Germination Characteristics of Broadscale: A Possible Saline-Alkaline Site Stabilizer

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Highlight: Germination of broadscale (*Atriplex obovata* Moq.), a perennial saltbush, was optimum when the seeds were exposed to light at 10 to 20°C. Germination was suppressed in the absence of light, although very brief exposure to light will overcome this inhibition. Seeds of intermediate size germinate best; gray seeds germinate better than tan seeds. Because of its growth on excessively alkaline, saline sand, and shale soils of the Southwest, as well as its nutritive value and palatability to livestock, broadscale has potential for stabilization of a variety of disturbed sites.

Broadscale (*Atriplex obovata* Moq.) grows on saline and alkaline soils of the Southwest. It is palatable to cattle and sheep (Goodin and McKell 1970), and has the ability to resprout from basal branches when severely cropped (Hall and Clements 1923).

Because of broadscale's growth and reproduction characteristics in an arid, harsh environment, it has good potential for use in revegetating disturbed sites in the Southwest. This study was undertaken to determine some of the factors affecting germination of broadscale.

Although seed size has not been shown to be a significant factor in germination of *Atriplex canescens* (Springfield 1970), larger seeds germinate better with some species (Knipe 1970). In other species, intermediate or small seeds have the higher germination percentage (Larson 1961). Dark *A. semibaccata* seeds germinate better than light, while light seeds of *A. inflata* germinate better (Beadle 1952).

Atriplex spp. have not been shown to require light to germinate (Beadle 1952; Springfield 1970); they germinate best between 5°C and 25°C (Springfield 1970; U.S. Forest Service 1974).

Several seed treatments promote germination of wild land as well as crop species. Soaking in solutions of gibberellic acid (Barton 1965), thiourea (Barton 1965; Kay 1974), potassium nitrate (Barton 1965; U.S. Forest Service 1974), dusting seeds with activated charcoal (Barton 1965; Kay 1974), soaking in water (Mikkelsen and Sinah 1961; Barton 1965), stratification (Barton 1965; U.S. Forest Service 1974), and scarification (Barton 1965; Springfield 1970) have all been shown to enhance seed germination. After-ripening often improves seed germination in general and *Atriplex* spp. in particular (Beadle 1952; U.S. Forest Service 1974).

Materials and Methods

Two sources of seeds were used. One was gathered in March 1974 from the Painted Desert in Arizona. The site was dominated by broadscale with virtually nothing else growing in the vicinity. The second source was collected from a sandy soil immediately north-northeast of Cabezon Peak on the west bank of Arroyo Balcon, 1 mile from San Luis, New Mexico, October, 1975. Cabezon seeds were mostly intermediate in size and tan in color at the time of collection, though they began to turn gray after 70 days.

The percentage of seeds containing normal embryos was determined by cutting away the seed coat of a random sample of 100 seeds from each source.

The Painted Desert broadscale seeds were separated according to size and color. The seeds were divided into the following groups by sieving: (1) those which would not pass through a 5-mm sieve (large seeds), (2) those which passed through a 5-mm sieve but remained on a 2-mm sieve (intermediate seeds), and (3) those which passed through a 2-mm sieve but remained on a 1-mm sieve (small seeds). All large seeds were tan, but the other two size groups had both gray and tan seeds. The resulting five classes of seeds, (1) large tan, (2) intermediate gray, (3) intermediate tan, (4) small gray, and (5) small tan, were tested for germinability.

Light and temperature requirements for germination of broadscale were determined using seeds of intermediate size from the Painted

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Table 1. Mean germination percent[1] of various sizes and colors of Painted Desert seeds.

Seed		Mean germination[1]
Size (mm)	Color	(%)
5	tan	26 bc
2 to 5	gray	48 a
2 to 5	tan	36 ab
1 to 2	gray	16 c
1 to 2	tan	10 c

[1] Any two percentages not followed by the same letter are significantly different at the .05 level.

Desert. Germination was tested at 3, 10, 20, 30, and 40°C with (1) continuous fluorescent light, (2) complete darkness, and (3) brief light exposure: 1 minute exposure to fluorescent room light after imbibition and 1 minute exposure every day for the duration of the test. Germination response to a diurnal regime of 14 hours of light at 22.5°C and 10 hours of darkness at 6.5°C, simulating a spring environment, was also tested.

Seeds from both sources, after-ripened at least 100 days, were subjected to the following treatments: soaked 16 hours in (1) 100 ppm solution of gibberellic acid, (2) .01 M solution of potassium nitrate, (3) 3.0% thiourea, and (4) distilled water. Both sources were also (5) dusted with superactivated charcoal, and (6) scarified from 10 to 80 seconds.

Cabezon seeds were stratified for a period of 11 weeks at 2°C in a moist atmosphere in the dark. These seeds were tested periodically to determine the effect of length of stratification on germination. All other seeds were stored in paper containers at room temperature. Cabezon broadscale seeds stored at room temperature were tested periodically to determine the effect of length of after-ripening on germination.

All seeds were dusted with a fungicide (thiram) and germinated on standard blotter paper in 50 cm^2 plastic germination dishes wetted with distilled water. Four replications of 25 randomly selected seeds were used in all tests. Unless otherwise stated, germination was tested at room temperature (23°C) with fluorescent room lights about 8 hours per day, 5 days per week.

Results and Discussion

Preliminary tests showed seeds from the Painted Desert, Ariz., germinated well at room temperature (23°C) with fluorescent light 8 hours per day, 5 days per week. The gray seeds of intermediate size germinated significantly better than seeds of any other size, and all intermediate seeds germinated significantly better than the small seeds (Table 1). Gray seeds of all sizes tended to germinate slightly but not significantly better than tan seeds. Germination was practically complete for all except the large tan seeds by the 8th day (Fig. 1).

Percentage germination in continuous light was significantly higher than in the dark at 3, 10, and 20°C (Fig. 2). There was no significant difference in germination in the light or dark at 30°C. Seeds germinated at 40°C, but all of the radicles died.

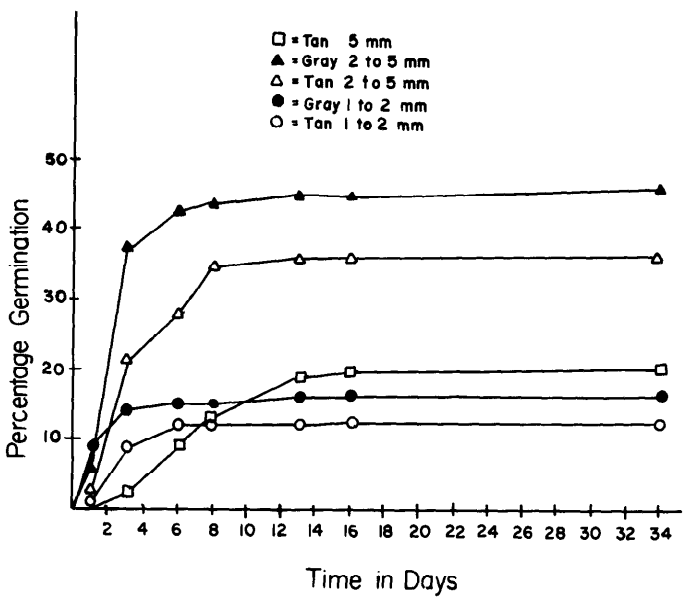

Fig. 1. *Germination of various sizes and colors of Painted Desert broadscale seeds.*

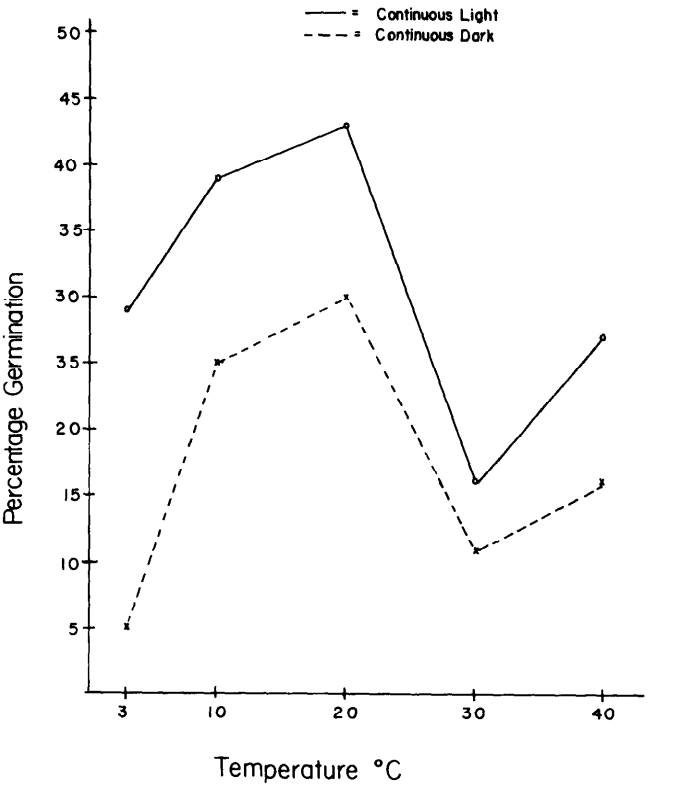

Fig. 2. *Effects of light at five temperatures on the germination of Painted Desert broadscale seeds.*

Seeds given 1-minute exposure to fluorescent light after imbibition and once every 24 hours showed no significant difference from those germinated in continuous light. There was no difference between the percentage germinated in the diurnal regime, and those seeds germinated at 20°C (the "optimum" constant temperature) with continuous light.

None of the chemical or mechanical treatments significantly increased the final germination percentage of seeds that had been after-ripened at least 100 days. Treated seeds, however, germinated much more rapidly (Fig. 3). For example, more than 40% of the seeds scarified 20 seconds had germinated in 3 days compared with less than 5% of the untreated seeds. The seeds from Cabezon had markedly softer seed coats than those from the Painted Desert. Scarification of Painted Desert seeds for 80 seconds excised only a small portion of the embryos. Twenty seconds scarification of Cabezon broadscale seeds with the same grade sand paper excised over 50% of the embryos; scarification for 40 seconds virtually destroyed all seeds. The Cabezon controls averaged 42% germination while 51% of the seeds apparently contained normal embryos. The Painted Desert controls showed an average of 39% germination, while 52% of the seeds contained normal embryos.

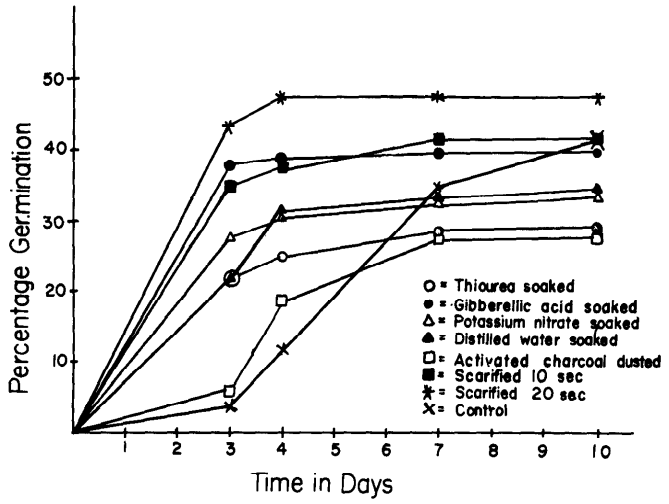

Fig. 3. *Germination of Cabezon broadscale seeds treated with various agents after 100 days after-ripening.*

Carbezon seeds after-ripened 10 weeks, seven with stratification, germinated significantly better than those after-ripened 10 weeks without stratification. In a 10-day germination test, 42% of seeds stratified for 7 weeks germinated, while only 3% of nonstratified seeds germinated. This test was carried out in a growth chamber under the diurnal regime.

Broadscale seeds produced in 1975 were allowed to after-ripen at 23°C and tested periodically for germinability to determine the length of after-ripening required for appreciable germination (Table 2). Less than 1% germinated with less than 70 days after-ripening. Three percent germinated after 70 days, 14% germinated after 85 days, and 42% germinated after 100 days. All germination tests for after-ripening were carried on for 10 days.

Conclusion

Atriplex spp. generally require after-ripening for 3 to 10 months (Springfield 1970; U.S. Forest Service 1974); 3½ months after-ripening is sufficient for good germination of broadscale. When possible, seeds of 2.0 to 5.0 mm size should be collected. Light is required for best germination, although very brief exposure is sufficient for optimal germination. Broadscale should be planted early in the spring to take advantage of cooler temperatures which promote germination.

Broadscale naturally inhabits saline and alkaline soils, and is good spring forage crop. It should be a good candidate for stabilization of slopes and other disturbed areas in the arid Southwest.

Table 2. After-ripening effects on germination of Cabezon broadscale seeds.

Days after-ripened	Germination [1] (%)
70	3 a
85	14 a
100	42 b

[1] Any two percentages not followed by the same letter are significantly different at the .05 level.

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