From Forest Nursery Notes, Winter 2012

53. © Overcoming dormancy and enhancing germination of *Sphaeralcea munroana* seeds. Kildisheva, O. A., Dumroese, R. K., and Davis, A. S. HortScience 46(12):1672-1676. 2011.

HortScience 46(12):1672–1676. 2011.

Overcoming Dormancy and Enhancing Germination of *Sphaeralcea munroana* Seeds

Olga A. Kildisheva
Center for Forest Nursery and Seedling Research, College of Natural Resources, University of Idaho, P.O. Box 441133, Moscow, ID 83843

R. Kasten Dumroese
USDA Forest Service Rocky Mountain Research Station, 1221 South Main Street, Moscow, ID 83843

Anthony S. Davis[1]
Center for Forest Nursery and Seedling Research, College of Natural Resources, University of Idaho, P.O. Box 441133, Moscow, ID 83843

Additional index words. Munro's globemallow, Malvaceae, germination, imbibition, water gap, gibberellic acid

***Abstract*. The results of a series of experiments involving a variety of dormancy-breaking treatments indicate that Munro's globemallow [*Sphaeralcea munroana* (Douglas) Spach] seeds are physically dormant, possess a cap-like structure in the occlusion of the water gap, which inhibits imbibition, and can be artificially dislodged through boiling water scarification. The highest germination capacity (93%) was achieved by mechanical scarification of previously stored seeds. Exogenous application of a gibberellin solution and cold stratification failed to enhance germination compared with scarification alone, indicating an absence of additional dormancy types. These results should improve the usefulness of this drought-tolerant perennial for landscaping and restoration given its effectiveness in soil stabilization, tolerance to a variety of soil types, extreme temperatures, and ecological importance.**

Munro's globemallow [*Sphaeralcea munroana* (Douglas) Spach] (Malvaceae), a herbaceous perennial endemic to the Great Basin of western North America, is an important candidate for use in horticulture and restoration. This species is able to tolerate drought, extreme temperatures, and establish on a variety of soil types. It serves as an important host for native pollinators, provides soil stabilization, and is a source of food for myriad mammals (Beale and Smith, 1970; Pendery and Rumbaugh, 1986; Rumbaugh et al., 1993). Currently, the lack of successful in and ex situ germination resulting from seed dormancy limits its use in restoration. Few sources explore the dormancy mechanisms and methods that induce germination in *Sphaeralcea* spp. (Page et al., 1966; Roth et al., 1987).

Vleeshouwers et al. (1995) describe seed dormancy as a state "the degree of which defines what conditions should be met to make the seed germinate." These conditions are characterized based on the mechanisms that prevent germination. Physically dormant seeds have a palisade layer of lignified cells that prevents water imbibition (Corner, 1951; Vazquez-Yanes and Perez-Garcia, 1976). Although a number of species in the *Sphaeralcea* genus have been observed to benefit from scarification, the cause of dormancy has not been examined directly (Page et al., 1966; Roth et al., 1987; Sabo et al., 1979; Smith and Kratsch, 2009). In these species, imbibition (critical for germination) is regulated by a water gap structure located within the seedcoat. The water gap can become permeable after exposure to temperature flux, drying, or scarification, thus allowing imbibition into an otherwise impermeable seed (Baskin, 2003; Baskin and Baskin, 1998; Baskin et al., 2000).

Ex situ, chemical and mechanical scarification has been used to improve germination of physically dormant seeds (Baskin and Baskin, 1998; Hoffman et al., 1989; Page et al., 1966; Roth et al., 1987). For example, Page et al. (1966) reported an up to 40% increase in germination of *S. grossulariifolia* after submergence in sulfuric acid, a substantial improvement compared with the control (0%). Similarly, submergence of *Sphaeralcea* seeds in 18 M sulfuric acid for 10 min improved germination of *S. coccinea* and two accessions of *S. grossulariifolia* (77%, 69%, and 62%) relative to the controls (5%, 14%, and 32%), but failed to do so for *S. munroana* (8%) compared with the control (2%) (Roth et al., 1987). Organic solvents have also been used to promote germination of physically dormant seeds. Page et al. (1966) reported 67% germination of treated *S. grossulariifolia* seeds after a 4-h submergence in diethyl dioxide vs. 0% germination of untreated seeds. Roth et al. (1987) found a 3-h submergence of *S. coccinea*, *S. munroana*, and two accessions of *S. grossulariifolia* in diethyl dioxide to significantly enhance germination (36%, 53%, 89%, and 68%) compared with the control (5%, 2%, 14%, and 32%). Despite the effectiveness of chemical scarification, chemicals can be hazardous, difficult to obtain, and present serious health risks (Mallinckrodt Baker, 2008a, 2008b).

Mechanical scarification has also been reported to boost germination rates of physically dormant seeds of Malvaceae species. The International Seed Testing Association recommends scarification (pierce, chip, or file off seedcoat) for *Althaea* hybrids (Malvaceae) (ISTA, 2011). In addition, Baskin and Baskin (1997) observed 100% germination after abrasion of *Iliamna corei* (Malvaceae) seeds.

Despite evidence for the presence of physical dormancy, reported germination of *S. munroana* has failed to exceed 53%, even when dormancy was presumably broken (Roth et al., 1987; Smith and Kratsch, 2009). Thus, it is unclear whether these seeds possess additional dormancy types. Physiological dormancy, characterized by the presence of chemical inhibitors that prevent embryonic growth, is commonly found in cold desert herbaceous perennials and can be relieved by stratification (Baskin and Baskin, 1998). In addition, gibberellic acid (GA_3) has been successful in alleviating the chemical constraints that prevent radical emergence and increasing embryonic growth in a number of physically dormant species (Bewley, 1997; Hilhorst, 1995; Koornneef et al., 2002; Leubner-Metzger, 2003).

Although less common, the coupling of physical and physiological dormancy (i.e., combined dormancy) requires both types to be broken before germination can occur (Baskin and Baskin, 1998; Emery, 1987). Dunn (2011) reports increased germination of *Sphaeralcea ambigua* and *S. coccinea* (45% and 85%) compared with the control (18% and 5%) after a 30-d stratification of scarified seeds. Similarly, Smith and Kratsch (2009) report that pairing mechanical scarification (nicking of the seedcoat) with a 6-week stratification at 4 °C resulted in higher germination of the bulked seeds of *S. grossulariifolia*, *S. parvifolia*, and *S. munroana* than either treatment alone, suggesting that seeds of *S. munroana* may exhibit combined dormancy.

Received for publication 5 June 2011. Accepted for publication 24 Oct. 2011.
Funding for this research was provided by the Idaho Transportation Department, the Great Basin Native Plant Selection and Increase Project, the University of Idaho Seed Grant Program, and the University of Idaho Center for Nursery and Seedling Research.
We thank Timothy R. Johnson for statistical support and Nalin Suranjith Gama-Arachchige for assistance in electron microscopy. We extend our thanks to Sabry Elias, Nancy Shaw, Matthew M. Aghai, Robert F. Keefe, Emily C. Overton, Matt Fisk, and Erin Denney who provided technical support.
This article is a portion of a thesis submitted by Olga A. Kildisheva in fulfilling a degree requirement.
[1]To whom reprint requests should be addressed; e-mail asdavis@uidaho.edu.