

Germination of Fourwing Saltbush Seed As Affected by Soaking and Chloride Removal

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Many western semi-desert ranges are in such a depleted condition that revegetation is of great importance to the range livestock industry in these areas. Because of the aridity and salinity of large expanses of this depleted land, they are not suited to restoration by reseeding with grasses. Often only halophytic plants will grow and produce forage on these areas.

Fourwing saltbush (*Atriplex canescens*) is ecologically adapted to many of these areas; however, because of a lack of adequate knowledge concerning its germination and establishment, artificial reseeding of this species has been conducted only on a limited scale.

Some halophytic plants produce seeds that are protected from germinating during periods of moisture which would be inadequate for establishment of the seedlings (Beadle, 1952). The germination-inhibiting factor might be in the form of salts which are picked up from the soil by these plants.

The purpose of this study was to determine the effect of soaking with water and chloride concentration on the germination of fourwing saltbush seed.

Review of Literature

Fourwing saltbush is a medium-sized shrub native to dry range lands. It has a range extending from South Dakota west through Oregon and south to Texas and Lower California (U. S. Forest Service, 1948). Many of the areas where this plant grows are so strongly alkaline that most grasses will not grow on them, whereas saltbushes (*Atriplex* spp.) will grow and produce an abundance of palatable forage (Ken-

edy, 1900). Smith (1896) stated that fourwing saltbush is a principal forage plant of the southwest and should be brought into cultivation, especially on saline or alkaline soils.

Trumble (1932), working with two Australian saltbushes (*Atriplex semi-baccata* and *A. vesicarium*), reported that these plants retain a high content of protein and phosphoric acid, which are usually lacking in other mature range forage during the winter months. Bidwell and Wootton (1935), in an analysis of fourwing saltbush forage collected in midwinter, found the average protein content to be 16.4 percent and the average nitrogen-free extract content to be 41.2 percent. Morrison (1949) gives the protein and nitrogen-free extract percentages for alfalfa (all analyses) as 14.8 percent and 36.6 percent respectively.

In 1924 the New Mexico Agricultural Experiment Station distributed seed of fourwing salt-

bush to several stockmen in the southwestern states for planting. Varied success was obtained from the plantings (Wilson 1928).

Germination trials in the laboratory have given varied results. Wilson (1928) reported an average germination of 9.2 percent from seed collected in New Mexico. The U. S. Forest Service (1948) reported an average germination percentage of 18 percent with a range from 4 percent to 47 percent, the highest germination resulting from seed that had the wings removed. It was also reported that length of storage appears to have little effect on seed viability.

Hervey (1955) states that in studies conducted at the Colorado Agricultural and Mechanical College the potential germination of fourwing saltbush was much higher than actual germination. One lot of seed germinated 15.5 percent and the potential, determined by cutting tests of the seed, was 57 percent.

Beadle (1952) found that the concentration of chloride in the bracteoles of Australian saltbushes retarded the germination of the seed and that partial removal of the chloride was essential to germination. Wood (1925) reported that saltbushes exhibit selective absorption of chlorides, and the amount of chloride absorbed is a function of the amount of salt in the soil. This variation in the amount of chloride absorbed indicates that the seed source might account for the variability in germination in past plantings and germination trials.

Beadle (1952) found that the chloride can be partially removed by soaking the seed in water and that a larger percentage of the seed germinates after soaking. He also states that the excess water must be removed to prevent waterlogging of the seed, which would retard germination. Soaking the seed 36 hours before planting is practiced in South Africa where *Atriplex nummularia* is planted extensively (Morai's and Bonsma, 1941).



Methods

Seed of fourwing saltbush, collected in December, 1953 near Roswell, New Mexico, was stored at room temperature in open paper bags until March, 1955, when the study was undertaken. The wings were removed from the seed by hand rubbing over a 3 mm. screen.

Seven soaking trials were used: 0, 2, 4, 8, 12, 16 and 20 hours. Approximately 30 grams of seed were used in each trial. After soaking in three liters of water, each sample of seed was rinsed with three liters of distilled water. Immediately after rinsing the seed was placed between paper blotters to remove the excess water. Four replicates of 100 seeds each from each of the seven lots were placed in petri dishes on two moist pre-cut "Seed Buro" germination blotters to germinate. The remaining seed was air-dried for two days and then placed in unsealed mason jars for further drying.

After seven days of drying four replicates of 50 seeds each from each of the seven soaking treatments were placed in petri dishes to germinate. At the end of 24 days this was repeated. Only 50 seeds in each replicate were used for this treatment because of the lack of a sufficient number of seeds.

Because of the apparent greater viability of those seeds that had been leached 20 hours, approximately 30 grams of winged seed were soaked 20 hours. Four replicates of 100 seeds each were tested, after 0 days drying, to determine the effect of wing removal on germination.

A trial with four replicates of 25 naked seeds each, seed coat removed, was conducted to determine if the seed covering, other than the wings, had any effect on germination.

All germination trials were conducted in the laboratory at room temperature, the range of temperature being from 63° F to 93° F, with a normal range of 75° F

to 85° F. All germination trials were of 30 days duration.

The germinated seeds were counted and removed daily. Germination was considered complete when the radicle emerged from the seed covering.

Total chloride concentration was determined for each of the seven soaking trials by the Husband and Godden method (Piper, 1950). The chloride concentration was also determined for the winged seeds that were soaked, but because of the lack of seed, it was not determined for non-soaked winged seed.

Results and Discussion

The results of the chloride removal by leaching with water are summarized in Table 1. The unsoaked seed contained 1.10 percent chloride by weight, a large percentage of which was removed by the soaking treatment. Two hours of soaking removed 90.9 percent of the chloride from the seed. The amount of chloride removed remained relatively unchanged for the 2, 4, 8 and 12 hours soaking. After 16 hours soaking the chloride removed increased to 92.7 percent and to 95.6 percent after 20 hours.

As can be seen in Table 1, the chloride removal is not directly proportionate to the length of soaking. Only a short period of leaching is required to remove the major portion of the chloride from the seed.

After soaking 20 hours the percent chloride in the winged seed

Table 1. Percent of chloride present, by total weight, and percent chloride removed after each soaking treatment.

Hours Soaking	Chloride Present	Chloride Removed
	(percent)	(percent)
0	1.10	0.0
2	.10	90.9
4	.11	90.0
8	.10	90.9
12	.10	90.9
16	.08	92.7
20	.06	95.6
20*	.11	—

* Winged sample.

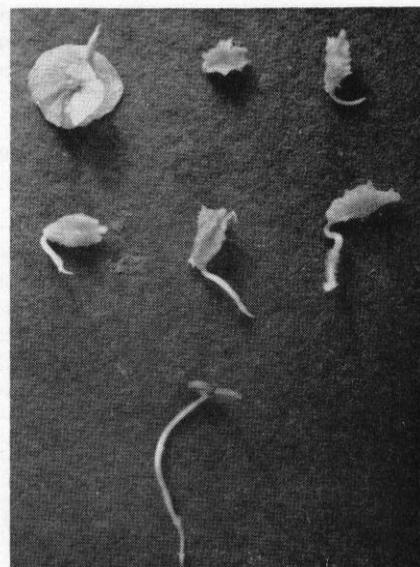


FIGURE 1. Germination of fourwing saltbush seed. *Upper row:* winged seed, wings removed, emergence of radicle; *middle row:* progressive stages of radicle emergence. *Bottom row:* seedling separated from seed covering.

remained higher than in the wingless seed soaked 20 hours. The chloride concentration was not determined for unsoaked winged seed; therefore, the percent chloride removed was not determined.

The germination results for the seven soaking and three drying treatments are summarized in Table 2. The germination percentages shown are the averages of the four replicates tested for each soaking treatment. The columns headed "range" give the maximum and minimum germination percentages for the four replicates.

The highest germination was obtained from the seed soaked 20 hours, and the lowest from the seed soaked two hours. However, there appears to be no direct correlation between the length of soaking and percent germination because of the lack of progressively higher germination with increased soaking time (Table 2).

The winged seed, soaked 20 hours, exhibited much lower germination than did the seed that had the wings removed and soaked 20 hours (Table 2, 0 days

Table 2. Percent germination of fourwing saltbrush seed after seven soaking treatments and three drying treatments.

Hours Soaking	0 days Drying		7 days Drying		24 days Drying	
	Ave.	Range	Ave.	Range	Ave.	Range
	%		%		%	
0	25	24-27	—	—	—	—
2	12.5	8-20	40	34-52	28	24-34
4	22.0	17-31	38	34-56	16	8-26
8	14.75	6-30	34.5	26-42	20	6-30
12	16	9-25	32	28-40	15	6-24
16	13.25	9-16	23.5	16-26	14	8-22
20	30	21-41	34.5	28-42	17.25	8-24
20*	5.75	3-11	—	—	—	—

*Winged sample

drying). This percentage was lower than that of all other soaking and non-soaking trials. The removal of the wings may have had some scarifying effect on the seed.

Soaking had no beneficial effect upon germination in the 0-days drying trial. This could possibly be due to a failure to remove the excess water from the seed, causing a waterlogged condition. Beadle (1952) stated the removal of excess water after soaking was essential to germination of Australian saltbushes.

There was a marked increase in the germination percentage after drying seven days. As shown in Table 2, germination was higher in all cases. There was no significant difference between either the replicates or the hours of soaking. This indicates that drying after soaking is essential for increased germination, while length of soaking, after the initial two hours, is of little importance.

Germination of the seed soaked two hours and dried seven days was 15 percent higher than that for unsoaked seed.

The results obtained after 24 days drying are summarized in Table 2. It was found after the test that a larger proportion of immature seed had been included in this trial than in the other drying trials. The author feels that the results are not representative, and

had there been adequate mature seed the germination percentage very possibly would have been higher. This assumption is strengthened by the results of the two-hour soaking treatment for which no immature seed was used.

The results obtained for the drying trials suggest that extended drying after soaking has little or no detrimental effect on the germinability of fourwing saltbush seed.

The naked seed tested, with seed coats removed, gave a very high germination in all cases. Germinations of the four 25-seed replicates were 100, 96, 92 and 88 percent. This indicates that viable embryos might be retarded from germinating by the seed coat covering the seed which possibly contains a high percentage of the chloride present in fourwing saltbush seed.

Summary

Many western range areas are in need of revegetation. Fourwing saltbush is ecologically adapted to many of these areas although past plantings and germination trials of this plant have given varied results. A possible cause of this variation is the presence of chlorides in fourwing saltbush seed.

Fourwing saltbush seeds were tested to determine the effect of soaking and chloride concentration on the germination. Soaking

the seed in water removed a major portion of the chloride. Only a short soaking period was required to remove the chloride.

A higher percent germination of fourwing saltbush seed resulted, after the chloride removal, when the seed was dried to remove the excess water.

The higher germination after chloride removal by soaking indicates that the chloride might inhibit maximum germination of fourwing saltbush seed.

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