

Technical Note: Pericarp removal has little effect on sagebrush seeds

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Abstract

Sagebrush (*Artemisia*) is commonly recommended for reclamation and restoration of shrublands of the Western United States and seeds are usually obtained from commercial sources. One result of commercial seed processing is the removal of the pericarp. We tested 2 seedlots of Wyoming big sagebrush (*A. tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) to determine if pericarp removal affected properties of seed hydration or seed germinability under different levels of water stress. In general, pericarp removal had a relatively minor effect on these processes and properties.

Key Words: *Artemisia tridentata* ssp. *wyomingensis*, germination percentage, germination rate, humidification, water stress

Pericarp removal is a side effect of commercial seed processing of sagebrush (*Artemisia*) (Welch 1995, Booth et al. 1997). Reclamationists are concerned that over-processing of sagebrush seeds by industrial debearders may contribute to poor seedling establishment. While seed germinability under optimal germination conditions is not affected by standard commercial procedures (Booth et al. 1997), it is unknown how pericarp removal influences seed germination under water stress.

Seed hydration treatments have been used to improve germination rate of many agricultural and rangeland species (Bleak and Keller 1974, Heydecker and Coolbear 1977, Hardegree 1996). Bai et al. (1997) found that presowing humidification did not improve seed germinability of Wyoming big sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) but these tests were conducted under optimal moisture conditions. The objectives of this study were to examine the effects of pericarp removal on water uptake during humidification and on subsequent germination of Wyoming big sagebrush seeds under water stress.

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Resumen

"Sagebrush" (*Artemisa*) es comúnmente recomendada para la recuperación y restauración de áreas invadidas con arbustos en el oeste de los Estados Unidos y la semilla utilizada usualmente se obtiene de fuentes comerciales. Uno de los resultados del procesamiento comercial de semilla es la remoción del pericarpio. Probamos dos lotes de semillas de "Wyoming big sagebrush" (*A. tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) para determinar si la remoción del pericarpio afecta la propiedades de la hidratación y germinabilidad de la semilla bajo diferentes niveles de estrés de agua. En general, la remoción del pericarpio tuvo un efecto relativamente menor en estos procesos y propiedades de la semilla.

Materials and Methods

Two seedlots, harvested in late October 1993, were obtained from a commercial supplier. Seedlot 1 was collected in Lincoln County, Wyo. at 2,044 m elevation. Seedlot 2 was collected near Casper, Wyo. at 1,624 m elevation. Seedheads were stored in large woven polypropylene bags in an unheated warehouse for approximately 4.5 months before being processed with a 48-inch Simon-Day debearder for 10 minutes (Booth et al. 1997). Seeds were stored at room temperature in a laboratory after processing and were 21-months old at the time of the study.

Seeds (achenes) with pericarp were separated from those without pericarp by hand sorting. Sets of 20 seeds from each seedlot were placed in 0.25 ml tin capsules for determination of initial weight (Booth and Bai 1998). The capsules were held upright in an open rack inside of a sealed 32 x 19 x 18 cm plastic box. Water was added to the box to a depth of 10 cm, 1-cm below the level of the capsules, and the box placed in an incubator at 10°C. Seed capsules were retrieved from the plastic box after 0, 8, and 48 hours of humidification, sealed and weighed. The seed capsules were then opened, dried in an oven for 24 hours at 80°C and reweighed to determine seed moisture content. Each humidification treatment was repeated 9 times for each seedlot in a completely randomized design.

Humidified seeds were germinated under different levels of water stress using the matric-potential control system

described by Hardegree and Emmerich (1992). In this system, seeds are equilibrated on top of a cellulose membrane that is in contact with an osmotic solution of polyethylene glycol 8000 (PEG) inside a clear plastic snap-top vial. Matric potential on top of the membrane is controlled by adjusting the concentration of the PEG in the solution reservoir under the membrane. PEG was mixed with water to obtain solutions with a water potential of 0, -0.25, -0.5, -0.75, -1.0, -1.25 and -1.5 MPa (Hardegree and Emmerich 1990).

Nine sets of 20 seeds each were evaluated for each combination of treatment and water stress level. Seeds were first held at 5°C in darkness for 4 days and then incubated at 20°C with a 12 hour photoperiod under fluorescent and incandescent lights for an additional 14 days. No seeds germinated during the 4-day imbibition period at 5°C. Germination was checked daily and seeds were counted and removed when they exhibited radicle extension of ≥ 5 mm. A completely randomized design with 9 replications was used and replications were arranged in separate incubators.

Two germination indices were calculated: total germination percentage (G); and the actual days required to achieve 50% (D50) of G as an index of germination rate. Seed-moisture-content data were analyzed with ANOVA and LSD mean separation (Snedecor and Cochran 1980). Cubic regression equations were calculated relating G and D50 to water potential for each humidification treatment. Regression equations were recalculated by deleting first cubic then quadratic terms that were not significant ($P > 0.10$). Lower order terms that were not significant were left in the equation if a higher level term was significant. Total germination (G) and D50 were estimated from the regression equations and model confidence intervals (95%) were determined for each treatment combination (Evans et al. 1982). Treatment effect was considered significant if the confidence intervals of the equations did not overlap each other. Total germination percentages at -1.25 and -1.50 MPa were excluded from the regression equation because they were less than 1% on average. Days to 50% germination could not be calculated for treatments that did not exhibit some germination. The D50 values were not included in the regression equation if

Table 1. Seed moisture content of Wyoming big sagebrush after humidification. Values are means \pm SE from 9 replications.

Seedlot/type	Humidification duration (hour)		
	0	8	48
	-----(-%)-----		
Seedlot 1			
Non-pericarp	4.95 \pm 0.17	21.14 \pm 0.45	50.49 \pm 1.19
Pericarp	4.95 \pm 0.20	20.37 \pm 0.31	50.35 \pm 1.14
Seedlot 2			
Non-pericarp	5.04 \pm 0.13	19.98 \pm 0.44	47.77 \pm 0.47
Pericarp	4.85 \pm 0.08	18.82 \pm 0.27	45.98 \pm 0.48

half or more of the replicate samples exhibited no germination, for example, at -1.25 and -1.50 MPa.

Results and Discussion

Seed moisture of both seedlots increased with increased duration of humidification (Table 1). The moisture content of seeds with and without pericarp was not significantly different for seedlot 1 within any humidification duration. Seeds without pericarp absorbed more moisture on a percentage basis after both 8 and 48 hours but only by a few percent. It is likely that the mostly dead pericarp tissue inherently holds less water than living cells inside the hydrating seeds. In any case, these differences are relatively small and do not appear to be biologically significant.

Humidification did not affect total germination (G) or time to 50% germination (D50) of any seedlot or treatment. Data were, therefore, pooled among the 3 humidification treatments for each seedlot. Humidification is similar to other prehydration treatments that have had some success at stimulating germination response (Bleak and Keller 1974). Other studies, however, have

generally found better success by equilibrating seeds at lower water potentials and for greater treatment durations (Heydecker and Coolbear 1977, Hardegree 1996). Prehydration seed treatments have also been shown to stimulate germination response under sub-optimal temperature conditions but this was not tested here.

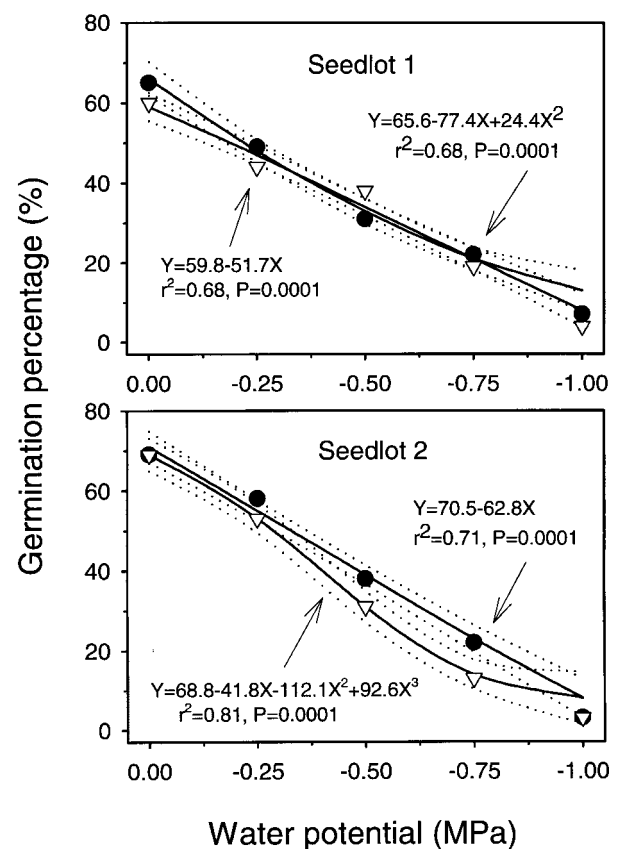


Fig. 1. Predicted germination percentage (solid line) with 95% confidence bands (dotted line) of Wyoming big sagebrush seeds with (filled circles) or without (open triangles) pericarp as a function of water potential. Symbols indicate actual values.

Literature Cited

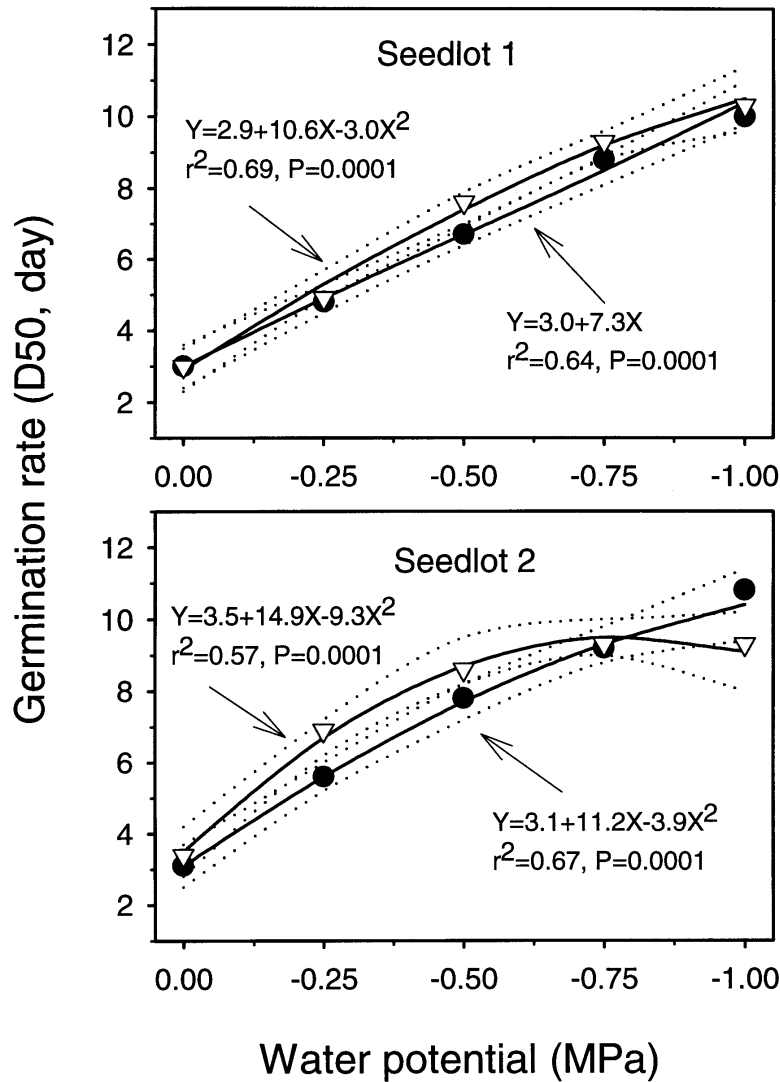


Fig. 2. Predicted germination rate (D50, solid line) with 95% confidence bands (dotted line) of Wyoming big sagebrush seeds with (filled circles) or without (open triangles) pericarp as a function of water potential. Symbols indicate actual values.

Seed germination and germination rate of Wyoming big sagebrush were limited by water stress, similar to basin big sagebrush (*A. tridentata* Nutt.) (Sabo et al. 1979) and fringed sagebrush (*A. frigida* Willd.) (Sabo et al. 1979, Bai et al. 1995). Pericarp removal did not affect germination percentage at any level of water stress for seedlot 1 (Fig. 1). Seeds without pericarp had higher germination percentages at -0.5 and -0.75 MPa for seedlot 2 but separation of confidence interval boundaries was not large. The biological significance of this is probably limited except to say that pericarp removal did not have a negative effect on total germination percentage (G). Welch (1995) tested the viability of sagebrush seeds with or without pericarp

using tetrazolium, and found no difference between the 2 groups after as much as 88 months of storage.

Germination rate was also similar between seeds with and without pericarp (Fig. 2). There were some water potentials where germination rate was significantly different but these differences were relatively small.

In summary, pericarp removal did not greatly affect either total germination percentage or germination rate of the 2 seedlots tested. These results confirm that debearder seed processing does not reduce seed quality of Wyoming big sagebrush and is, therefore, unlikely to affect relative success of seedling establishment.

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