Pregermination Treatments and Temperature Requirements for Germination of Mexican Redbud, Evergreen Sumac, and Mealy Sage Seeds

J. L. Tipton

ABSTRACT

Scarification and stratification requirements of Mexican redbud and evergreen sumac seeds and the effects of temperature on Mexican redbud, evergreen sumac, and mealy sage seed germination were investigated. The maximum predicted germination from a quadratic response surface was 94.9% after 62 minutes scarification and 35 days stratification for Mexican redbud and 59.3% after 52 minutes scarification and 73 days stratification for evergreen sumac. Mexican redbud seeds germinated from 23.8 to 30.5 C, evergreen sumac from 20.8 to 30.6 C, and mealy sage from 20.6 to 34.2 C. Maxium predicted final percent germination and the temperature at which it occurred for Mexican redbud, mealy sage, and evergreen sumac was 104.2 at 27.5 C, 89.8 at 29.2 C, and 42.4 at 22.1 C, respectively.

INTRODUCTION

Mexican redbud (Cercis canadensis var. mexicana) and evergreen sumac (Rhus virens) are two southwestern shrubs with ornamental potential (Duffield and Jones, 1981; Miller, 1978; Nokes, 1986). Mexican redbud leaves are smaller than those of the eastern redbud (Cercis canadensis var. canadensis) and are coriaceous and shiny with a thick cuticle. The plant is easily grown on calcareous soils, a major advantage over the eastern redbud. Eastern redbud seeds require concentrated sulfuric acid scarification for 15 minutes to 60 minutes followed by stratification for 30 days to 60 days (Hamilton and Carpenter, 1975; Frett and Dirr, 1979; Roy, 1974). Eastern redbud germination occurs over the range of 0.6 to 38 C with optimum response at 21 C (Roy, 1974). Mexican redbud germination requirements have not been documented, as have those of eastern redbud, and it is native to a warmer and drier habitat, which could influence its pretreatment and temperature requirements.

Sumacs also have an impermeable seedcoat requiring scarification. Brinkman (1974) reported acid scarification durations ranging from 1 hour to 6 hours depending upon the species, and states only R. aromatica and R. trilobata have a dormant embryo requiring stratification for 30 days to 90 days. Nokes (1986) recommends 30 minutes to 45 minutes of acid scarification for evergreen sumac, and states no stratification is required, but presents no data. Temperature requirements for sumac germination are unknown but most studies have been conducted at 20 C or alternating 20/30 C (Brinkman, 1974). The lack of detailed germination information limits Mexican redbud and evergreen sumac culture by the nursery industry.

Mealy sage (Salvia farinacea) is an established herbaceous perennial ornamental with at least one recognized cultivar (Staff of the Liberty Hyde Bailey Hortorium, 1976). Like most salvias, mealy sage requires no pregermination treatments to overcome dormancy, but optimum temperatures for germination are unknown (Nokes, 1986; Young and Young, 1986). The objectives of these studies were to 1) estimate the scarification and stratification requirements of Mexican redbud and evergreen sumac seeds, and 2) estimate the effects of temperature on germination of Mexican redbud, evergreen sumac, and mealy sage seeds.

MATERIALS AND METHODS

First experiment - The first experiment was designed to estimate the optimum scarification and stratification durations for Mexican redbud and evergreen sumac. Mexican redbud seeds harvested from a single cultivated plant were cleaned and divided into 5 equal- sized lots, which were scarified in concentrated sulfuric acid for 0, 30, 60, 90, and 120 minutes, respectively, rinsed in deionized water and subdivided into 5 equal-sized lots. These lots were sealed in a polyethylene bag with moist vermiculite and stratified at 5 C for 0, 15, 30, 45, and 60 days, respectively. Following stratification the seeds were subdivided into 8 lots of 5 seeds each, and each lot placed on a moistened No. 1 filter paper in a 50 x 9 mm seal-tight plastic petri dish. The petri dishes were placed in a germination chamber held at a constant 21 C with an 18 hour light, 6 hour dark cycle. Germination, defined as the presence of a radicle as long as the seed, was counted daily for 14 days. Evergreen sumac seeds harvested from a single cultivated plant were treated in a similar manner except stratification durations ranged from 0 days to 120 days at 30-day intervals.

Final percent germination (FPG) for each replication was transformed to $\sin^{-1} (FPG / 100)^{1/2}$ and related to scarification and stratification durations by a quadratic polynomial response surface in an analysis of variance to estimate optimums and confidence limits (Evans et al., 1982). Untransformed results are reported.

Second Experiment - The second experiment was designed to estimate the effect of temperature on germination of Mexican redbud, evergreen sumac, and mealy sage seeds. Mexican redbud and evergreen sumac seeds were scarified and stratified according to the predicted optimums from the first experiment. For each species 5 seeds each were placed on a moistened No. 1 filter paper in eighty-one 50 x 9 mm seal-tight plastic petri dishes. The petri dishes were arranged 9 per column in 9 columns 15 cm apart and perpendicular to the temperature gradient on a thermogradient plate. The aluminum thermogradient plate was 61 cm wide, 122 cm long and 2.5 cm thick, insulated on the bottom and sides, and covered with a Plexiglas shield. A 30 x 30 cm heat plate in contact with the bottom surface at one end provided heat while compressed freon circulating through eight 6.4 cm diameter lateral holes in the opposite end removed heat. Light on a 18 hour light, 6 hour dark cycle was provided by 2 fluorescent tubes 40 cm above the plate surface.

A thermocouple was placed on a moistened filter paper in a petri dish placed in the center of each column. Temperature was recorded hourly by a data logger for the duration of each test. Fourier analysis (not shown) on a 24 hour cycle with days as replications for each column indicated temperatures varied diurnally and daily with room temperature. There was little or no overlap among columns during the evergreen sumac and mealy sage tests. Temperatures were more variable during the Mexican redbud test and there was some overlap among columns, probably due to a greater range in room temperature. Column means were uniform and linearly related to column location (analysis not shown).

Germination, as previously defined, was counted daily for 14 days. FPG was related to temperature by polynomial regression in an analysis of variance as described above. To facilitate fitting a meaningful curve, only those columns immediately before and after the ones in which germination occurred were included in the regression.

RESULTS AND DISCUSSION

First Experiment - No Mexican redbud seeds germinated without some duration of both scarification and stratification. For 60 days stratification, germination occurred only after 30 minutes scarification. For 120 minutes scarification, germination occurred only after 30 days stratification. To obtain a significant fit for a quadratic response surface the data set was restricted to the region of 30 minutes to 90 minutes scarification and 15 days to 45 days stratification, which included the maximum response (Table 1). The maximum predicted germination was 95% after 62 minutes scarification and 35 days stratification (Fig. 1). The lower 99% mean confidence limit was 85%, which is predicted to occur within the region of 50 minutes to 70 minutes scarification followed by at least 20 days stratification.

These results are similiar to those of Frett and Dirr (1979) for eastern redbud. Although they reported a maximum germination after 15 minutes scarification and 60 days stratification, they also reported increased response to longer scarification when followed by only 30 days stratification. Predictions for the maximum response differ from recommendations of Roy (1974) only in a slightly longer scarification duration. Certainly the degree of testa hardness and embryo dormancy varies within and among seed harvests; and the seeds used, which represent a limited genetic and environmental pool, may have had a slightly harder testa than most. But the results may also reflect an adaptation to the drier, warmer habitat of the Mexican redbud.

Evergreen sumac germination response to scarification and stratification duration fit a quadratic response surface without restricting the data set (Table 1). The maximum predicted germination was 59% after 52 minutes scarification and 73 days stratification (Fig. 1). The lower 99% mean confidence limit was 51%, which is predicted to occur within the region of 20 minutes to 90 minutes scarification followed by stratification for 30 days to 110 days. While the results suggest some germination would occur following scarification alone as suggested by Nokes (1986), stratification would enhance the response. The durations and variability of response are similar to those reported by Brinkman (1974) for other sumacs.

Second experiment - Extreme temperatures inhibited germination for all three species (Fig. 2). Mexican redbud had a very narrow temperature range for germination to occur, 24 to 31 C, compared to the other species studied and to that reported for eastern redbud (Roy, 1974). The temperature range for evergreen sumac germination, 21 to 31 C, was intermediate among the species studied and comparable to that generally recommended for sumacs (Brinkman, 1974). Mealy sage germinated over the widest temperature range, 21 to 34 C. The predicted maximum FPG was 104.2 at 27.5 C for Mexican redbud, 89.8 at 29.2 C for mealy sage, and 42.4 at 22.1 C for evergreen sumac (Fig. 2).

NOTE

This research was conducted at the Texas A&M University Research and Extension Center at El Paso.

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Table 1. Polynomial regression analysis of variance for the effect of scarification and stratification duration on germination of Mexican redbud and evergreen sumac seeds.

	Mexican redbud		Evergreen sumac	
Source	df[z]	Mean square	df	Mean square
Model	5	7456.4**	5	2405.5**
Total error	66	209.8	194	191.4
Lack of fit	3	457. NS	19	240. NS
Pure error	63	198.	175	186.1

[z]Degrees of freedom.
NS,**Nonsignificant, or significant at P = 0.01, respectively.

Table 2. Polynomial regression analyses of variance for the effect of temperature on the final percent germination, maximum germination rate, and inflection time of Mexican redbud, evergreen sumac, and mealy sage seeds.

	Final percent germination		Maximum germination rate		Inflection time	
Source	df[z]	Mean square	df	Mean square	df	Mean square
			Mexican redbud			
Model[y]	4	13608.8**	1	635.2*	2	52.4**
Total error	35	846.9	16	136.6	15	5.2
Lack of fit			1	7.5NS		
Pure error	35	846.9	15	145.2	15	5.2
			Evergreen sumac			
Model	3	4037.6**	1	5813.6*	2	21.9**
Total error	36	236.3	18	876.3	17	3.6
Lack of fit	1	88. NS	1	123. NS		
Pure error	35	240.6	17	920.6	17	3.6
			Mealy sage			
Model	5	14534.7**	2	10974.2*	2	39.3**
Total error	42	268.3	28	2665.4	28	2.7
Lack of fit	1	658.1NS	1	0.4NS		
Pure error	42	268.3	27	2739.8	27	2.7

[z]Degrees of freedom.
[y]Model degrees of freedom indicates the degree of polynomial.
NS,*,**Nonsignificant, or significant at P = 0.05, or 0.01, respectively.

Fig. 1. Germination response of Mexican redbud (A) and evergreen sumac (B) seeds to scarification and stratification times.

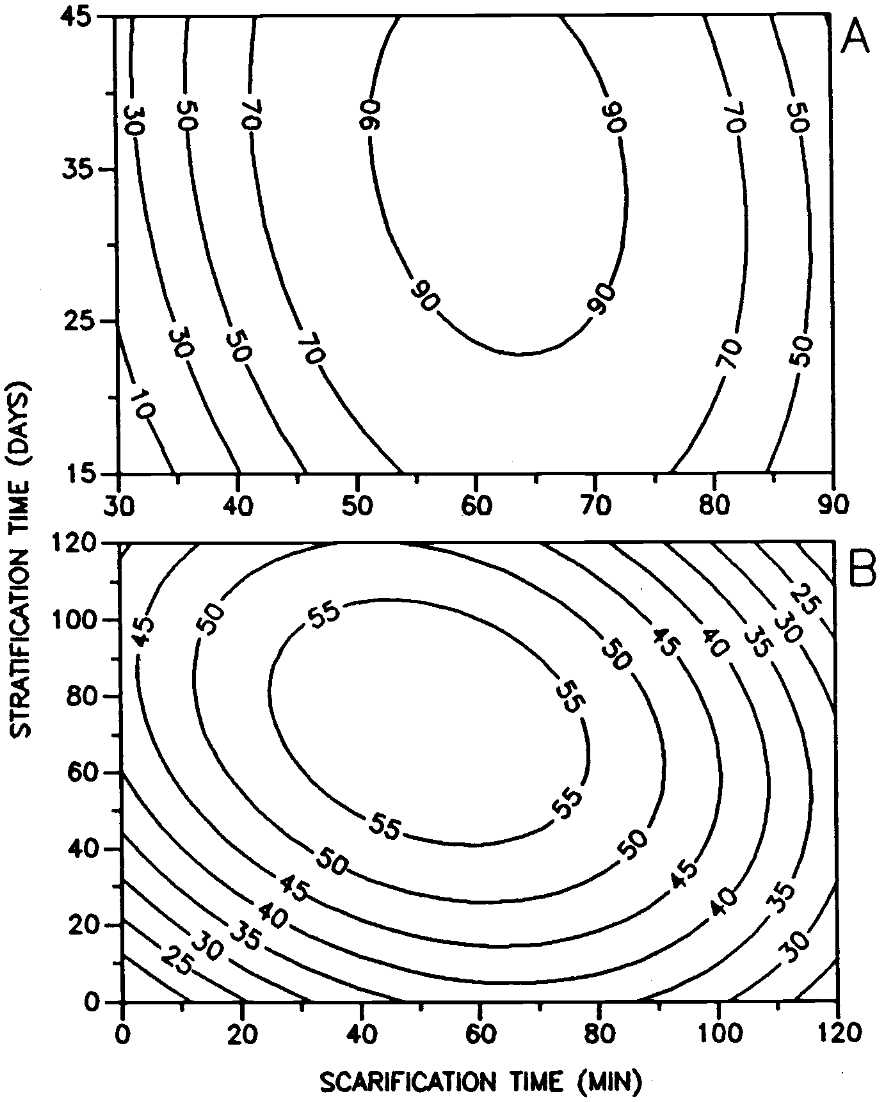

Fig. 2. Germination response of Mexican redbud (A), evergreen sumac (B), and mealy sage (C) seeds to temperature.