Requirements for Seed Germination of Mexican Redbud, Evergreen Sumac, and Mealy Sage

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Abstract. Seed scarification and stratification (moist-prechilling) requirements of Mexican redbud [Cercis canadensis var. mexicana (Rose) M. Hopk.] and evergreen sumac (Rhus virens Gray) and the effects of temperature on final percent germination, maximum germination rate, and inflection time (time to maximum germination rate) for the above species plus seeds of mealy sage (Salvia farinacea Benth.) were investigated. Maximum predicted germination from a quadratic response surface was 95% after 62 minutes of concentrated sulfuric acid scarification plus 35 days of stratification for Mexican redbud, and 59% after 52 minutes of scarification plus 73 days of stratification for evergreen sumac. Mexican redbud germinated at 24 to 31C. Predicted optima for final percent germination, maximum germination rate, and inflection time were 100% at 28C, 30% germination per day at 31C, and 4 days at 29C, respectively. Evergreen sumac germinated at 21 to 31C. Final percent germination for this species declined with increasing temperature from a predicted maximum of 52% at 21C, whereas maximum germination rate increased with temperature to a predicted maximum of 69% germination per day at 31C. Inflection time was high at both extremes with a predicted minimum of 10 days at 25C. Mealy sage germinated at 21 to 34C. Predicted optima for final percent germination, maximum germination rate, and inflection time were 96% at 25C, 104% germination per day at 27C, and 3 days at 28C, respectively. Mexican redbud and evergreen sumac are two southwestern shrubs with ornamental potential (Nokes, 1986; Raulston, 1990). Leaves of Mexican redbud are smaller than those of the eastern redbud [Cercis canadensis (L.) M. Hopk.] and are coriaceous and shiny with a thick cuticle. Seeds of eastern redbud require concentrated sulfuric acid scarification for 15 to 60 min followed by stratification (moist-prechilling) for 30 to 60 days (Afanasiev, 1944; Frett and Dirr, 1979; Geneve, 1991; Hamilton and Carpenter, 1975; Roy, 1974) to induce germination in vitro. Unlike for eastern redbud, seed germination requirements of Mexican redbud have not been documented and could be influenced by the warmer and drier native habitat.

Sumacs also have an impermeable seed-coat requiring scarification in vitro. Brinkman (1974) reported acid scarification durations ranging from 1 to 6 h, depending
Table 1. Analyses of variance for the effect of scarification and stratification durations on seed germination of Mexican redbud and evergreen sumac, and the effect of temperature on aced germination of Mexican redbud, evergreen sumac, and mealy sage. Data set for the effect of scarification and stratification on seed germination of Mexican redbud was restricted to facilitate fitting a model (see text).

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*Models for scarification and stratification effects were quadratic polynomials with two independent variables. Models for temperature effects were polynomials with a single independent variable. The degree of polynomial is indicated by the number of degrees of freedom.

Scarcification and stratification durations by a quadratic polynomial fit a quadratic response surface, the data set (Table 1). The maximum predicted germination was 59% after 52 min of scarification and 35 days of stratification (Fig. 1). The lower 99% mean confidence limit was 85%, which is predicted to occur within the region of 50 to 70 min of scarification followed by at least 20 days of stratification. These results are similar to those of Frett and Dunn (1979) for eastern redbud. Although they reported maximum germination after 15 min of scarification and 60 days of stratification, they also reported increased response to longer stratification when followed by only 30 days of stratification. Predictions for the maximum response differ from recommendations of Roy (1974) only in a slightly longer scarification duration.

Germination response of evergreen sumac to scarification and stratification fit a quadratic response surface without restricting the data set (Table 1). The maximum predicted germination was 59% after 52 min of scarification and 73 days of stratification (Fig. 2). The lower 99% mean confidence limit was 50%, which is predicted to occur within the region of 20 to 90 min scarification fol-
would enhance the response. The durations would occur following scarification alone, as placed on one sheet of Whatman 1 filter paper. After adding 2.1 ml deionized water, the petri dishes were covered with a plexiglass shield. A 30 x 30-cm heat plate in contact with the petri dish surface at one end provided heat while compressed freon circulating through eight 6.4-cm-diameter lateral holes in the opposite end provided heat. A 18-h photoperiod was provided by two cool-white fluorescent tubes positioned 40 cm above the plate surface. Seeds of mealy sage were placed on the thermogradient plate in Sept., 1987, seeds of evergreen sumac in June, 1988, and seeds of Mexican redbud in July, 1988.

Germination, as previously defined, was measured by counting daily for 14 days. Data for each replication were fit to Redard’s function using the derivative-free algorithm of Ralston and Jennich (1978). Richard’s function is: Cumulative percent germination = \( a \left[1 + \exp(b + cT)\right]^{-v} \), where \( a, b, c, v \) are parameters and \( T \) is time. Maximum percent germination \( MGR \), a measure of the delay in germination (IT), was low with a predicted optimum of 100% at 28°C. MGR was low and increased with increasing temperature to a predicted maximum of 52% at 21°C, whereas MGR increased linearly with temperature to a predicted maximum of 69% germination per day at 31°C (Table 1, Fig. 3). Inflection time was high at both extremes with a predicted minimum of 10 days at the midrange, 25°C. These results predict that under low temperatures, germination would be delayed and slow but eventually yield more seedlings. Under high temperatures, germination would also be delayed but relatively rapid and yet yield few seedlings. The linear relationship between MGR and temperature exhibited by seeds of evergreen sumac and Mexican redbud has been documented for other species (Bewley and Black, 1982).

Mealy sage germinated over the widest temperature range, 21 to 34°C. Final percent germination and MGR were high, with predicted maximums of 96% at 25°C and 104% germination per day at 37°C (Fig. 3). Inflation time was high at both extremes with a predicted minimum of 3 days at 28°C. The temperature range of predicted optimum was only 2°C out of the 7°C range in which germination occurred. For predicted optima was 3°C out of the 7°C range in which germination occurred. For predicted optimum was 3°C out of the 7°C range in which germination occurred.

Evergreen sumac germinated at 21 to 31°C, similar to that reported for other sumacs (Brinkman, 1974). This species exhibited anomalous response to temperature for FPG and MGR. Final percent germination declined linearly with increasing temperature from a predicted maximum of 52% at 21°C, whereas MGR increased linearly with temperature to a predicted maximum of 69% germination per day at 31°C. (Table 1, Fig. 3). Inflection time was high at both extremes with a predicted minimum of 10 days at the midrange, 25°C. These results predict that under low temperatures, germination would be delayed and slow but eventually yield more seedlings. Under high temperatures, germination would also be delayed but relatively rapid and yet yield few seedlings. The linear relationship between MGR and temperature exhibited by seeds of evergreen sumac was documented for other species (Bewley and Black, 1982).

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a limited genetic and environmental pool, the results establish initial values for testing the scarification and stratification requirements of subsequent seed lots. These values are 50 to 70 min of scarification followed by at least 20 days of stratification for Mexican redbud, and 20 to 90 min of scarification followed by 30 to 110 days of stratification for evergreen sumac. Sample limitations may also have influenced observed responses to temperatures. Nevertheless, the narrow temperature range of predicted optima for both Mexican redbud (28 to 31°C) and mealy sage (25 to 28°C) suggests starting points for additional studies. The lack of a differential temperature effect on FPG, MGR, and IT for these two species is in agreement with other studies that also show similar responses of percent germination and germination rate to temperature (Cluff and Roundy, 1988; Fulbright and Flenniken, 1986). In contrast, the differential responses of evergreen sumac are analogous to seed germination responses to drought stress in creosotebush [Larrea tridentata (D. C.) Cov.] (Tipton, 1985) and guayule [Parthenium argentatum Gray] (Tipton, 1988), and illustrate the benefits in examining all three parameters to understand environmental influences on seed germination.

**Literature Cited**


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