Report of the Intermountain Native Plants Cooperative

Volume 1 *December 2009*

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 petiolatus* Brandegee in the Mojave Desert of Washington Co. Utah.

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Announcements

2010 WERA Meeting will be hosted by Stephen Love, October 8, 2010 at the University of Idaho, Aberdeen Research and Extension Center, Aberdeen, ID 83210

Summary report of activities to WERA 1013

William R. Graves

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Trees and shrubs native to North America are the focus of my research program. My coworkers and I have targeted species that, despite possessing desirable traits for horticulture, have not been used as specialty crops in the nursery trade. For some taxa, difficulties with propagation have prevented commercial use, so research on sexual or asexual means of propagation is needed. Additional research has been designed to examine variation within species in ornamental traits (such as flowers) or physiological attributes (such as tolerance of drought or alkaline soils). Our ultimate goals are to identify new taxa for horticultural use and to gain information on genetics and ecology that will aid efforts to conserve certain rare species in their native habitats.

Taxa that have been studied recently include:

Alnus maritima (seaside alder): This rare species is restricted to wetlands in the wild but has proved remarkably resistant to drought. A cultivar, 'September Sun', has been released and is available for commercial production.

Foliage and flowers of *Alnus maritima*

Shrub form of *Dirca* spp.

Dirca spp. (leatherwoods): Yellow flowers in winter or early spring, yellow autumnal foliage, and arborescent growth habits are ornamental hallmarks of leatherwoods. We are studying the species' genetics, establishing methods of propagation, determining environmental conditions under which the species thrive, and assessing modes of reproduction in native habitats.

Flowers of *Dirca* spp.

Nyssa aquatica (water tupelo): This fast-growing tree from the swamps of the southeastern United States has received little attention from horticulturists. Propagation methods, genetics, and environmental stress resistances are being evaluated.

Styrax americanus (American snowbell): Dainty white flowers are the main ornamental feature of these large shrubs/small trees. While the species is most prevalent in regions with mild winters, we are focusing on the cold hardiness and water-stress tolerance of plants from a small population in northern Illinois.

Selected Publications, 2008 - 2009

Peterson, B.J. and W.R. Graves. 2009. Variation in development and response to root-zone pH among seedlings of *Dirca palustris* (Thymelaeaceae) from three provenances. HortScience 44:1319-1322.

Boyer, N.Z. and W.R. Graves. 2009. NAA is more effective than IBA for rooting stem cuttings of two *Nyssa* spp. Journal of Environmental Horticulture 27:183-187.

Peterson, B.J., Graves, W.R., and J. Sharma. 2009. Color of pubescence on bud scales conflicts with keys for identifying species of *Dirca* (Thymelaeaceae). Rhodora 111:126-130.

Graves, W.R. 2008. Habitat and reproduction of *Dirca mexicana*. Rhodora 110:365-378.

Graves, W.R. and J.A. Schrader. 2008. At the interface of phylogenetics and population genetics, the phylogeography of *Dirca occidentalis (*Thymelaeaceae). American Journal of Botany 95:1454-1465.

Sharma, J., J.A. Schrader, and W.R. Graves. 2008. Ecology and phenotypic variation of *Leitneria floridana* (Leitneriaceae) in disjunct native habitats. Castanea 73:94-105.

Schrader, J.A. and W.R. Graves. 2008. Nodulation and growth of *Alnus nitida* and *Alnus maritima* inoculated with species-specific and nonspecific *Frankia*. Journal of Environmental Horticulture 26:29-34.

Evaluating intraspecies diversity of Intermountain West native plants

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In 2005, we began a project at Utah State University to evaluate various Intermountain West native plant species for their adaptability to different climate and soil conditions to correspond to potential ornamental markets for these plants in Utah. We chose to perform reciprocal trials of native plant species from across the state, with common garden plots located in northern Utah (North Logan and Kaysville) and southern Utah (Kanab and St. George). Since water is the resource that most limits crop production and landscape management in the Intermountain West, species selected for our evaluation program are those known to have potential for use in low-water ornamental landscaping. Our objectives are: 1) to identify, evaluate, and select native plant species and varieties that show promise for water and resource conservation in ornamental nursery crop production and in ornamental landscape systems; 2) to collect and disseminate information about heat and drought tolerance, ease of production, and limits of environmental adaptation of evaluated plants to the scientific community, to growers and retailers, and to the public.

Three or more accessions each of seven species from collected from diverse habitats across the state were grown from seed in a greenhouse and overwintered in a cold-frame house. In fall 2007, they were installed in plots arranged in a randomized complete block design with 5 replications; plants were spaced one meter on-center (northern plots). The two southern plots are arranged for public viewing and are, therefore, arranged in an ornamental fashion (5 replications per accession). Common garden studies have allowed us to tease out differences in cold-hardiness, drought-tolerance, and morphological form across accessions; this has provided us with information that will be useful in determining appropriate markets for selected species, limits of adaptability for some species accessions, and sources of germplasm for further selection and possible cultivar development.

Each of the four plots differs in climatic and edaphic characteristics:

Greenville Farm (North Logan, UT): elevation 4,300 feet, soil loam, cold hardiness zones 3-5

Utah Botanical Center (Kaysville, UT): elevation 4,400 feet, soil loam, cold hardiness zones 4-6

Kane County Extension (Kanab, UT): elevation 6,500 feet, soil sandy loam, cold hardiness zones 5-8

Tonaquint Gardens (St. George, UT): elevation 2,750 feet, soil sandy loam, cold hardiness zones 6-8

All soils were at pH above 8.0. Plots were irrigated only as often as needed to prevent wilting of plants. Irrigation was by a drip system arranged in a grid. During summer of 2009, plants at the Kaysville location were not irrigated at all. Pre-emergence herbicide was applied early in spring 2009. Weeds that escaped herbicide control were hand-pulled.

The following are results of 2009 data collection at the two northern sites:

Cercocarpus ledifolius (Curlleaf mountain mahogany) is a large shrub or small tree that shows a fair degree of variability in form across the state. This is a broadleaf evergreen with long, narrow aromatic leaves and ornamentally attractive fruit that is feather-like and corkscrew in appearance. The species occurs naturally in mountainous areas of the state from 4,462 to 9,514 feet. We found no differences among accessions in tolerance to cold or drought at either of the two northern sites. We did find that one accession collected from Millard County, Utah grew in a more compact in form, regardless of irrigation regimen or plot site, that has potential for cultivar selection.

Purshia mexicana (Mexican cliffrose) is a broadleaf evergreen shrub that is more compact in size than mountain mahogany. It has small, dark green, deeply lobed foliage and white honey-scented flowers with a yellow center. The species occurs across the state at elevations from 2,660 to 7,150 feet. Of the three accessions we collected, one accession from Iron County, Utah at 6,400 feet exhibited significantly greater winter survival. Two of the three accessions survived the summer without irrigation in Kaysville.

Agastache urticifolia (Nettleleaf giant hyssop) is an aromatic perennial herb that occurs naturally from 5,450 to 9,800 feet in foothill to mountainous areas across the

Intermountain West. As a member of the mint family, this plant has square stems with oppositely attached leaves and a dense spike of pink to purple flowers up to 8 cm long at the terminal end of the stems. We were primarily interested in finding an accession that would withstand minimal irrigation. During our evaluation, the accessions from below 5,500 feet did not survive the heat of the summer, whereas the higher elevation accessions (above 8,000 feet), or those from the northern latitudes of the state survived and showed no growth differences across the two sites, even without summer irrigation.

Monardella odoratissima (Mountain beebalm) is a mound-forming perennial with bright purple flowers and a mint aroma that attract bees and butterflies. It occurs at higher elevations across the Intermountain West at elevations from 5,940 to 10,955 feet. All plants overwintered successfully at both sites. Our evaluation indicated significant differences in height and width among accessions at the end of the summer between two of the three accessions at the North Logan site; no differences were observed in plants grown without irrigation (Kaysville). We presume that drought-stress masked size differences among species accessions.

Geranium viscosissimum (Sticky geranium) is a perennial with flowers that occur 2 or 3 to a cluster at the terminal end of stems. Flowers are pink to purple in color; leaves are basal and divided. Unlike most other herbaceous perennials, sticky geranium foliage exhibits a brick-red fall color. This species occurs naturally at higher elevations in the northern part of the Intermountain West, at elevations from 5,151 to 10,500 feet. Our evaluations of three accessions indicate growth differences among accessions only under drought-stress conditions (Kaysville plot), so there may be opportunity for selection of a more drought-tolerant cultivar.

Stanleya pinnata (Prince's plume) is a tall perennial with a wide mound of coarse foliage at its base and tall plumes of lemon yellow flowers in summer. It occurs naturally at elevations from 2,986 to 9,121 feet across the state. Extremely drought-tolerant, we were more concerned about the over-wintering capacity of different accessions. We found low winter survival of the southern-occurring accessions when planted in the two northern plots. However, one accession from Iron

County, Utah at 6,000 feet overwintered at both sites; this same accession grew faster at the Kaysville site with no irrigation. We suspect this species will not tolerate over-watering in an ornamental setting.

Penstemon eatonii (Firecracker penstemon) is a bright red-flowered penstemon that has shown to be widely adaptable to common garden conditions regardless of accession or plot site. Plants overwintered at both northern sites, and thrived at all sites through the summer. The species occurs throughout the north-central and southern part of the interior West at elevations ranging from 2,756 to 11,154 feet. Seed source should not be an issue with this species, either for growers or for retailers seeking an appropriate ornamental market.

Publications:

Beddes, T. and H.A. Kratsch. 2009. Seed germination of *Shepherdia rotundifolia* and *Shepherdia argentea* in three substrates. Journal of Environmental Horticulture 27(3):129-133.

Kratsch**,** H.A. 2008. *Alnus maritima* ssp. *oklahomensis* performance in non-irrigated landscapes in the Intermountain West. Journal of Environmental Horticulture 26(4):229-234.

Published Abstracts:

Hunter, G.C., H. Kratsch, R. Kjelgren, D. Hole, L. Schultz. 2009. Water use of *Eriogonum corymbosum* in an irrigated field study. HortScience 44: 1159. (Poster)

Panter, K. and H. Kratsch. 2009. Intermountain regional evaluation and introduction of native plants. HortScience 44: 1151. (Poster)

Sriladda, C., H. Kratsch, R. Kjelgren. 2009. Potential for domestication of *Shepherdia rotundifolia* (roundleaf buffaloberry). HortScience 44: 1052. (Oral)

Sriladda, C., H. Kratsch, B. Curtis, R. Kjelgren. 2009. Vegetative propagation of *Shepherdia rotundifolia* (roundleaf buffaloberry) from softwood cuttings. HortScience 44: 1105. (Poster)

Selectable variation among species and accessions of plants included in the Idaho Native Plant Domestication Project

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In 2005, the University of Idaho initiated support for program objectives to domesticate Intermountain West native plants for use in the landscape and nursery industry. Smith and Whalley (2002) described a 12-step approach for domestication and use of native grasses that has application for any native or adapted species; 1) determine the need, 2) choose appropriate species, 3) determine a breeding system, 4) access appropriate ecological range, 5) make collections, 6) assess genetic diversity, 7) determine species limitations, 8) develop an appropriate breeding strategy, 9) devise a release strategy, 10) develop seed production strategies, 11) develop management strategies, and 12) develop a market. This is a valid approach that can be applied to any native plant research program. Steps 1-5 have been entirely or partially completed, leading to the need for assessment of genetic diversity.

The ultimate goal for this project is to develop unique plant materials that will attract new consumers and help make local landscape nurseries more competitive and profitable, especially, but not limited to, nurseries specializing in the production and sale of native plants. Extensive evaluations were completed on 2.5 acres of plant materials established in 2006, 2007, and 2008. These plots had progressed through one to three winter seasons, providing opportunity for observation on hardiness, adaptation, mature appearance, flowering period, and horticultural value.

Two difficult environmental factors were imposed on these plants. First, they were planted in a moderately heavy silt-loam soil with a high pH (8.2). Also, these established plots were irrigated with only 25 to 30% of the amount of water (based on evapotranspiration) typically used to maintain a Kentucky bluegrass lawn in SE Idaho. Depending on the year, five to eight inches of supplemental (above natural precipitation) water was applied to the plots over the period June to September. These conditions provide opportunity for selecting plants that can thrive in southern Idaho water-conserving gardens.

Grass species in the native plant evaluation plots at the Aberdeen R & E Center

This report summarizes visual observations made to document selectable variation within native plant species and accessions planted at the Aberdeen R & E Center. Only a small representative list of available species will be presented.

Rhus trilobata (oak-leaf sumac) is a widespread native shrub with excellent landscape potential. It shows considerable variation in the plots for many characteristics, including growth habit, leaf glossiness, and intensity of fall leaf color. Growth habit among and within accessions varies remarkably, ranging from open to dense, and from upright to prostrate. Pictures below illustrate some of the growth habit variability in this species.

Salvia azurea (blue sage) is a blue-flowered native plant in the mint family. It is potentially valuable in the landscape because of its unique flower color and late fall bloom period. However, it tends to be tall and leggy. We have discovered one plant among the several accessions evaluated with a dwarf growth habit. Picture at right shows the dwarf plant in the front, a typical plant in the back.

Philadelphus lewisii (syringa or mockorange) is a spring-flowering shrub that typically grows in riparian areas. It often exhibits iron chlorosis when grown in high pH soils. Some accessions of this species include plants that vary for susceptibility to this problem. Picture at right shows a plant with yellowing typical of iron chlorosis symptoms (front, left) next to a plant that exhibits no visible susceptibility (back, right).

Eriogonum umbellatum (sulfurflower buckwheat) is a woody shrublet that exhibits outstanding horticulural value in the dry garden. It is a wildly variable species and accessions express variability for virtually every measurable trait. One interesting expression of variability found in the plots is repeat bloom in a species that is typically once-blooming. Picture at the right shows a plant expressing a second fall bloom cycle (front) next to a plant that shows no tendency to bloom again (back).

Penstemon venustus (Venus penstemon) is one of many outstanding penstemon species that could be utilized in the nursery industry. Although of great potential value, it often expresses serious symptoms of powdery mildew in the plots. Resistant individuals commonly show up in generally susceptible accessions. Picture at the right shows both resistant (left) and susceptible (right) plants growing side by side in the plots.

The Idaho native plant domestication project now includes more than 2,000 accessions, representing almost 600 species of Intermountain West native plants. Documentation of variability within these accessions is far from complete. However, based on the work that has been done, there is evidence to support the conclusion that most species contain sufficient variation to allow selection of superior forms, thus allowing the completion of the domestication process outlined by Smith and Whalley (2002).

Reference:

Smith, SR Jr. and RDB Whalley. 2002. A model for expanded use of native grasses. Native Plant J 3:38-49.

Salt tolerance of two native woody species

Genhua Niu

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Texas mountain laurel and Mexican redbud, native to Texas and New Mexico, are popular landscape plants for many Southern and Western states. Due to the decreasing availability of high quality irrigation water, information on salt tolerance of landscape plants is of increasing importance. Seedlings of these two plants were grown in two substrates and irrigated with saline solutions at three salinity levels. The type of substrate did not affect the growth and performance of both species. For Texas mountain laurel, salinity treatment did not affect the growth in the first three months. After six months of treatment, significant growth reduction was observed at electrical conductivity of 3.0 dS m^{-1} or higher. For Mexican redbud, plants were shorter and growth was slower under elevated salinity after three months of treatment compared to the control. Although Texas mountain laurel was more tolerant to salt stress compared to Mexican redbud, both species are not recommended to be planted where soil salinity is high or low quality water may be used for irrigation.

Irrigation levels affected bedding plant performance

Eleven popular and economically-important bedding plants were selected and grown in raised beds under three irrigation levels, which ranged from 20 to 50%, 50-85%, or 100 to 150% reference evapotranspiration (ET_0). The corresponding volumetric soil moisture contents ranged from 5 to 10%, 7 to 13%, or 10 to 18%. Among 11 species, shoot growth of plumbago (*Plumbago auriculata*), vinca 'Titan' (*Catharanthus roseus*), helenium (*Helenium amarum*), and three ornamental pepper (*Capsicum annuum*) cultivars, Black Pearl, Calio, and Purple Flash was not affected by the irrigation level. Angelonia (*Angelonia angustifolia*) 'Lavender Pink' and 'Purple', licorice plant (*Helichrysum petiolatum*), zinnia (*Zinnia maritima*), and vinca 'Pacifica' had reduced growth under reduced irrigation level. Except for ornamental pepper 'Calico' and 'Purple Flash', all species have been tested for multiple years. Generally, all species can be irrigated with as low as 50% PET, although plants become smaller, potentially saving 50% water.

Drought tolerance of four gaillardia species evaluated

The performance of four *Gaillardia* species: firewheel (*Gaillardia aristata*), burgundy (*G. grandiflora*), painters palette *(G. grandiflora*), and blanket flower (*G. pulchella*) were evaluated in the field raised beds in a semi-arid desert environment. This was a repeat of last year's study where six species were tested. The irrigation levels ranged from 20 to 50%, 50-85%, or 100 to 150% reference evapotranspiration (ET_0). We found that shoot growth was not affected by the irrigation treatment except for firewheel. Generally, all gaillardia species performed acceptable to excellent, even at the lowest irrigation.

Therefore, these gaillardia species can be used in landscape with reduced irrigation requirement, potentially saving more than 50% water.

Salt tolerance of bedding plants evaluated

Bedding plants are extensively used in landscapes in the United States. As high quality water supply becomes limited in many parts of the world, recycled water is being encouraged to irrigate landscapes. The relative salinity tolerance of 10 selected bedding plants, which were previously proved to be acceptable or excellent in semi-arid environment, was evaluated. Seedlings were irrigated with saline solutions at various salinity levels and salinity tolerance was determined according to their growth, visual quality, and physiological responses (water status and ion uptake). Results indicated that all species did not exhibit any foliar salt damage up to salinity level of 7.0 dS m^{-1}, which was the highest level in the study. Salinity threshold where significant growth reduction was observed varied with species. For most species, this threshold was 3.5 dS m^{-1}, which is higher than the salinity of municipal reclaimed water. Therefore, it is safe to use reclaimed water to irrigate landscape where these bedding plants are used. Conservatively speaking, the potential water saving may reach to 19,528 MG per year, assuming 50% landscapes in El Paso is irrigated with recycled water.

Publications:

Referred journal papers

Niu, G. & Rodriguez, D.S. 2008. Responses of growth and ion uptake of four rose rootstocks to chloride or sulfate dominated salinity. Journal of American Society for Horticultural Science 133(5):633-669.

Niu, G., Rodriguez, D.S., & Aguiniga, L. 2008. Effect of saline water irrigation on growth and physiological responses of three rose rootstocks. HortScience 43:1479-1484.

Niu, G., Rodriguez, D.S., & Mackay, W. 2008. Growth and physiological responses to drought stress in four oleander clones. Journal of American Society for Horticultural Science 133:188-196.

Published proceedings papers

Niu, G. & Rodriguez, D.S. 2008. Rose rootstocks responded differently to chloride versus sulfate salinity. Proceedings of Southern Nursery Association 53:403-406.

Niu, G. & Rodriguez, D.S. 2008. Irrigation levels affected performance of *Gaillardia* species. Proceedings of Southern Nursery Association 53:544-548.

Niu, G. & Rodriguez, D.S. 2008. Responses of four rose rootstocks to cyclic drought stress. Proceedings of Southern Nursery Association 53:407-409

Niu, G., M. Gu, and D.S. Rodriguez. 2009. Effects of substrate and salinity of irrigation water on the growth of *Sophora secundiflora*. Proceedings of Southern Nursery Association 54:1-7.

Niu, G. and D.S. Rodriguez. 2009. Salt tolerance of ten bedding plants. Proceedings of Southern Nursery Association 54:405-410.

Presentations with published abstracts

Niu, G. & Rodriguez, D.S. 2008, July. Response of six *Gaillardia* species to irrigation regimens. Annual Conference of American Society for Horticultural Science (ASHS), Orlando, FL, HortScience 43:1192.

Niu, G. & Rodriguez, D.S. 2008. Response of four rose rootstocks to chloride versus sulfate salinity. Annual Conference of American Society for Horticultural Science (ASHS), Orlando, FL, HortScience 43:1097-1098.

Niu, G. & Rodriguez, D.S. 2008. Relative drought tolerance of four rose rootstocks. Annual Conference of American Society for Horticultural Science (ASHS), Orlando, FL, HortScience 43:1098.

Niu, G. & Rodriguez, D.S. 2008. Salt tolerance of three rose rootstocks. The southern region annual meeting of the American Society for Horticultural Science (ASHS), Dallas, Texas, HortScience 43:611.

Project I. The effect of etiolation on rooting of *Acer grandidentatum* cuttings

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Introduction

We have investigated vegetative propagation of bigtooth, or canyon, maple (*Acer grandidentatum* Nutt.) for use in the landscape industry. The objective of this study was to evaluate the effect of etiolation on rooting *A. grandidentatum* softwood cuttings.

Materials and Methods

In January of 2009, five native selections of bigtooth maple (USU-ACGR-1001, 1002, 1003, 1004, and 1005) grafted onto seedling rootstocks of the same species and grown in a coppiced nursery environment were prepared for etiolation by pruning just below the third node from the base and leaving a 7-13 cm stub above the second node. At bud swell, in late April, black velour, drawstring bags (18 x 8 cm), with open ends, were placed over the terminal of the pruned shoots with the drawstrings tied off just below the second node. The stub left at pruning supported the bag, allowing the emerging shoots to grow out of the bag, resulting in shoots with etiolated bases and normal terminals. Controls were allowed to grow without bags. When approximately two sets of fully expanded leaves had emerged from the bag, the cuttings were harvested by cutting the parent shoot just above the first node. Cuttings were prepared for sticking by removing the bags, cutting at the base of the current season's growth, removing the terminal above the second node, wounding by scraping off one cm of bark down to the xylem on both sides, and then dipping in 4000 ppm IBA as Dip 'N Grow (1% IBA, 0.5% NAA diluted as 20mL Dip 'N Grow and 30mL 50% ethanol) for five seconds. Cuttings were stuck in 3.5"x 5" containers with premoistened media (3:1 perlite:peat mixture). Cuttings were then placed under shade cloth (at light levels of approximately 470 micromoles/m2/sec PPF) and mist with bottom heat at 25-26 C. Reverse osmosis water was used for misting at 7 seconds every 12 minutes during daylight hours. Day/night temperatures were set at 21/15.5C. Cuttings were drenched to drain with 0.6 mL 22.5% mefenoxam as Mefenoxam 2 AQ/3.8L water and sprayed to runoff with 1.0 mL 41.25% thiophanate-methyl as Cleary 3336/L water to control root rot and *Botrytis*, respectively. Cleary 3336 applications continued on a weekly basis.

Results

Overall, 88% of etiolated cuttings rooted, whereas only 48% of the non-etiolated cuttings rooted. Trees 1001, 1002, 1004, and 1005 all had rooting percentages of over 85% with etiolation. The greatest difference in etiolated and non-etiolated rooting was found with tree 1001 where etiolation increased rooting by 68 percent. The least difference was with tree 1005 where etiolation increased rooting by 31 percent. Data collected on the number of roots per cutting indicated that, overall, etiolated cuttings had an average of 11.3 roots per cutting, while non-etiolated averaged 2.1 roots per cutting. Cuttings from all trees had significantly more roots per cutting when etiolated.

Discussion
The results of this study indicate that etiolation of bigtooth shoots from coppiced clones grown on seedling rootstocks significantly improves rooting of softwood cuttings. The use of bags to provide etiolation has proven to be an effective means of etiolation.

Project 2. Selection and propagation of Utah native plants for the landscape industry

Two projects have been funded through the Specialty Crops Block Grant program through the Utah Department of Agriculture and Food: *Locating and Documenting Clones of Native Utah Plants with Superior Potential for Adoption in the Landscape Industry* (2008) and *Propagating Superior Clones of Native Utah Plants for Use in the Landscape Industry* (2009). To date, individuals with expertise in native plants have been contacted in regards to the identification of specific clones of native with potential use in the industry. Candidate plants identified thus far include a tightly columnar *Juniperus scopulorum*, various *Acer grandidentatum* selections with exceptional fall color, a columnar *Cercocarpus intricatus*, a weeping *Pinus edulis*, a weeping *J. scopulorum*, a deer-resistant *J. osteosperma* hybrid from a common garden, selections of *Arctostaphylos patula*, hardy selections of *Rhus glabra* var. *cismontana*, a very white, vertically oriented *Ericameria nauseosa* ssp. *nauseosa* var. *speciosa*, and cascading and hedge-type selections of *Amelanchier utahensis*.

Initial attempts at vegetative propagation by cuttings have resulted in success with *Ericameria*, *Cercocarpus*, and *Arctostaphylos* selections. Cutting propagation of *Juniperus* selections has had only limited success.

Publications:
Reed, M. and L.A. Rupp. 2009. The effect of etiolation on rooting of *Acer grandidentatum* cuttings. International Plant Propagators Society Western Region Annual Meeting. (*Abstract*).

Rupp, L.A., M. Reed, W.Varga, V.P. Rasmussen, and C. Neale. 2009. Collecting *Acer Grandidentatum* clones in northern Utah: An overview. The International Plant Propagators' Society Combined Proceedings. 58:379-380.

Understanding *Penstemon* diversity in an effort to initiate a breeding program within the genus for urban landscapes of the Intermountain West

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Our research has focused on identifying native plants for utilization in the urban landscapes of the arid Intermountain West. Our objective is to identify/develop native plants that commercially compete with traditional urban landscape flowering plants but require less water and fertilizer than traditional commercialized nursery and bedding plants. Although there are excellent native candidate genera to choose from, the genus *Penstemon* has tremendous horticultural potential and is a logical choice for initial work. There are over 270 *Penstemon* species ranging from Alaska to Guatemala with the vast majority in the Western US (Wolfe et al., 2006). Depending on the cited reference, there are approximately 70 species native to Utah, 21of which are found solely within the state with another 25 that are only found in Utah and one adjacent state. About one third of these 70 species are considered rare. By comparison, 80 species are found in all of Washington, Oregon, Idaho, and Montana (Strickler, 1997). New Mexico has 45 *Penstemon* species (Heflin, 1997) with the remaining western non-Utah states having similar species counts.

Besides gaining an understanding of the diversity of regional *Penstemon* we have also taken two addition steps to initiate our efforts in breeding *Penstemon*. First, we have collected seed from over 150 species of *Penstemon*. This germplasm has been procured through purchasing, collecting, and trading seed and plants. Second, we have initiated studies on understanding basic genetic information about this genus. Several authors have provided fundamental information on the genetics of *Penstemon* (Freeman, 1983; Gross and Rieseberg, 2005; Keck, 1945; Wolfe et al., 2002; Wolfe and Elisens, 1993; Wolfe and Elisens, 1994; Wolfe and Elisens, 1995; Wolfe et al., 2006; Wolfe et al., 1998). However, surveying the nucleic content of the *Penstemon* genome has not been reported and that has been the focus of our recent studies.

To better understand the *Penstemon* genome size we have tested106 specimens (cultivars, unknown species and 91 identified species) and found that the nucleic acid content doubles in size from the smallest to largest 2n species and three times the in the 8 polyploids studied (Fig. 1). This wide range of nucleic acid content (almost doubling the nucleic acid from the smallest to the largest) within *Penstemon* correlates with the phenotypic and genotypic diversity previously reported (Wolfe et al., 2006). Knowing the nucleic acid content may be useful in choosing genetically divergent but potentially compatible parental candidates for future breeding programs. It may also provide clues into evolutionary events leading to speciation.

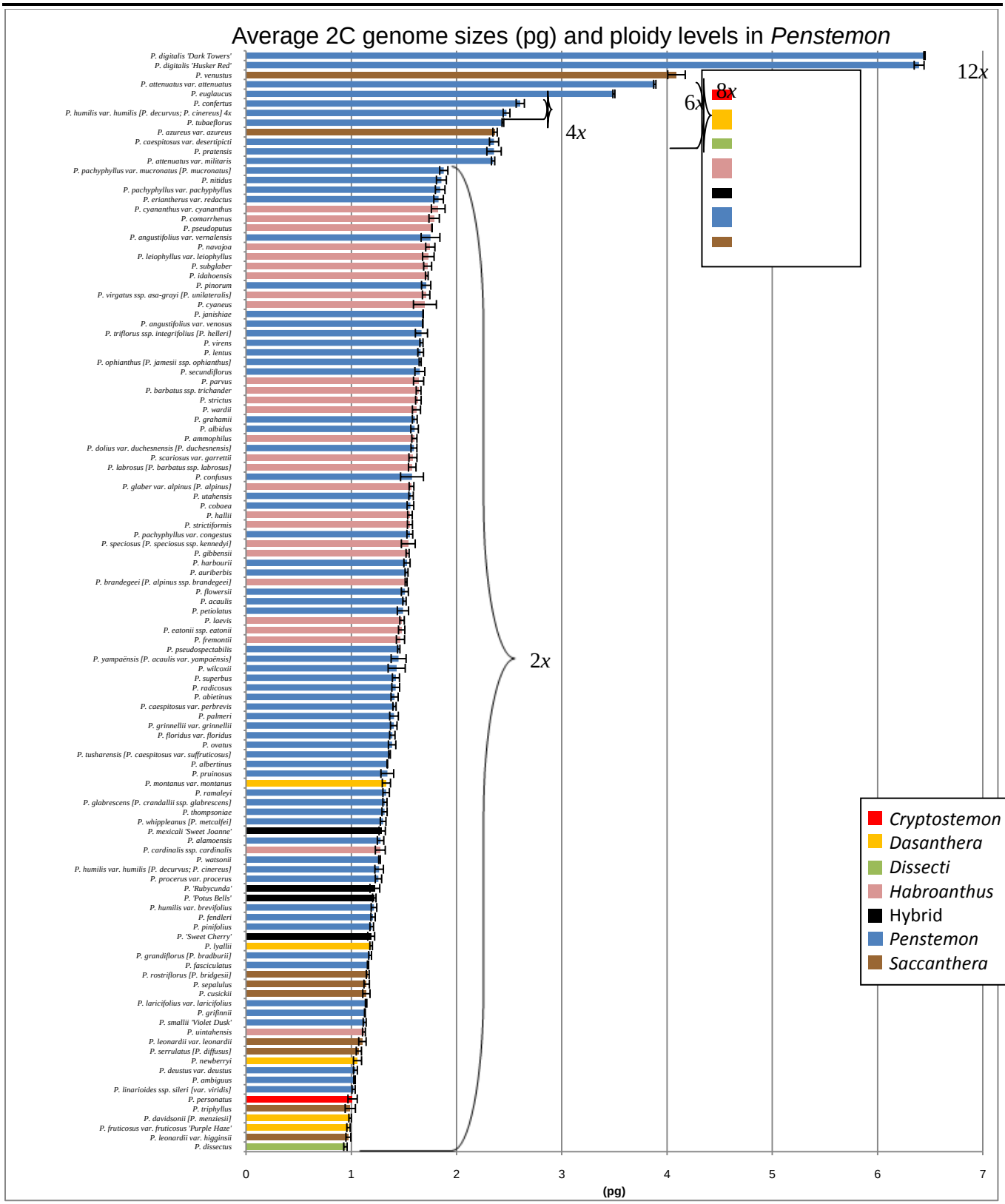

Fig. 1. Using flow cytometry we have shown that in the 106 specimens (cultivars, unknown species and 91 identified species) tested an almost two-fold difference in the genome size (between 1C of 450 - 894 Mb [megabases]) exists among 2*n* species. Eight polyploidy species (ranging in genome size from 2.197 to 6.403 pg) are represented by the top eight bars in this graph.

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