http://apsdev.org/aps/meetings.html

2012 Eriogonum Society Annual Meeting will be at Steen's Mountain, Oregon, July 19-22, 2012. For details visit http://www.eriogonum.org/

The 3rd Annual Penstemon Festival will be hosted June 8 & 9, 2012 in Richfield, Utah by the Fremont Chapter of the Utah Native Plant Society

2012 WERA Meeting will be hosted October 12-13, 2012 by Genhua Niu, Texas AgriLife Research at El Paso, The Texas A&M University System, El Paso, TX

Colorado State University, Department of Horticulture and Landscape Architecture, Fort Collins, Colorado

James E. Klett

Colorado State University, Horticulture and Landscape Architecture

Colorado State University hosted the 2011 meeting of WERA-1013 on October 6 & 7, 2011 in Fort Collins, Colorado. Participants viewed first hand some of the research associated with this regional project. Three major areas were viewed and discussed.

1) **Annual and Perennial Flower Evaluation Research –** In 2011 approximately 1100 different varieties of annuals were grown in our research/display garden. Twenty-six vegetative and seed companies participated in the trials. On June 8, 2011, the trial garden suffered from a moderate hail storm (pea size) causing moderate damage to many of the vegetative varieties. Petunias and verbenas seemed to withstand the hail the best while phlox, heliotropium and lantana were particularly hard hit. Also, the hail damage seemed to significantly slow geranium growth. August 2011 was also one of the hottest Augusts on record for Colorado. On August 1st the annuals were judged by over one hundred industry personnel and advanced Master Gardeners to determine 'Best Of's in many categories. *Argyranthemum* 'Flutterby Yellow' was chosen as our Best of Show and *Lantana* 'Bandana Rose Improved' was the Best New Variety. Twenty-eight other varieties were chosen to be 'Best Of' in each of their separate genera.

   Approximately seventy-five new perennial taxa were added in 2011 to our two-year perennial trials. Eight taxa were identified as 'Top Performers' including, *Echinacea* 'Mistral'; *Penstemon* 'Prairie Twilight'; and *Penstemon* 'Red Riding Hood'. These three were also outstanding in our trials in 2010.

2) **Nursery Tree Production and Transplant Success of *Pyrus calleryana* 'Glen's Form' Influenced by Container Types and Overwintering**

Treatment - Research at Colorado State University with *Pyrus calleryana* ‘Glen’s Form’ is comparing production techniques in a nursery setting and landscape tree establishment using two fabric containers along with black plastic containers. In 2010, there were no significant container effects on fresh and dry leaf weight, shoot and root weight and new growth increments. The black plastic containers seem to encourage significantly more circling roots and bottom root matting versus the two fabric containers. Analysis of the 2010-11 winter thermocouple data showed that the black plastic containers had the coldest soil temperatures during below freezing periods and the warmest soil temperatures during above freezing temperatures. Media temperatures differed significantly among container types for the cold periods but not for warmer spring periods. Research will continue during the winter of 2011-12 and summer of 2012.

3) **Plant Select® -** In 2011, seven plants were either introduced or recommended to industry and gardening public. Introductions included: *Osteospermum* ‘Avalanche’[PPAF] (Avalanche white sun daisy), and *Bouteloua gracilis* ‘Blonde Ambition’[PPAF] (Blond Ambition blue grama grass). The five recommended plants included: *Amsonia jonesii* (Colorado desert blue star), *Erodium chrysanthum* (Golden storksbill), *Chrysothamnus nauseosus* var. *nauseosus* (Baby Blue rabbit brush), *Crataegus ambigua* (Russian Hawthorn), and *Penstemon mensarum* (Grand Mesa Beardtongue). Evaluation trials for future Plant Select® introductions and recommendations are being conducted at Colorado State University in Fort Collins and Denver Botanic Gardens at Chatfield in the Denver, Colorado metro area. Currently, fifty eight different taxa are being evaluated under two irrigation treatments. One treatment is no additional irrigation after established and the other is irrigation as needed after established. Data is recorded every two weeks concerning flowering, overall plant appearance, and potential for self-seeding. Industry personnel also view trials yearly at both sites and evaluate.

Potential for roundleaf buffaloberry adaptation to urban landscapes

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Introduction

Roundleaf buffaloberry (*Shepherdia rotundifolia*) is a broadleaf evergreen shrub species endemic to the Colorado Plateau region of southern Utah and northern Arizona. Despite its exceptional ornamental qualities, which include silvery green, cup-shaped leaves and tight, rounded or cascading form, the species is rare in the horticultural trade because of difficulty with propagation and long-term survival under urban landscape conditions. Our goal was to document the variability in environmental and morphological adaptations of the species in its native habitats to better understand its limits of adaptability in urban landscapes.

Methods and Results

Environmental Adaptations. Six populations of roundleaf buffaloberry, located in an arc ranging from southwestern through south-central to southeastern Utah, were selected for study because they represented the diversity of environmental and morphological conditions present in the species habitat range (Fig. 1). Environmental conditions recorded included elevation, average 30-year precipitation and air temperature (minimum and maximum), relative light intensity (Table 1), and soil properties. Relative light intensity, as a percent of total incoming solar radiation below the canopy compared to total incoming solar radiation above the canopy, was estimated from three canopy images taken at each study site.

Fig. 1. Six roundleaf buffaloberry populations in Utah were selected for study.

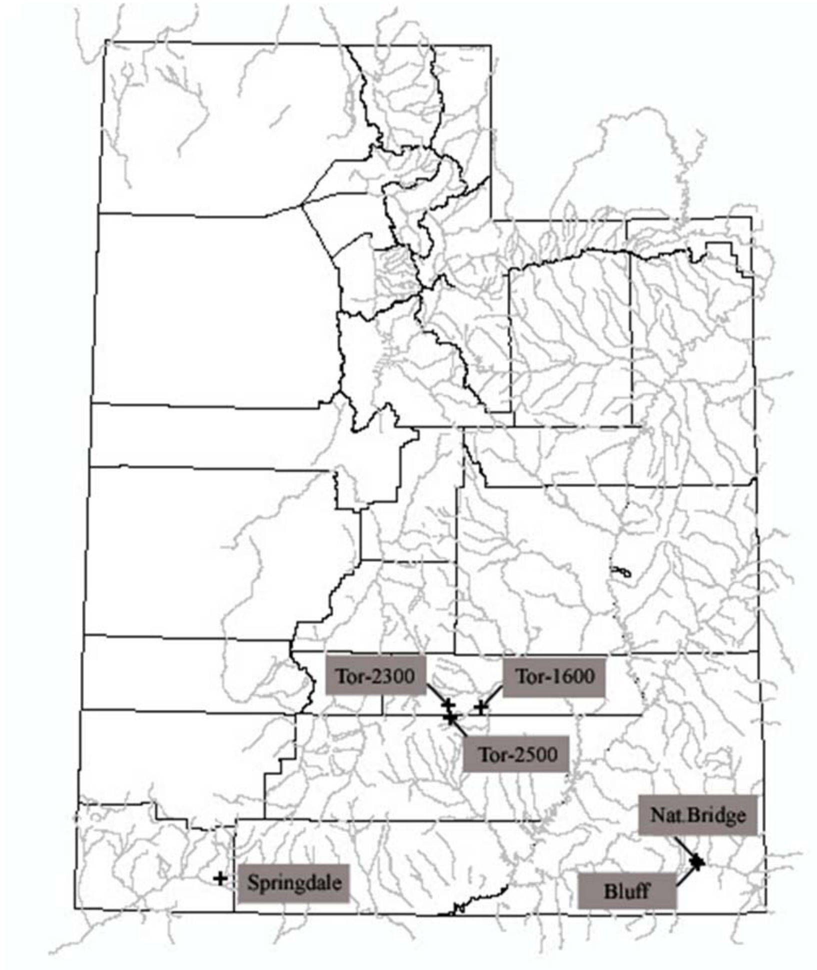

Table 1. Environmental conditions for roundleaf buffaloberry habitats for each site studied. RLI = Relative Light Intensity.

		Average over 30 yrs (1981-2010) (n = 30)			RLI (%)
Pop. ID	Location	Precip. (mm/yr)	T_{max} (^{o}C)	T_{min} (^{o}C)	
Tor-2500	38.13N, 111.33W Elev. 2,507m Torrey	285	17	3	31
Tor-2300	38.20N, 111.35W Elev. 2,295m Torrey				98
Tor-1600	38.19N, 111.10W Elev. 1,642m Torrey	210	19	6	100
Nat. Bridge	37.30N, 109.54W Elev. 1,34 m Blanding	327	17	4	99
Bluff	37.28N, 109.53W Elev. 1,342m Bluff	199	17	4	94
Springdale	37.19N, 113.00W Elev. 1,188m Springdale	409	25	9	88

Soil samples were analyzed for texture, salinity, pH, phosphorus, potassium, and organic matter. Soil characteristics varied among the six collection sites. All, except for the highest elevation site, were sandy in texture; soil at 2500 m in Torrey, UT was a silty loam. Soil salinity level at the six sites was relatively low compared to some areas in southern Utah, ranging from 0.7-1.2 dS/m. Soil pH at most sites was slightly alkaline, ranging from 7.4-7.9, with the exception of the high-elevation Torrey site, where soil pH was slightly acidic (6.5). This may be due to a relatively high content of organic matter in these soils, probably due to the presence of fallen needles on the ground from ponderosa pine in the overstory. Nutrient levels in the native soils varied among collection sites. In particular, potassium levels were high compared to that recommended for crop production. The ramification of high potassium levels in these soils is unknown, although potassium is known to be essential for nodule formation and symbiotic nitrogen fixation, and *Shepherdia* species are symbiotic nitrogen-fixers. *Morphological Adaptations*. Leaf punches were collected from five plants at each site and directly fixed in formalin-aceto-alcohol solution in the field. The fixed leaf tissue was subjected to critical point drying and viewed using a scanning electron microscope.

Although leaf morphology varied among populations, roundleaf buffaloberry plants appeared to have overall morphological characteristics that make them suitable for hot, dry conditions. Variation in leaf size and leaf thickness suggests mechanisms for coping with varying conditions in their native habitats. Trichomes present on the adaxial (upper) and abaxial (lower) leaf surfaces were peltate (star-shaped) and stellate (shield-shaped), respectively (Fig. 2).Leaf thickness is largely accounted for by the abaxial trichome layer. The abaxial trichome thickness of plants from the site Tor-1600, the hottest site with the greatest relative light intensity, was almost two times greater than plants from the site Tor-2500, where plants received greater precipitation and less light (Table 1). Abaxial surface trichome density in roundleaf buffaloberry was about five times greater than adaxial density, similar to the findings of Bissett et al. (2009) on leaves of *Elaeagnus umbellata,* also in the Eleagnaceae family. The peltate trichomes on the upper surface help to reflect excess radiation at specific wavelengths to protect the underlying tissues against ultraviolet radiation damage. The thicker lower-leaf stellate trichomes insulate and trap moisture in the leaf and increase the boundary layer to reduce stomatal water loss by transpiration. The relatively thick stellate trichomes on plants at the site Tor-1600 suggests regulating transpiration is more important for plants at this site than at the site Tor-2500.

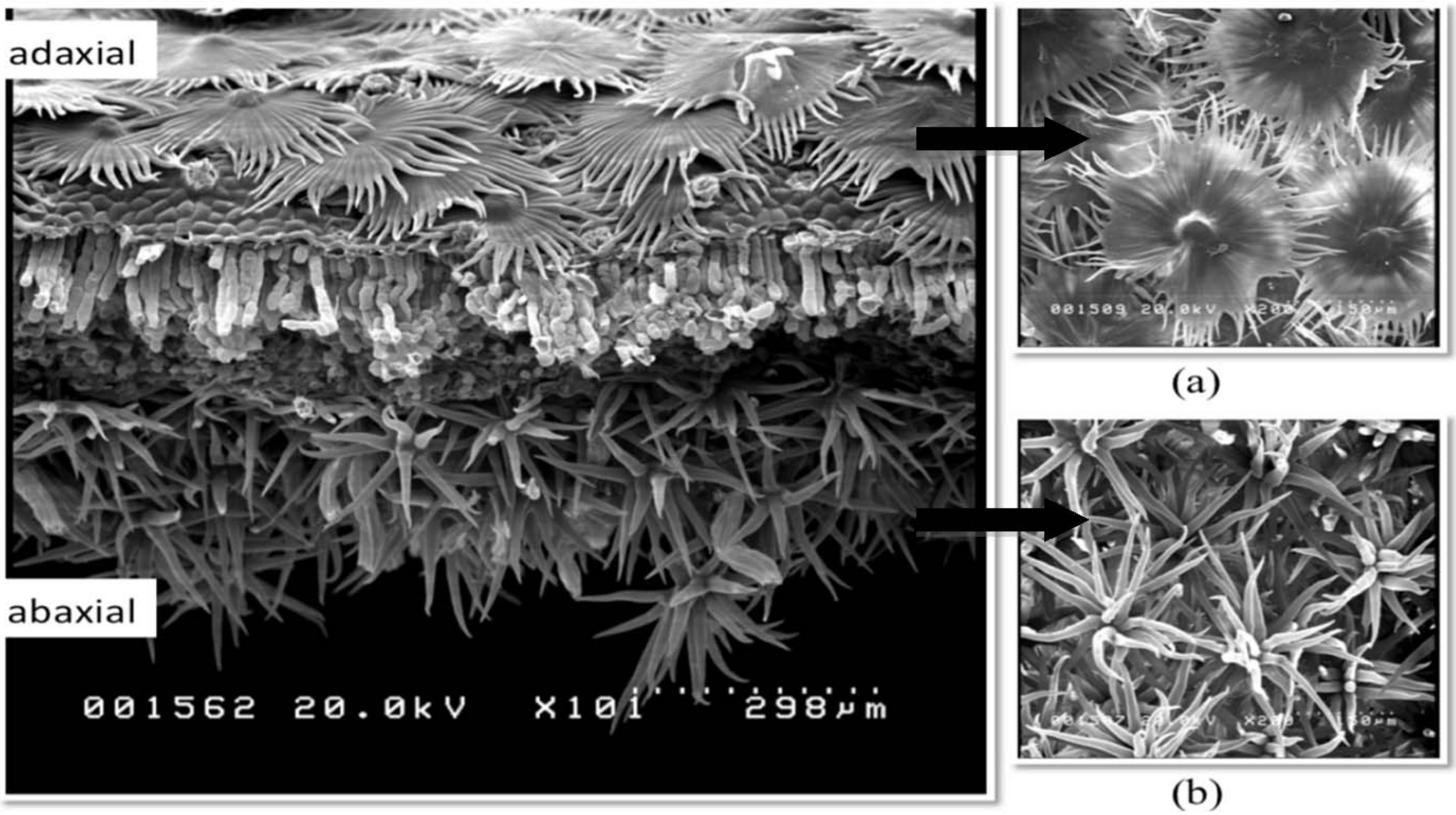

Fig. 2 Roundleaf buffaloberry leaves are covered with leaf hairs (trichomes), which can vary from stellate (star-shaped) to peltate (shield-shaped).

Conclusions

Roundleaf buffaloberry occurs naturally within a range of environmental conditions. The relatively wide variation in site conditions suggests a species tolerance for shade, as well as tolerance to drought, heat, and cold. The species has characteristics that make it particularly well-adapted to drought and heat. Leaf thickness and tall, star-shaped trichomes on the lower leaf surface control transpiration. Surface-hugging, shield-shaped trichomes on the upper leaf surface reflect light and moderate leaf temperatures. The variability among native sites suggests an opportunity for selection of individuals that may be more adapted to the reflected light and heat and wetter, richer soils common to many urban sites.

Literature Cited

Bissett, S.N., J. Naumann, D.R. Young, J. Edwards, and J.E. Anderson. 2009. Adaptive characteristics of drought resistance and shade tolerance enhance invasive success of *Elaeagnus umbellate* Thunb. 94th ESA Annual Meeting COS26-7.

Commercialization of native plant species; evaluation of Idaho fescue (*Festuca idahoensis*) germplasm for use as native turf

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Commercialization of Idaho native plant selections

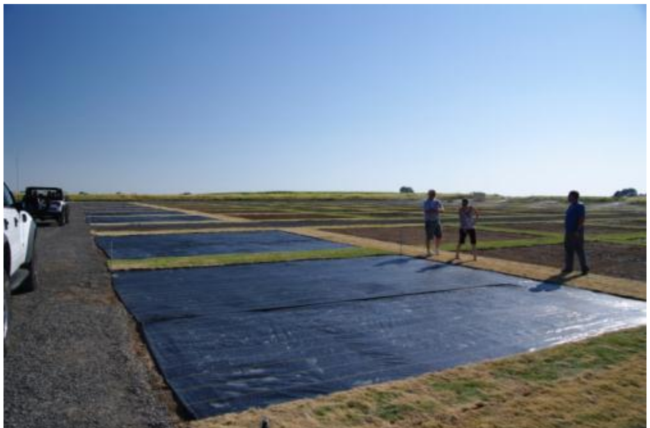
In 2005, researchers at the University of Idaho’s Aberdeen R & E Center initiated a research program to domesticate native plants specifically for use in home and commercial landscapes. In subsequent years, over 900 accessions of native plants, representing approximately 600 species, have been imported (collected or purchased) for evaluation and selection. Over these six years of research, many species and selections of species with superior landscape attributes have been identified.

Oenothera brachycarpa in evaluation plots at the University of Idaho’s Aberdeen R & E

As this research progressed and attractive, manageable plant selections emerged, it became apparent that finding garden-worthy plants is not a barrier to successful utilization of native species. The most significant obstructions are associated with marketing, namely creation of a propagation system that can handle high volumes of plants, and finding nursery proprietors willing to take risks on plant products perceived as being outside mainstream markets.

Seed cleaning equipment purchased with Idaho State Board of Education funds.

Two recent events moved the program toward a solution for market development issues. The first was the successful acquisition of a competitive grant from the Idaho State Board of Education. The funds were used to enhance breeder seed increase plots and to purchase equipment for cleaning and handling seed of native plant selections.



Increase blocks at the seed increase farm developed by the 'Native Roots' company.

Second and more importantly, in the fall of 2010, a progressive southern Idaho native plant nursery, Conservation Seeding and Restoration, Inc. expressed interest in marketing landscape-destined native plants. This company has extensive expertise, facilities, and equipment dedicated to native plant propagation. Recently, they established a native plant retail division as part of the operations and also hired personnel trained in native plant landscape design. Company owners expressed a desire to incorporate University of Idaho native plant selections into their new business functions. The result of subsequent discussions was a partnership between the University of Idaho and creation of a new subsidiary company named 'Native Roots'.

During the spring of 2011, the first allotment of seeds and plants of native species selections was transferred from the University of Idaho to 'Native Roots'. This initial material transfer consisted of 67 selections (59 species) of superior native plants. Table 1 provides a summary listing of the plant materials conveyed and descriptions of their unique horticultural properties. These propagation materials were used by Native Roots personnel to grow plants destined for market development activities and also to establish increase blocks in a new, dedicated seed production farm.

A partnership between the University of Idaho and 'Native Roots' results in a unique opportunity to infuse native plants into the western US nursery industry. It creates an optimal opportunity for wide distribution of native plants and for boosting general public acceptance of the many remarkable native, water-conserving species endemic to the Intermountain Region.

Eriogonum heracleoides, one of the species transferred to 'Native Roots' for nursery

Table 1. List of plants transferred by the University of Idaho to 'Native Roots' for propagation and commercial exploitation.

Species	Origin	Horticultural Properties
Penstemon ambiguus	*Collected*: Coconino Co, AZ *Endemic*: Southwestern US	Bushy habit. Light pink flowers, phlox-like flowers. Selection based on hardiness.
Penstemon barbatus	*Collected*: Unknown *Endemic*: Southwestern US	Very tall, upright habit. Bright red flowers. Selection based on high numbers of flower spikes and dark colored flowers.
Penstemon cardinalis	*Collected*: Lincoln Co, NM *Endemic*: NM, west Texas	Medium height, upright habit. Dark red flowers. Selection based on longevity and bloom profusion.
Penstemon confertus	*Collected*: Unknown *Endemic*: Northwestern US	Short, habit growth. Light to medium yellow flowers. Selection based on alkaline soil adaptation and dark flower color.
Penstemon cyananthus	*Collected*: Caribou Co, ID *Endemic*: Northern US Rockies	Medium height, upright habit. Dark blue flower color. Selection based on longevity and bloom profusion.
Penstemon humilus	*Collected*: Custer Co, ID *Endemic*: Western US	Small, spreading habit. Medium to dark blue flowers. Selection based on compact growth, dark blue flower color.
Penstemon idahoensis	*Collected*: Cassia Co, ID *Endemic*: ID, UT	Small, low-spreading habit. Dark blue flowers. Selection based on flower profusion.
Penstemon labrosus	*Collected*: San Bernardino Co, CA *Endemic*: Southern CA	Tall, upright habit. Bright orange flowers with long petal lobes. Selection based on consistent orange flower color.
Penstemon linarioides	*Collected*: Lincoln Co, NV *Endemic*: Southern US Rockies	Dense mat habit. Medium blue flowers. Selection based on hardiness, longevity, and long bloom period.
Penstemon montanus	*Collected*: Lemhi Co, ID *Endemic*: Northern US Rockies	Short, spreading habit. Large lavender flowers. Selection based on plant health and bloom profusion.
Penstemon ovatus	*Collected*: Western Cascades *Endemic*: WA, OR	Medium height, upright habit. Small medium blue flowers. Selection based on alkaline soil adaptation and repeat bloom.
Penstemon platyphyllus	*Collected*: Salt Lake Co, UT *Endemic*: UT	Medium height, bushy habit. Light purple flowers. Selection based on resistance to powdery mildew and bloom period.
Penstemon pinifolius	*Collected*: Unknown *Endemic*: AZ, NM	Small, bushy growth. Medium to dark red flowers. Selection based on dark flower color, length of bloom period, and health.
Penstemon richardsonii	*Collected*: Eastern Cascades, WA *Endemic*: WA, OR	Medium height, open spreading habit. Light pink flowers. Selection based on bloom density and length of bloom period.
Penstemon rostriflorus	*Collected*: Beaver Co, UT *Endemic*: Southwestern US	Medium height, spreading habit. Red flowers. Selection based on dark red flower color, compact habit, and long bloom period.
Penstemon sepalulus	*Collected*: Utah Co, UT *Endemic*: UT	Medium height, bushy habit. Light lavender flowers. Selection based on extended bloom period.
Penstemon strictus	*Collected*: Torrance Co, NM *Endemic*: Central Rockies, CA	Medium height, upright habit. Dark blue flowers. Selection based on resistance to powdery mildew and dark flower color.
Penstemon venustus	*Collected*: Unknown *Endemic*: Northwestern US, UT, CA	Medium height, bushy habit. Light to medium purple or blue flowers. Selection based on flower color, resistance to mildew.
Penstemon whippleanus	*Collected*: Unknown *Endemic*: Intermountain West	Medium height, upright habit. White to dark purple flowers. Selection based on compact growth and very dark flower color.
Eriogonum brevicaule	*Collected*: Sanpete Co, UT *Endemic*: Northern Rockies, Plains	Small, mound to spreading habit. Dark yellow flowers. Selection based on flower profusion, long bloom, and long peduncles.
Eriogonum compositum	*Collected*: Washington Co, ID *Endemic*: Northwestern US, CA	Medium size, spreading habit. Dark yellow flowers. Selection based on flower profusion and reddish leaf color.
Eriogonum corymbosum	*Collected*: San Juan Co, UT *Endemic*: South & Central Rockies	Medium size, bushy habit. White to pink flowers. Selection based on dense, compact growth.

Eriogonum heracleoides	*Collected*: Fremont Co, ID *Endemic*: Western US	Medium size, upright habit. Creamy-white flowers. Selection based on inflorescence size and leaf hardiness.
Eriogonum jamesii	*Collected*: Unknown *Endemic*: Central Rockies	Medium size, spreading habit. *E. arcuatum* form with bright yellow flowers. Selection based on large flower heads.
Eriogonum jamesii	*Collected*: Unknown *Endemic*: Southwest US, OK	Medium size, spreading habit. Var. *jamesii* form with cream flowers. Selection based on red leaf color and late bloom period.
Eriogonum niveum	*Collected*: Unknown *Endemic*: ID, OR, WA	Medium size, bushy habit. White flowers. Selection based on compact form, heavy bloom, and adaptation to alkaline soil.
Eriogonum ovalifolium	*Collected*: 1. White Pine Co, NV 2. Idaho Co, ID *Endemic*: Western US	Very small, mat to spreading habit. White flowers fade to red. Two forms selected: 1. Var. *nivale* selected for dense silver leaves. 2. Var. *purpureum* selected for leaf health, silver leaf color.
Eriogonum strictum	*Collected*: Idaho Co, ID *Endemic*: Northwestern US, CA, NV	Medium height, spreading habit. White, yellow or pink flowers. Selection based on healthy leaves, pink flower color, compact growth.
Eriogonum umbellatum	*Collected*: 1. Custer Co, ID 2. San Bern. Co, CA 3. Beaver Co, UT 4. Owyhee Co, ID 5. Unknown 6. Fremont Co, ID *Endemic*: Western US	Medium height with upright, mounding, or spreading habit. Light to dark yellow flowers. Six forms selected: 1. Var. *dichrocephalum* selected for flowers that age red. 2. Var. *munzii* selected for late bloom and bloom profusion. 3. Dwarf form selected for dense habit and repeat bloom. 4. Var. *ellipticum* selected for profuse late season bloom. 5. Giant mound form selected for foliage density, profuse bloom. 6. Var. *dichrocephalum* selected for dwarf form, red flowers
Agastache cusickii	*Collected*: Custer Co, ID *Endemic*: ID, MT, OR, NV	Small, upright habit. White to pink flowers. Selection based on compact, dwarf form and pink flower color.
Monarda menthaefolia	*Collected*: Unknown *Endemic*: Western and Central US	Medium height, upright to spreading habit. Dark purple flowers. Selection based on dark purple flower and seed head color.
Aster speciosus	*Collected*: Caribou Co, ID *Endemic*: Intermountain West	Medium height, bushy habit. Medium purple flowers. Selection based on flower profusion, flower size, and length of bloom period.
Gaillardia aristata	*Collected*: 1. Beaverhead Co, MT 2. Unknown *Endemic*: Northern & Western US	Medium height, spreading habit. Yellow to red flowers. Two forms selected: 1. Large dark red flowers with upright habit. 2. Small yellow and orange flowers with spreading habit.
Erigeron glaucus	*Collected*: Unknown *Endemic*: OR, CA	Small, mound habit. Dark purple daisy flowers. Selection based on hardiness, compact habit, and adaptation to alkaline soils.
Hymenoxys acaulis	*Collected*: 1. Emery Co, UT 2. Unknown *Endemic*: Eastern Rockies, Plains	Small, upright habit. Bright yellow daisy flowers. Two forms selected: 1. Dwarf form selected for longevity and bloom profusion. 2. Tall form selected for hardiness and bloom profusion.
Townsendia incana	*Collected*: Garfield Co, UT *Endemic*: Intermountain West	Small, mound habit. White daisy flowers. Selection based on longevity, plant health, and bloom profusion.
Zinnia grandiflora	*Collected*: Fremont Co, CO *Endemic*: Southwestern US, OK, KS	Small, mound habit. Dark yellow flowers. Selection based on non-spreading growth, abundant flowers, and orange flower centers.
Calylophus lavandulifolia	*Collected*: White Pine Co, NV *Endemic*: Southwestern US, Plains	Small, prostrate habit. Large, crinkled yellow flowers. Selection based on longevity, compact growth, and flower profusion.
Oenothera brachycarpa	*Collected*: Unknown *Endemic*: Southwestern US, KS	Small, mound habit. Very large lemon-yellow flowers. Selection based on longevity and hardiness.
Aquilegia chrysantha	*Collected*: Unknown *Endemic*: Southwestern US	Tall, upright habit. Yellow flowers with long spurs. Selection based on healthy leaves, compact growth, and flower profusion.
Aquilegia	*Collected*: Unknown	Medium height, spreading habit. Dark yellow/red flowers with long

desertorum	*Endemic*: UT, AZ, NM	spurs. Selection based on dark bloom color and flower profusion.
Aquilegia formosa	*Collected*: Twin Falls Co, ID *Endemic*: Western US	Tall, upright habit. Yellow/red flowers with short spurs. Selection based on dark bloom color and flower profusion.
Aquilegia scopulorum	*Collected*: White Pine Co, NV *Endemic*: Central Rockies	Very small, mound habit. Blue/white flowers with long spurs. Selection based on dark bloom color and short flower stalks.
Geum rossii	*Collected*: Box Elder Co, UT *Endemic*: Intermountain West	Short, spreading habit. Bright yellow flowers. Selection based on season-long attractive foliage and recurring bloom.
Mirabilis multiflora	*Collected*: Unknown *Endemic*: Southwestern US	Short but very broad-spreading habit. Dark purple flowers. Selection based on dark bloom color and reddish-hued leaves.
Papaver radicatum	*Collected*: Unkown *Endemic*: Intermountain West	Short, upright habit. Bright orange flowers. Selection based on longevity and flower profusion.
Potentilla thurberi	*Collected*: Unknown *Endemic*: AZ, NM	Medium height, spreading habit. Dark red flowers. Selection based on dark color, compact branching, and alkaline soil adaptation.
Sphaeralcea caespitosa	*Collected*: Millard Co, UT *Endemic*: UT, NV	Small, prostrate habit. Bright orange flowers. Selection based on silver leaf color and flower size.
Zauschneria garrettii	*Collected*: Cache Co, UT *Endemic*: Rocky Mountains	Medium height, spreading habit. Dark orange flowers. Selection based on bloom period, dark bloom color, and ease of propagation.
Deschampsia caespitosa	*Collected*: Connecticut *Endemic*: Western & Northern US	Medium height, spreading habit. Sparkling flower spikes. Selection based on leaf health, spike abundance, and purplish leaf color.
Festuca idahoensis	*Collected*: Unknown *Endemic*: Western US	Small, flaring habit. Amethyst flower spikes. Selection based on blue leaf color, longevity, and clump health.
Poa secunda	*Collected*: Sherman Co, OR *Endemic*: Western US, Plains	Medium height, very upright habit. Persistent flower spikes. Selection based on blue leaf color and dense flower spikes.
Sporobolus wrightii	*Collected*: Unknown *Endemic*: Southwestern US, UT	Very tall, upright habit. Late, feathery flower spikes. Selection based on spike profusion, hardiness, and dark green leaf color.
Artemisia frigida	*Collected*: Box Elder Co, UT *Endemic*: Western & Central US	Small, spreading habit. Attractive foliage, inconspicuous flowers on short spikes. Selection based on season-long attractive foliage.
Chamaebatiaria millefolium	*Collected*: Bingham Co, ID *Endemic*: Intermountain West, OR	Medium height woody shrub. White flowers, copper seedheads. Selection based on plant health and compact habit.
Clematis columbiana	*Collected*: Garfield Co, UT *Endemic*: Rockies, Northwest US	Scrambling short vine. Purple-red leaves. Light purple flowers. Selection based on transplant survival and flower profusion.
Philadelphus lewisii	*Collected*: Washington Co, ID *Endemic*: Northwestern US, CA	Tall upright shrub. Large white flowers. Selection based on alkaline soil adaptation, compact growth, and flower profusion.
Rhus trilobata	*Collected*: Boise Co, ID *Endemic*: Western US, Plains	Arching to prostrate shrub. Orange fall leaf color. Selection based on fall leaf color, prostrate habit, and foliage density.
Salvia pachyphylla	*Collected*: San Bernardino Co, CA *Endemic*: AZ, NV, CA	Short spreading evergreen shrub. Dark blue/purple flowers in large clusters. Selection based on compact habit and long bloom period.

Evaluation of Idaho fescue for use as turf

One of the glaring holes in native plant nursery offerings in the western US is the lack of good options for planting native turfgrass. A research project to select for turf-quality Idaho fescue has been incorporated into recent native plant domestication efforts at the University of Idaho.

Idaho fescue is a northern Intermountain native and member of the *Festuca ovina* species complex. Leaf color is variable with blue to dark green forms common within many populations. Populations also vary in tendency for summer dormancy. The presence of natural variation suggests considerable potential for improvement and commercialization of Idaho fescue for utilization as a native turf.

Methods: In 2009, 36 accessions of Idaho fescue were acquired from the USDA germplasm storage facility at Pullman, Washington, Benson Farms (Oregon),NRCS Plant Materials Center at Aberdeen, ID, Thorn Creek Native Seed (Idaho), Currans Family Farm (Idaho) and Seeds Trust (Idaho). One additional collection was made by project personnel in the Island Park region of southeastern Idaho. Accessions were chosen specifically to represent ecotypes from a variety of Intermountain environments In March 2010, seed was planted in plug trays and thinned to a single plant per plug. Field transplanting occurred on May 17, 2010 when seedlings were approximately 3 inches tall. One-hundred plants of each collection were established in the field, arranged with four replicates of 25 plants each. Replicates were arranged as square blocks, 5 ft x 5 ft., with plants on 12 inch centers.

Evaluation on a block by block (25 plants) basis was completed in late summer of 2010. Evaluation of blocks and individual plants within blocks was started in the spring of 2011. Consideration was given to traits of value in turf plantings, including habit (upright to prostrate), leaf texture (course to fine), leaf color (dark green to silver-blue), dormancy avoidance, vigor, tendency for center die-out, and mowing quality (shredded to clean cut).

Idaho fescue evaluation trial showing variability between and among collections.

In the fall of 2011, superior individual plants were identified and grouped as follows within five potential market types: course-textured, dark green; fine-textured, dark green; fine-textured, medium-green; fine-textured, blue-green; and fine-textured, silver-blue. The first three types are intended for mowed, high-maintenance turf applications, the second two for un-mowed or lightly mowed, low-maintenance groundcover applications. During late fall, crown cuttings of superior plants were taken and planted in pots in the greenhouse. In the spring of 2012, these plants will be used to establish isolated crossing blocks.

Results and Discussion: After evaluation, several general conclusions were reached with respect to variability for important turf characteristics. First, some collections were quite homogeneous for part or all of the measured variables while others were extremely variable. Second, the collections that had a history of some selection - those obtained from companies or institutions - tended to be more uniform and have a higher proportion of plants with acceptable turf quality. Exceptions to this finding were the three released rangeland varieties (‘Elmer’, ‘Joseph’ and ‘NezPurs’) which were all highly variable and produces few or no plants with acceptable turf traits.
Within-collection variability for leaf color and dormancy tended to be very high. For color, eight collections were fairly homogenous while 28 were moderately to highly variable. Dormancy was homogenous in nine collections and moderately to highly variable in 27.

Individual collections tended to be fairly homogenous for growth habit, leaf texture, and vigor. The number of collections ranked homogenous was 22, 26, and 22 for growth habit, leaf texture, and vigor, respectively. That left 14, 10 and 14 collections that expressed moderate to high variability for the same three characteristics. Mowing quality and tendency for center die-out were characteristics that also tended to vary widely between collections but be relatively homogenous within collections.

The best individual plants from the overall trial were selected, propagated through crown cuttings, and established in the greenhouse. A total of 106 selections were harvested. As categorized by market type, 28 selections were of the dark green course-textured form, 19 dark green fine-textured type, 32 medium green fine-textured type, 17 blue-green fine-textured type, and 10 of the silver-blue fine textured form.

Selections were strongly biased toward and taken from a relatively few collections. Specifically, 88 % of the selections were derived from seven collections. No selections were made from 19 of the collections, more than half of the entries in the trial. A limited number of selections were made from the remaining 10 selection

Typical Idaho fescue plant selected for silver-blue, fine-textured market type.

One collection, obtained from the Island Park area of Idaho by project personnel, provided 25 of the 28 selections for the dark green course-textured market type. This collection had an unusual phenotype with wide leaf blades, dark green color, high plant vigor, decumbent habit, and minimal dormancy.

Selections for the dark-green fine textured form were derived from six collections. Six selections were made from the collection Benson Farms #1, two from Benson Farms #3, one each from Benson Farms #4 and Benson Farms #7, seven selections from a collection provided by the Aberdeen NRCS PMC, and two from a Pullman germplasm accession collected in Gallatin County, Montana.

Sixteen of the 32 medium green fine-textured selections were taken from the Benson Farms #1 collection. Thirteen were derived from a collection obtained from the Aberdeen NRCS PMC. Individual selections were derived from Bensons Farms #6, Benson Farms #10, and the Thorn Creek Native Seed collection.

Plants of the blue-green fine-textured form were selected from seven different collections. These plants usually appeared as a sole plant among 25 in a block/replication. This segregative distribution suggests the potential for heterozygosity, meaning it may be difficult to stabilize this form. Time will tell. On the other hand, half of the silver-blue selections came from a single source, the Currans Family Farm collection which appears to be fairly homozygous for bright blue leaf color and minimal dormancy. Most of the remaining silver-blue selections were derived from the Pullman germplasm accession from Gallatin County, Montana. As a side note, it was noted in the evaluation that there appears to be an association between blue leaf color and tendency to express summer dormancy.

In 2012, evaluation and selection for turf quality of individual plants will continue. Additional superior plants will be added to seed blocks, if appropriate. Isolated seed blocks will be established for each of the five market types and bulked seed will be produced for initial large-scale turfgrass evaluations. If necessary, additional cycles of selection will be employed. In 2013, the original evaluation blocks will be allowed to bloom and seed productivity measured. Seed productivity data, along with turf quality measurements, will be used to amend selection decisions and create final parental pools for each crossing block.

Crown division procedure for selected Idaho fescue plants.

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Salt tolerance of eleven cultivars of ornamental chile peppers

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Introduction

High quality irrigation water for green industry is becoming increasingly limited. Alternative water source such as municipal reclaimed water is being used for irrigating landscapes in some areas in the Southwest. Ornamental chile peppers are popular for container-grown plants as well as bedding plants providing unique foliar and fruit colors (Bolsand, 1992; Niu et al., 2010; Stommel and Griesbach, 2008;). However, information in the responses of ornamental chile peppers to irrigation water with elevated salts is limited. This study quantified the responses of 11 ornamental chile peppers to elevated salinity. Our results indicated that most cultivars were moderately tolerant to salinity with little or no foliar salt injury, although growth is reduced at elevated salinity. 'NuMex Memorial Day' was most sensitive among the 11 tested cultivars with foliar damage and significant growth reduction.

Materials and Methods

Seeds of 11 cultivars of ornamental chile peppers (NuMex Twilight, NuMex Centennial, NuMex Christmas, NuMex April Fool's Day, NuMex Cinco de Mayo, NuMex Valentine, NuMex Easter, NuMex Halloween, NuMex St. Patrick's Day, NuMex Memorial Day, NuMex Thanksgiving) were sown on 2 Jun in plug cells filled with Redi-earth Plug & Seedling Mix (SunGro Hort., Bellevue, WA) and covered with 0.25 inch coarse vermiculite. Germinated seedlings were transplanted to 6-inch round plastic pots filled with Sunshine Mix No. 4 (SunGro Hort., Bellevue, WA).

Saline solutions at electrical conductivity (EC) of 1.3 (nutrient solution, control, no addition of salts), 4.1, and 8.1 $dS \cdot m^{-1}$ were created by adding appropriate amounts of sodium chloride (NaCl) and calcium chloride ($CaCl_2$) at 2:1 (molar ratio) to nutrient solution. The EC of tap water was 0.8 $dS \cdot m^{-1}$ and the major ions in the tap water were Na^+, Ca^{2+}, Mg^{2+}, Cl^-, and SO_4^{2-} at 184, 52.0, 7.5, 223.6, and 105.6 $mg \cdot L^{-1}$, respectively. Saline solution irrigation (treatment) was initiated on 15 July and irrigation frequency was determined based on cultivar (biomass), treatment, and climatic conditions to avoid overwatering and water stress. The temperatures in the greenhouse during the experimental period were at 33.3 ± 2.6 C (mean ± SD) during the day and 25.6 ±1.6 C at night. The daily light integral (photosynthetically active radiation) was measured at 18.6 ± 3.0 $mol \cdot m^{-2} \cdot d^{-1}$.

Experiment was terminated on 9 Sept. Upon termination of the experiment, shoots were severed at the substrate surface. Leaves, stems and fruits were separated and the dry weights (DW) were determined after oven-dried at 70 °C to constant weight. Foliar salt damage was rated by giving a score to every plant from 0 to 5, where 0 = dead, 1 = over 90% foliar damage (salt damage: burning, necrosis, and discoloration); 2 =

moderate (50-90%) foliar damage; 3 = slight (<50%) foliar damage; 4 = good quality with minimal foliar damage; and 5 = excellent without any foliar damage. Leaf osmotic potential was determined as described in Niu et al. (2010). Specifically, leaves were sampled from the middle section of the shoots in the early morning at the end of the experiment, sealed in a plastic bag, and immediately stored in a freezer at –20 °C until analysis. Frozen leaves were thawed in a plastic bag at room temperature before sap was pressed out with a Markhart leaf press (LP-27, Wescor, Logan, UT) and analyzed using a vapor pressure Osmometer (Vapro Model 5520, Wescor, Logan, UT).

The experiment was a split-plot design with salinity of irrigation water as the main plot and species subplot with 10 replications. All data were analyzed by a two-way ANOVA using PROC GLM. When the main effect was significant, linear regression was performed using PROC REG. To determine the differences among salinity level on plant growth, Student-Newman-Keuls multiple comparisons were performed. All statistical analyses were performed using SAS software (Version 9.1.3, SAS Institute Inc., Cary, NC).

Results and Discussion

Plants irrigated with nutrient solution (no additional salts) and saline solution at EC of 4.1 $dS \cdot m^{-1}$ did not have any foliar damage, regardless of cultivar. However, plants of some cultivars irrigated with saline solution at EC of 8.1 $dS \cdot m^{-1}$ had foliar damage (Table 1). 'NuMex Memorial Day' had the most severe damage and had an average score of 2.45. 'NuMex Thanksgiving', 'NuMex Twilight', 'NuMex Cinco de Mayo', and 'NuMex April Fools' had little or no foliar damage. Salinity treatment decreased leaf osmotic potential for most cultivars but not on 'NuMex Easter' and 'NuMex Halloween' (Table 1) and the degree of decreasing in leaf osmotic potential varied among cultivars.

Shoot dry weight (DW) was reduced by elevated salinity except for 'NuMex Thanksgiving' (Table 2). The reduction percentages by salinity varied with cultivars. For example, the shoot DW of 'NuMex Memorial Day' was reduce by 73.7% in EC 8.1 compared to the control, followed by 'NuMex Centennial' and 'NuMex Christmas' by 50% to 52%, 'NuMex Easter' at 46%, 'NuMex St. Patrick' at 48%, and the rest of the cultivar had a reduction below 40%. The highest shoot DW reduction in 'NuMex Memorial Day' coincided with lowest visual score, indicating that this cultivar was most sensitive to salinity. Although the foliar damage in other cultivars were minor, the low visual scores are generally found in plants with larger shoot DW reduction when irrigated with saline solution. The final plant size (growth index) of 'NuMex April Fools' and 'NuMex Centennial' were not affected by the salinity treatments (Table 3). All other cultivars became shorter and more compact as salinity of irrigation water increased. In summary, all cultivars were moderately tolerant to saline water irrigation except for 'NuMex Memorial Day', which was the most sensitive among the 11 cultivars with severe foliar damage at EC 8.1 $dS \cdot m^{-1}$ and 70% shoot growth reduction compared to the control.

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Fig. 1. Salt tolerance of ornamental chile pepper study in a greenhouse.

Table 1. Leaf osmotic potential of 11 ornamental chile pepper cultivars irrigated with saline solution at electrical conductivity (EC) of 1.3 (control, nutrient solution), 4.1, or 8.1 $dS{\cdot}m^{-1}$ for 8 weeks.

Cultivars	**Osmotic potential**			**Visual Score**
	Control	**EC 4.1**	**EC 8.1**	**EC 8.1**
April Fool's Day	-1.80 a	-1.72 a	-2.01 b	4.98
Centennial	-1.82 a	-2.02 b	-2.44 c	4.8
Christmas	-1.58 a	-1.69 b	-1.76 b	4.69
Easter	-1.83 a	-1.95 a	-1.88 a	4.91
Halloween	-1.2 a	-1.16 a	-0.99 a	4.88
Cinco de Mayo	-0.82 a	-0.98 a	-1.34 b	5
Memorial Day	-1.35 a	-1.52 a	-1.89 b	2.45
St. Patrick's Day	-1.49 a	-1.82 b	-1.72 b	4.87
Thanksgiving	-1.57 a	-1.78 b	-2.03 c	5
Twilight	-1.64 a	-1.97 b	-2.15 b	5
Valentine	-1.58 a	-1.71 b	-1.90 c	4.83

[z] means with the same small letters in the same row (among treatment) were not different tested by Student-Newman-Keuls multiple comparisons at P = 0.05.

Table 2. Shoot dry weight of 11 ornamental chile pepper cultivars irrigated with saline solution at electrical conductivity (EC) of 1.3 (control, nutrient solution), 4.1, or 8.1 dS·m^{-1} for 8 weeks.

Cultivars	**Shoot Dry Weight (g/plant)**			**Reduction (%)**
	Control	**EC4.1**	**EC8.1**	**EC8.1**
April Fool's Day	20.88 a	16.74 b	13.18 c	36.9
Centennial	54.7 a	42.8 b	27.1 c	50.5
Christmas	15.02 a	11.94 b	7.16 c	52.5
Easter	23.42 a	21.52 a	12.6 b	46.2
Halloween	20.38 a	17.94 a	13.32 b	34.6
Cinco de Mayo	18.44 a	19.60 a	12.64 b	31.5
Memorial Day	19.52 a	13.34 b	5.14 c	73.7
St. Patrick's Day	16.26 a	16.7 a	8.5 b	47.7
Thanksgiving	42.02 a	39.5 a	35.92 a	14.5
Twilight	43.5 a	31.72 b	27.4 b	37.0
Valentine	16.42 a	17.08 a	10.82 b	34.1

[z] means with the same small letters in the same row (among treatment) were not different tested by Student-Newman-Keuls multiple comparisons at *P* = 0.05.

Table 3. Growth index [(height + width1 + width 2)/3] of 11 ornamental chile pepper cultivars irrigated with saline solution at electrical conductivity (EC) of 1.3 (control, nutrient solution), 4.1, or 8.1 $dS \cdot m^{-1}$ for 8 weeks.

Cultivars	**Growth Index (cm)**			**Reduction (%)**
	Control	**EC4.1**	**EC8.1**	**EC8.1**
April Fool's Day	31.93 a	27.4 a	27.52 a	13.8
Centennial	46.68 a	30.4 a	33.72 a	27.8
Christmas	25.18 a	25.01 a	19.3 b	23.4
Easter	32.68 a	28.74 b	22.9 c	29.9
Halloween	29.82 a	25.58 b	24.23 b	18.7
Cinco de Mayo	29.26 a	29.1 a	25.06 b	14.4
Memorial Day	25.68 a	24.2 a	16.17 b	37.0
St. Patrick's Day	24.13 a	23.84 a	18.71 b	22.5
Thanksgiving [y]	109.1 a	101.5 b	73.0 c	33.0
Twilight	59.94 a	51.84 a	39.62 b	33.9
Valentine	29.13 a	26.72 ab	23 b	21.0

[z] means with the same small letters in the same row (among treatment) were not different tested by Student-Newman-Keuls multiple comparisons at $P = 0.05$.

[y] Height but no width were measured.

Selection and vegetative propagation of native Plants for landscape use

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Abstract — Utah State University and the USU Botanical Center are committed to the goal of maintaining the quality of life enjoyed through landscaping while conserving water in those landscapes. One of the primary means of achieving that goal is through the use of water-conserving plants. Bigtooth maple (*Acer grandidentatum*) has been identified as a native Utah tree with potential for use in water-conserving landscapes. In 2011 evaluations of selected maple accessions were begun in North Logan, Kaysville, and Lehi, Utah as well as Aberdeen, Idaho to determine trueness to type, rootstock effects, and landscape performance. Preliminary research on propagation of mature maple accessions by mound layering indicates a high level of success and potential for use of this method in Intermountain nurseries. In addition, layering was shown to be effective for chokecherry (*Prunus virginiana*) and littleleaf mountain mahogany (*Cercocarpus intricatus*). Preliminary research on propagation of Utah juniper (*Juniperus osteosperma*) examining the effects of rooting substrate, auxin concentration, and environmental conditions revealed rooting percentages as high as 66% when juvenile cuttings were treated with 8000 ppm IBA, stuck in a 2 perlite : 1 peat rooting substrate, and held in a white polyethylene tent with periodic mist. These results indicate that while recalcitrant, selected specimens of juvenile Utah juniper can be successfully propagated by cuttings. A project examining the development of the native zauschneria (*Epilobium canum*) as a perennial flowering plant for water conservation is also being conducted. To date, multiple accessions have been collected, a vegetative propagation protocol developed, and hybridization of accessions initiated.

Introduction

Past research at Utah State University has focused on the identification of native plant accessions with potential for use in water conserving landscapes. A key part of this project is the development of propagation protocols for selected accessions. In some cases, such as bigtooth maple, we have been successful in developing methods of cutting propagation. As a result, we have now turned our efforts to the development of mound layering as a sustainable method of propagating mature accessions. In other cases, such as Utah juniper, simple vegetative propagation remains elusive and we are continuing to work toward the development of protocols that will permit effective rooting of cuttings.

With the development of vegetative propagation methods for bigtooth maple, we are now evaluating selected accessions in landscape environments as a final step before recommending their adoption by the landscape industry. We are also focusing a research program on the improvement of zauschneria (*Epilobium canum*) for landscape use. This flowering perennial is native to the Great Basin and has already been used to a limited extent in landscaping. We hope to develop hybrids of related species and subspecies from the western United States that have even greater potential for use in water-conserving landscapes.

Evaluation of Bigtooth Maple Accessions

A critical step in the release of any plant material to the landscape industry is an evaluation of that material in a landscape environment to insure that it remains true-to-type across a range of geographical locations. In order to expedite the production of commercial grade nursery stock, beginning in 2008, we have transferred budwood of selected bigtooth maple accessions to J. Frank Schmidt and Son Nursery in Boring, Oregon under material transfer agreement. These accessions have been propagated by budding onto sugar maple (*Acer saccharum*) or bigtooth maple seedling rootstocks. In the spring of 2011, bareroot trees of several accessions of bigtooth maple were sent from Oregon to the USU Botanical Center.

Figure 1. Grafted bigtooth maple (Acer grandidentatum) trees shipped as bareroot plants from Oregon and established in containers in a retractable root greenhouse at the USU Botanical Center.

These accessions include two from J. Frank Schmidt & Son Nursery (KW-1AGRA and KW-2AGRA), three from New Mexico State University (NMSU-1, 2, and 3), and eight from Utah State University (USU-ACGR- 1001-6, 1008, and 1009). All selections were budded on sugar maple rootstock with the exception of four USU-ACGR-1002, four USU-ACGR-1005, and three USU-ACGR-1009, which were budded on bigtooth maple rootstock. The bareroot trees were potted and held in a retractable roof greenhouse under microspray irrigation (Fig. 1) until the fall of 2011 when they were planted at locations in North Logan, Kaysville, and Lehi, Utah as well as Aberdeen, Idaho.

Beginning in the spring of 2012, we will evaluate these maple accessions for trueness to type (in regards to form and fall color) as well as growth and performance in the landscape (Fig. 2). One of the perennial questions about Oregon-grown bigtooth maple in Utah is the effect of sugar maple rootstocks. Nurseries in Oregon have developed very successful maple production systems around seedling sugar maple rootstocks. However, when bigtooth maple is sold in Utah as a native tree while grafted on to a non-native rootstock, it raises series questions in consumer's minds. While there is anecdotal information about performance of such trees in Intermountain soils, there have not been any controlled studies. We hope to determine if the sugar maple rootstock is a detriment based on both overall landscape performance and susceptibility to iron chlorosis. While it would have been best to directly compare trees on both sugar and bigtooth maple rootstocks, production challenges with bigtooth rootstocks have limited the number and quality of trees available.

Figure 2. Planting of bigtooth maple accessions for landscape evaluation at the USU Botanical Center.

Mound Layering of Woody Plants

In order to reach our ultimate goal of having selected native plants produced by local nurseries and adopted for use in water-conserving landscapes, an efficient means for their production must be identified. We have successfully developed means of propagating bigtooth maple from cuttings, but have hypothesized that mound layering techniques would be more amendable to adoption by local, small-scale nurseries. We have hypothesized that development of native plant stool beds will be of value in the propagation of selected accessions. To test this hypothesis we have established a stool bed with several accessions of bigtooth maple as well as chokecherry, white rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *speciosa*), littleleaf mountain mahogany, and green manzanita (*Arctostaphylos patula*). All plants are clonal materials originally propagated from mother planst by cuttings so that they are on their own roots. All plants are performing well in the stool bed with the exception of manzanita which is not thriving under the growing conditions. The stool bed is located at the USU Botanical Center in Kaysville, Utah.

On 7 March 2011, accessions of bigtooth maple where heavily pruned to basal buds. Beginning in in mid-May, wood shavings were mounded around plant bases. On 11 July plants within accessions were selected for propagation based on having a minimum of four well developed shoots of current season's wood. Shoots within plants were randomly assigned one of four treatments: control, auxin, girdle, or auxin and girdle. Auxin treatments consisted of application of 4000 ppm IBA as Dip 'N Grow applied to a 2.5 cm region at the base of the stem with a cotton swab. Girdling treatments consisted of applying 4-inch cable ties to the base of the current season's wood and pulling as snug as possible by hand (Fig. 3). Following treatment

Figure 3. Girdling done with a cable tie.

Figure 4. Rooting of bigtooth maple layer.

applications, wood shavings were again re-mounded around the plants and twice daily sprinkle irrigation begun the following day.

Preliminary results of the maple layering showed considerable success (Fig. 4) with overall rooting of 5% for controls, 33% for the auxin treatment, 45% for girdling treatment, and 83% for combined auxin and girdling treatments (Fig 5). Measures of roots per cutting indicate 0.1, 4.2, 2.6, and 11.1 roots per cutting for control, auxin, girdle, and auxin/girdle treatments respectively (Fig. 6).

Less extensive treatments were applied to other woody plants and all indicated that mound layering can be an effective means of propagating accessions of selected native woody plants.

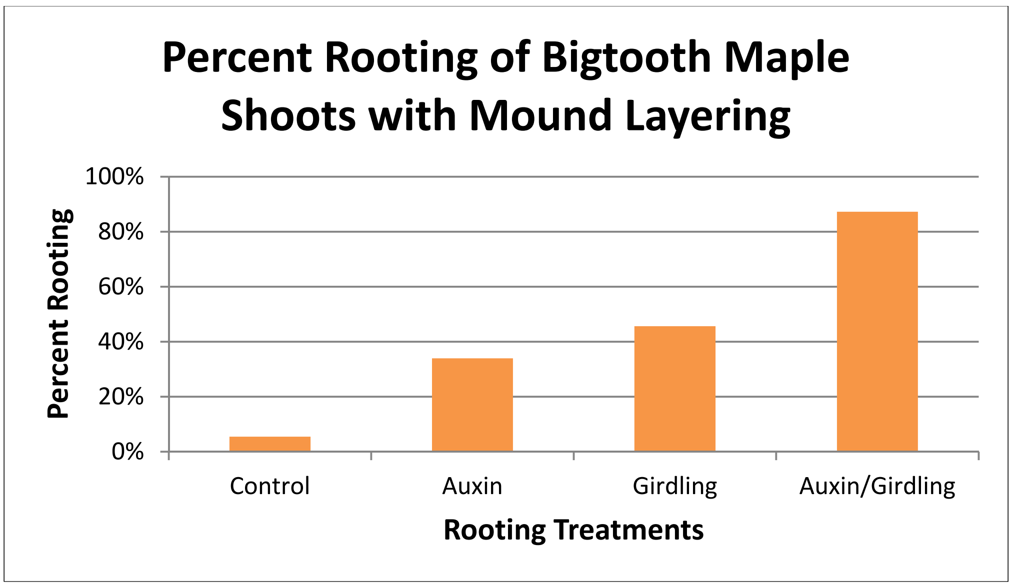

Figure 5. Percent rooting of bigtooth maple shoots in a stool bed environment as influenced by treatment with auxin (4000 ppm IBA/2000 ppm NAA), girdling (cable ties at shoot base) or both auxin and girdling.

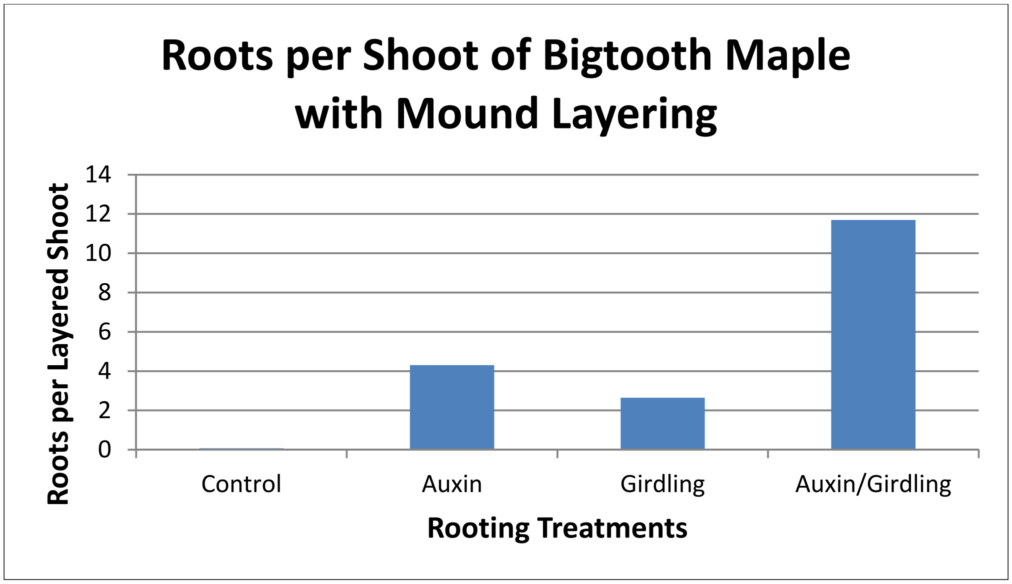

Figure 6. The effect of auxin (4000 ppm IBA/2000 ppm NAA), girdling (cable ties at shoot base), and both auxin and girdling on the number of roots per layered shoot of bigtooth maple in a stool bed environment.

Propagation of Utah Juniper by Cuttings

As a drought tolerant plant, the Utah juniper has potential for application to the water-conserving, landscape environment. Certain specimens of Utah junipers found in the wild have unique morphological characteristics that make them attractive options for landscape design. Such phenotypic characteristics can only be perpetuated through asexual propagation techniques, such as cutting propagation. Unfortunately, Utah junipers are not easily propagated by cuttings. As an undergraduate research project by Kevin Cope, cuttings were collected from terminal stems of several wild, juvenile Utah junipers in Park Valley, UT on 16 Nov 2010. Cuttings were randomly assigned to treatments (n=18) of 2 perlite : 1 peat or 4 perlite : 1 peat (by volume) rooting substrate; 0, 1000, 3000, or 8000 ppm IBA as Hormodin 1, 2, or 3; and either an open, intermittent mist bench (7 s mist/30 min during the day) or a white polyethylene tent (mist for 30 s at 0900 and 1300 HR). All cuttings were in the same greenhouse with 18/15.5 °C D/N temperatures, 16 hour days, and bottom heat at ~21 °C. Misting was with deionized water and cuttings were irrigated as needed with culinary water.

On 21 Jan. 2011 all cuttings were analyzed for rooting. Rooted cuttings were carefully removed from the media and analyzed (Fig. 7).

Figure 7. Rooted cuttings taken from juvenile Utah juniper (*Juniperus osteosperma*).

The number of roots, length of longest root, presence of callus, and foliar status were noted. Un-rooted cuttings were rinsed and re-dipped in hormone. Both rooted and un-rooted cuttings were returned to their previous conditions. On 25 Mar. 2011 the experiment was concluded and only previously un-rooted cuttings were analyzed. For each cutting, presence of roots, number of roots per cutting, presence of callus, foliar status, and root or stem disease were noted. Overall, 25% of the cuttings rooted, with up to 14 roots per cutting. In general, as IBA concentration increased, presence, number, and length of roots increased. Total number of rooted cuttings was greater and foliage was healthier in the white polyethylene tent compared to the mist bench. Rooting was also more frequent in the 2:1 perlite:peat media compared to the 4:1. The highest rooting percentage (66%) was found in the poly tent, 8000 ppm IBA, and 2:1 perlite:peat treatment (Fig. 8). Future studies will be conducted with unique Utah juniper specimens found in the wild that have the potential for application in the drought tolerant landscape.

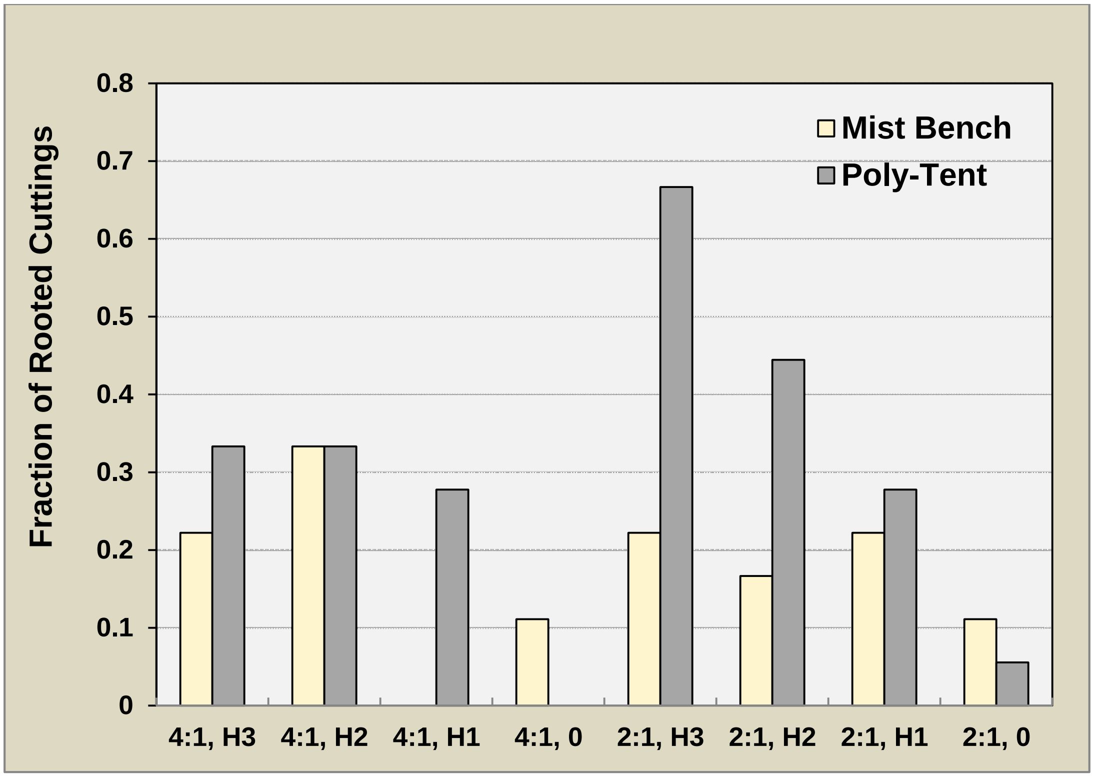

Figure 8. The effect of aerial environment, rooting substrate (4:1 or 2:1 perlite:peat by volume), and auxin (8000, 4000, 1000 and 0 ppm IBA) on the percent rooting of Utah juniper cuttings.

Development of Zauschneria as a Perennial Flowering Crop for Low-Water Landscaping

This project is led by Richard Anderson, Nursery Manager at the USU Botanical Center. The specific objectives are to collect and establish breeding lines of *Epilobium canum* and *E. suffruticosum* at the USU Botanical Center, initiate a hybridization program using collected germplasm (Table 1), improve propagation techniques for vegetative propagation of selected accessions, and begin the development of a production system for development and release of new perennial landscape plants (Fig. 9).

Equally important to finding the desired accessions is the ability to propagate them and establish mother plants for future plant breeding work. A propagation protocol has been developed where cutting material of *Epilobium canum* subsp. *garrettii* is held at 4° C overnight to increase turgidity. Cuttings are made from the terminals of non-flowering stems approximately 3-5 mm in diameter cut to 5 cm in length. Leaves below the terminal and first node are removed and the cuttings dipped in Hormodin #1 rooting powder (0.1% indolebutryic acid). Following dipping, the cuttings are stuck in Oasis® rooting cubes and placed in a 21-24° C greenhouse under intermittent mist. Rooting of nursery-grown stock can be improved by holding stock plants under shade at 4-10° C which provides shorter internodes, thicker stems, and a longer window of opportunity for taking cuttings. Rooting percentages can approach 100%. Cuttings are rooted after two weeks and can be transplanted and grown for four more weeks under cool (4-10° C) temperatures before harvest as liners. In the fall of 2011, the first hybridizations within this collection of germplasm were conducted. Seeds from crosses will be germinated and grown on next spring for evaluation.

Table 1. *Epilobium* accessions held at the Utah State University Botanical Center.

	Accession Number	Source	Propagules	Date
Epilobium canum* subsp. *garrettii				
1.	2010-0010-0059	Farmington Canyon, UT	vegetative	15 Jul 2010
2.	2010-0010-0060	Farmington Canyon, UT	vegetative	8 Aug 2010
3.	2010-0010-0061	Willow Flat, ID	vegetative	10 Jun 2010
4.	2010-0010-0062	Tony Grove, UT	vegetative	13 Aug 2010
5.	2010-0010-0063	Adams Canyon, UT	vegetative	27 Apr 2010
6.	2010-0010-0064	Thistle Junction, UT	vegetative	7 Aug 2010
Epilobium canum* subsp. *latifolium				
7.	2011-0010-	Soda Springs, CA	seed	21 Sep 2011
8.	2011-0010-	Soda Springs, CA	seed	25 Sep 2011
Epilobium canum* subsp. *canum				
9.	2011-0010-	Wright Lake Road, CA	vegetative	17 Aug 2011
10.	2011-0010-	Wright Lake Road, CA	vegetative	17 Aug 2011
11.	2011-0010-	Wright Lake Road, CA	seed	21 Sep 2011
12.	2011-0010-	Wright Lake Road, CA	seed	21 Sep 2011
13.	2011-0010-	Bridal Veil Falls North, CA	vegetative	17 Aug 2011
14.	2011-0010-	Bridal Veil Falls North, CA	seed	17 Aug 2011
15.	2011-0010-	Lake Berryessa, CA	vegetative	Jun 2011
16.	2011-0010-	Lake Berryessa, CA	seed	22 Sep 2011
***Epilobium canum* subsp. *canum* 'Ettri'**				
17.	2010-0010-0065	Gayle Allen/Harrisville, UT	13	8 Sep 2010
***Epilobium canum* subsp. *canum* 'Alba'**				
18.	2010-0010-0066	Gayle Allen/Harrisville, UT	9	8 Sep 2010
***Epilobium canum* subsp. *canum* 'Dublin'**				
19	2010-0010-0066	Gayle Allen/Harrisville, UT	9	8 Sep 2010
Epilobium septentrionale				
20.	2011-0010-	Davis, CA	seed	24 Sep 2011
21.	2011-0010-	Davis, CA	seed	24 Sep 2011
22.	2011-0010-	Davis, CA	seed	24 Sep 2011
Epilobium suffruticosum				
23.	2010-0010-0067	Snake River, WY	0	5 Aug 2010
Purchased vegetative accessions (June, 2011)				
24.	Epilobium septentrionole 'Wayne's Silver'		vegetative	Jun 2011
25.	Epilobium septentionole 'Mattole Select'		vegetative	Jun 2011
26.	Epilobium canum subsp. latifolium 'Bowman'		vegetative	Jun 2011
27.	Epilobium canum 'Ettri'		vegetative	Jun 2011
28.	Epilobium canum 'Solidarity Pink'		vegetative	Jun 2011
Controlled crosses				
29-33.	2011-1010-	Five accessions		Oct 2011

Figure 9. *Epilobium canum* subsp. *garrettii* accession located at Tony Grove, UT.

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