CENTER FOR FORESTRY NURSERY AND SEEDLING RESEARCH 2001-2005

Edited by David L Wenny

Forest Nursery Research Update No 15

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RECENT AWARDS, RECOGNITION, AND CONGRATULATIONS

Pitkin Scholarship

Jeremy Pinto received the Franklin H. Pitkin Scholarship from the 2003 fall semester through the 2005 spring semester. Jeremy just completed his Master of Science with Dr. Wenny, and is starting to work on his PhD in Nursery Management.

University of Idaho Excellence in Outreach Award

The University's Excellence in Outreach Award was given to Dave Wenny for his transfer of important, practical information to nursery managers and the citizens of Idaho. Dave retired from the University of Idaho in June 2005 after 26 years serving as Director.

RECENT NURSERY PUBLICATIONS

Relationship of seed microsite to germination and survival of lodgepole pine on high-elevation clearcuts in northeastern Utah

Deborah S. Page-Dumroese, R. Kasten Dumroese, Connie M. Carpenter, David L. Wenny

USDA Forest Service, Rocky Mountain Research Station Research. Note RMRS-RN-14. 4 p. 2002.

On two high-elevation sites (~3,000 m) in northeastern Utah, lodgepole pine (*Pinus contorta* var. *latifolia*) seeds germinated best (53 percent) on large mineral microsites (5 x 5 m), and percentage survival of germinating seeds was best on microsites covered with forest floor material. Seed predation was severe at both study sites; protecting seeds increased germination three to ten times. On harvested sites dependent on natural regeneration for seedling establishment, some predation control may be necessary to achieve rapid and complete stocking. After harvesting, maintenance of a combination of mineral soil and forest floor is critical for long-term seedling success.

Native Plants Journal

R. Kasten Dumroese, editor-in-chief

University of Idaho Press.

Volume 2, Number 1. 2001.

This journal, initiated through an agreement between the Forest Research Nursery and the USDA Forest Service, State & Private Forestry, is a forum for dispersing practical information about growing and planting native plants. Volume 1 contains 126 pages and 27 articles, and Volume 2, Number 1, another 68 pages and 14 articles. Both refereed research and general technical papers are presented.

Plant your seedlings right

R. Kasten Dumroese, David L. Wenny, Yvonee C. Barkley

University of Idaho, Idaho Forest, Wildlife and Range Experiment Station. Contribution Number 929. 2001.

The third revision of University of Idaho CIS 528, this extension publication is designed to provide small private landowners with proper techniques for storing, handling, and planting container seedlings in reforestation settings, as well as some tips for after planting weed control, watering, shading, fertilization, and animal protection. A section on developing plantations of specialty hardwood crops is also included.

Hot water and copper coatings in reused containers decrease inoculum of *Fusarium* and *Cylindrocarpon* and increase Douglas fir seedling growth

R. Kasten Dumroese, Robert L. James, David L. Wenny

HortScience 37(6):943–947. 2002.

Inoculum of Douglas fir root diseases caused by the fungi *Fusarium* and *Cylindrocarpon* is carried from crop to crop in reused containers. Soaking containers for 90 seconds in 80 °C water removed 99% of *Fusarium* and 100% of *Cylindrocarpon* inoculum between growing cycles. Overall seedling growth was also improved; seedlings grown in containers soaked between growing cycles were 10% taller and had 20% more biomass than seedlings grown in nonsoaked containers. We obtained a 13% increase in the number of deliverable seedlings from containers soaked in hot water between crops, from the use of copper coated containers, or from both practices combined.

Tips for improving seed planting efficiency

R. Kasten Dumroese, David L. Wenny, Susan J. Morrison

Native Plants Journal 3(2):140–141. 2002.

The efficiency of a precision seeder was improved by adding a mirror so employees could monitor seed levels and by marking seeds with brightly colored talc to quickly verify the accuracy of the machine.

The chilling optimum of Idaho and Arizona ponderosa pine buds

David L. Wenny, Daniel J. Swanson, R. Kasten Dumroese

Western Journal of Applied Forestry 17(3):117–121. 2002.

Ponderosa pine (*Pinus ponderosa*) seedlings from Idaho (var. *ponderosa*) and Arizona (var. *scopulorum*) grown in a container nursery received optimum chilling [2,010 hr (84 days) of temperatures below 5°C]. While seedlings were in the greenhouse, days required for 50% of the population to break bud were similar for both seed sources, and decreased inverse exponentially from 74 to 23 days as chilling hours accumulated to the optimum. When subsequently placed into either refrigerated or frozen storage, Idaho seedlings broke bud significantly faster than Arizona seedlings when returned to favorable environmental conditions for growth. All seedlings removed from refrigerated storage broke bud faster, were less cold tolerant, and therefore less quiescent, than seedlings that had been frozen.

Installing practical research projects and interpreting results

R. Kasten Dumroese, David L. Wenny

In: Dumroese R.K., Riley L.E., Landis T.D., technical coordinators. National proceedings, forest and conservation nursery associations—1999, 2000, and 2001. Ogden (UT): USDA Forest Service, Rocky Mountain Research Station. Proceedings. RMRS-P-24:5–11. 2002.

and also reprinted in:

Tree Planters' Notes 50(1):18-22. 2003.

The basic concepts of science and research and the scientific process are reviewed. Using an example from a bareroot nursery, we show how a practical research project can be done at any type of nursery, meshing sound statistical principles with limitations of busy nursery managers.

Propagation protocol for container willows and poplars using mini-cuttings

R. Kasten Dumroese, David L. Wenny, Susan J. Morrison

Native Plants Journal 4(2):137–139. 2003.

Techniques for vegetative propagation of willows and poplars using short (7.5-cm [3-in]) cuttings is presented. Tips for installing and maintaining stooling beds are given, as well as all other cultural techniques for producing, harvesting, storing, and shipping rooted cuttings for restoration plantings, are provided.

Grow your own: collecting seeds

R. Kasten Dumroese, Thomas D. Landis, David L. Wenny

Stockton (CA): California Department of Forestry and University of California Cooperative Extension. California Forest Stewardship Program. Forestland Steward. Summer 2004:6–7.

Simple methods for collecting and evaluating small batches of conifer seeds were described.

Growth and nutrition of container-grown ponderosa pine seedlings with controlled release fertilizer incorporated in the root plug

Zhaofei Fan, James A. Moore, David L. Wenny

Annals of Forest Science 61:117–124. 2004.

Prior to sowing seeds, three controlled-release fertilizers (fast release (FR), moderate release (MR) and slow release (SR)) were incorporated into the growing media at rates of 0.8, 1.6 or 3.2 g as supplements to nursery supplied soluble fertilizer to grow containerized ponderosa pine (*Pinus ponderosa* Doug. ex Laws) seedlings in the greenhouse. At lifting, the stem diameter, height and total mass of fertilized seedlings ranged from 14 to 29%, 15 to 22%, and 39 to 100% larger than those of the unfertilized seedlings, respectively. FR provided more balanced nutrients than did MR or SR. The root growth potentials of ponderosa pine treated with 3.2 g of MR or SR were much lower than those of other treatments; indicating that a 3.2 g rate of MR or SR was too high for the seedlings. The estimated best dosages for maximum caliper and height growth were 0.8, 2.2 and 2.0 g for FR, MR and SR fertilizers, respectively.

Determining seed germination requirements for 12 Palouse Prairie wildflowers

Christine Nauman, David L. Wenny, R. Kasten Dumroese, Jim Kingery

University of Idaho Master of Science Thesis: 2002

From two remnants of Palouse Prairie, seeds of 12 forb species were collected during the years of 1999 and 2000. Seeds were cleaned and put into a growth chamber for five different cold stratification (3°C) lengths (120, 90, 60, 30, 0 d) followed by a 30 d warm period under light or dark conditions to break dormancy. The results showed that stratification increased germination for all species and germination mainly occurred during the cold stratification period; light or dark requirements varied between species. *Geum triflorum, Heuchera cylindrica* and *Helianthella uniflora* seeds germinated best in the light with 120 days of cold stratification. *Phlox speciosa, Erythronium grandiflorum, Calochortus elegans*, and *Delphinium nuttallianum* seeds required dark conditions and at least 120 days of cold stratification to break dormancy. *Fritillaria pudica* and *Camassia quamash* seeds need at least 90 days of cold stratification in the dark or 120 days of cold stratification in the light. Dark conditions and 90 to 120 days of cold stratification promoted germination of *Sisyrinchium inflatum* and *Brodiaea douglasii* seeds. Although it was difficult to obtain viable seeds of *Clematis hirsutissima*, best germination occurred in the light with 120 days of cold stratification.

Container and physiological status comparisons of ponderosa pine seedlings

Jeremy R. Pinto, David L. Wenny, R. Kasten Dumroese, John D. Marshall, Robert L. Mahler

University of Idaho Master of Science Thesis: 2005

In an effort to minimize the physiological differences between seedlings in container comparison studies, ponderosa pine (*Pinus ponderosa* Laws. var. *ponderosa*) seedlings were grown in six different containers varying in density, volume, and depth in two locations with unique growing regimes to compare morphological and physiological characteristics. Morphological traits for both locations followed the pattern of increasing height, root collar diameter, and seedling dry weight for decreasing density and increasing container volume. Analysis done on all six containers by location found intrinsic water-use efficiency measurements and cold hardiness levels (CH) significantly different at both locations, despite rigorously controlled nitrogen (N) fertilizer and irrigation at one location versus a production facility cultural regime at the other. Foliar nitrogen concentrations were significantly different in the production facility, but not different in the controlled facility. Further analysis of seedlings grouped by container density showed that N, and CH were generally not significantly different. Although physiological and morphological differences were minor in this study, the importance of minimizing physiological differences should still be given adequate consideration for a thorough assessment of morphological advantages in future container comparison studies.

Improve growth after incorporating controlled release fertilizer into containerized ponderosa pine and western white pine seedlings in the greenhouse environment and the field

Donald J. Regan, David L. Wenny, James A. Moore, Robert L. Mahler

University of Idaho Master of Science Thesis: 2002

Incorporating controlled release fertilizer (CRF) into the growth medium of containerized ponderosa pine (*Pinus ponderosa* Laws.) and western white pine (*Pinus monticola* Dougl.) seedlings improved height growth during operational production in the greenhouse and after outplanting. CRF was incorporated either by machine or hand into the growing medium at rates of 8.9 and 17.8 mg/ml. The commercial-mixed method (machine) incorporated significantly greater amounts of CRF prills than the hand-mixed method in the smaller container size (90 ml volume) while results were similar between methods in the larger container size (340 ml volume).

At the end of the growing season in the greenhouse, almost all the N in the CRF prills had released; resulting in significantly more N in the needles of CRF western white pine seedlings. Foliar N levels in ponderosa pine seedlings (90 ml containers) may have been masked by greenhouse fertilization regimes. Greenhouse grown CRF ponderosa pine seedlings in the smaller container size, had 12% greater heights and 14% larger root collar diameters (RCDs) than controls. Transplanting procedures may have influenced heights and RCDs in the larger container size western white pine seedlings. In the field, seedling survival, RCDs and foliar nitrogen concentrations of CRF-treated seedlings were similar to controls but relative height growth was 32% greater.

Effects of nursery environment on needle morphology of *Pinus monticola* Dougl. and implications for tree improvement programs

K-S. Woo, Lauren Fins, Geral I. McDonald, David L. Wenny, Aram Eramian

New Forests 24:113-129. 2002.

Statistically significant differences were found in 14 needle traits of western white pine (*Pinus monticola* Dougl.) seedlings grown from the same seed orchard source in the three nurseries in northern Idaho. Traits with significant variation included needle length and width, number of stomatal rows, number of stomata per row, total stomata per needle, adaxial surface area, stomatal density, major axes of stomata, stomatal shape, stomatal area, stomatal occlusion, epistomatal wax degradation, weight of wax per dry weight of needle, and the contact angles of water droplets placed on adaxial needle surfaces. Wax crystallites on needle surfaces were hollow and tubular and the amount of surface wax appeared to be associated with surface wettability. These results may have important implications for tree improvement programs that require successful inoculation of nursery-grown seedlings with spores of *Cronartium ribicola* J.C. Fisch. ex Rabenh., to reliably screen white pines for resistance to blister rust.

FUNDED NURSERY RESEARCH PROJECTS

Seed production rates and the importance of microsite on germination and survival of high-elevation lodgepole pine (*Pinus contorta* var. *latifolia*) in northeastern Utah

Investigators: Carpenter, MC; Wenny, DL.

Funding Support from the US Forest Service

Abstract - Lodgepole pine (*Pinus contorta*) generally is a species that readily populates forested areas subjected to disturbance (i.e. fire, clearcutting). However, several clearcut areas in the Ashley National Forest of northeastern Utah have failed to naturally regenerate although they are surrounded by an available seed source. This study, in conjunction with the U.S. Forest Service's Rocky Mountain Research Station, examines two possibilities for this failure to regenerate. The first looks at the quality and quantity of available seed by conducting germination tests and determining the number of viable seeds produced by each tree sampled. The second aspect of this study examines the effect of microsite on seed germination and survival. Seeds were placed onsite and provided protection from mammal and bird predation, had their microclimates modified

by means of plastic cones, or were provided no protection or microclimate modification. Germination and survival rates were determined approximately one year after placement on the site in an effort to find a relationship between microsite characteristics and seed and seedling mortality.

Endophytes and the survival and growth of outplanted nursery trees

Investigators: Newcombe, G; Wenny, DL; Morrison, T

Project Term: 2005 - 2007

Funding Support from University of Idaho Seed Grants

Abstract - Nursery and greenhouse crops are the fastest growing segment of U.S. agriculture. Tree seedlings for landscaping and reforestation are shipped all over the country, but their symbionts are largely left behind. Some of these symbionts are endophytic fungi known to enhance nutrition and defence of their tree hosts. In their natural environment, tree seedlings become infected with endophytes that had infected previous generations of related trees. In greenhouses and nurseries, infection does not occur and outplanted trees may be more susceptible to various biotic and abiotic factors. We are proposing to inoculate UI Center for Forest Nursery and Seedling Research seedlings (ponderosa and western white pines, and Douglas-fir) with the full complement of endophytes from their source populations. Upon outplanting in the UI Experimental Forest, the growth, disease, insect resistance and survival of these seedlings will be monitored. Resistance and survival should be enhanced by endophytes. Although we are starting to publish our endophyte research in leading scientific journals, field trials are essential to demonstrate the need to modify industry practices. A proof of concept is needed, and collaboration among the UI Forest Pathology Lab, The Center for Forest Nursery and Seedling Research and the UI Experimental Forest will provide it.

Comparing growth and survival of western white pine and ponderosa pine containerized seedlings grown in copper and non-copper coated cavities then planted in the field

Investigators: Regan, D; Wenny, DL; Miller, D

Project Term: March 2004 – October 2007

Funding Support from Potlatch Corporation

Abstract - To ensure containerized greenhouse seedlings have well developed lateral root systems that provide maximum growth and survival potential, the interior walls of seedling containers will be coated with cupric carbonate. We plan to examine effects of copper coated container cavities on the growth and survival of western white pine (*Pinus monticola* Dougl.) and ponderosa pine (*Pinus ponderosa* Laws.) seedlings grown for one season in the greenhouse then planted the following year in the field. In addition, the growth and survival of seedlings grown at two locations (University of Idaho Center for Forest Nursery and Seedling Research, and Potlatch Corporation Nursery) will be observed in the field.

Growth and ectomycorrhizal formation of container-grown ponderosa pine seedlings inoculated with *Rhizopogon vulgaris* at different nitrogen and phosphorous fertilization levels

Investigators: Rost, B; Wenny, DL.

Funding Support from Boise Cascade, Washington Region

Abstract - This research will evaluate the effects of nitrogen and phosphorus fertilizer levels on mycorrhizal formation and seedling growth of container-grown ponderosa pine seedlings. Using a Boise Cascade seedlot, and basidiospores of *Rhizopogon vulgaris* from Forest Mycorrhizae Applications of Grants Pass, Oregon, I will develop a model for fertilizer levels that will yield consistent ectomycorrhizal root systems. This is a factorial design with 24 treatments, 4 nitrogen and 3 phosphorous levels and 2 levels of inoculation (inoculated and non-inoculated). In conjunction, we will grow 17,760 seedlings for a production scale field test of *Rhizopogon vulgaris*. These seedlings will be planted operationally on Boise Cascade sites that are old homestead locations.

RESEARCH NOTES PRESENTED TO THE INTERMOUNTAIN CONTAINER SEEDLING GROWERS' ASSOCIATION

Comparing the third year growth of outplanted western white pine seedlings – Pablo Meeting, 2003

Investigators: Regan, D; Wenny, DL

Project Term: March 2000 to October 2003

Seeds of western white pine (*Pinus monticola* Dougl.) were sown in the greenhouse, into study containers in March 1999. We compared the growth of third year outplanted seedlings grown in containerized copper cavitites to seedlings grown in containerized non-copper cavities. The results show that seedlings grown in containerized cavities coated with copper had significantly greater caliper (P = .0201) and stem volume (P= .0381) than seedlings grown in containerized non-copper coated cavities.

Improving the rooting success of willow and poplar cuttings – Lewiston Meeting, 2004

Investigators: Regan, D; Wenny, DL

Project Term: November 2003 – July 2004

Hybrid poplar (*Populus spp.*) and mackenzie willow (*Salix prolixa*) cuttings were stuck into media with either the top bud exposed to sunlight or all buds buried. We compared the two treatments to determine which treatment had the greater number of successfully rooted cuttings, and met specifications for sale to customers at the end of the growing season. The experiment showed that for both species, sticking the cuttings with the first bud exposed to sunlight resulted in significantly greater survival.

Improving seed germination of black hawthorn – Lewiston Meeting, 2004

Investigators: Regan, D; Wenny, DL

Project Term: December 2003 – July 2004

Black hawthorn (*Crataegus douglassii*) is a native shrub that is highly beneficial to wildlife for food and cover, and is very difficult to propagate from seed. We are conducting experiments to determine treatments that will increase germination. Applied treatments consist of acid scarification and/or warm and cold stratification periods. These treatments are replicated on multiple seed lots to compare their response. The results from the experiment in 2004, showed germination significantly greater when black hawthorn seed had a one month warm stratification in moist media, followed by a five month cold stratification.

Using probability tables to compare greenhouse seed germination with seed germination tests – Moscow Meeting, 2005

Investigators: Regan, D; Wenny, DL

Project Term: Jan 2005 – April 2005

Seed germination tests conducted under optimum laboratory temperatures can differ when compared with seed germinated under greenhouse conditions. We are conducting seed germination tests under greenhouse conditions to ensure that accurate amounts of seed can be prepared for sowing. Probability tables were examined to compare seed germinated in plastic trays at greenhouse temperatures to seed sown and germinated in the greenhouses. The results showed no significant difference in seed germination between the two treatments.

Improving seed germination of black hawthorn – Moscow Meeting, 2005

Investigators: Regan, D; Wenny, DL

Project Term: December 2004 – July 2005

We are conducting further experiments on black hawthorn (*Crataegus douglassii*) seed to determine treatments that will increase germination. Applied treatments consist of acid scarification and/or warm and cold stratification periods. These treatments are replicated on multiple seed lots to compare their response. The results showed germination significantly greater when black hawthorn seed had five month cold stratification versus a four month cold stratification.