Crested Wheatgrass & Winterfat Emergence Under Simulated Drouth

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Seeding of rangelands is particularly uncertain on arid and semi-arid ranges. Plants must become established where rainfall is low and poorly distributed and where temperatures and winds are high and humidity is low. All of these factors contribute to low soil moisture and rapid evaporation of limited supplies. To reduce these effects and increase the chances of seeding success many treatments must be made, such as control of competing vegetation; pitting and plowing to increase infiltration; mulching to reduce evaporation, temperature and wind effects; soil compaction to improve plant-soil-water relations; and proper depth of planting to facilitate seedling emergence and to more effectively utilize soil moisture.

To study some methods of improving the seedling microenvironment, a greenhouse experiment was conducted to measure the effects of soil moisture, planting depth and soil compaction on the emergence and survival of crested wheatgrass (*Agropyron desertorum*) and winterfat (*Eurotia lanata*).

Species

Crested wheatgrass is a cool-season, drouth-tolerant, bunchgrass introduced from Asia that has been planted extensively in the west for soil stabilization and forage production. It

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Figure 1. The winterfat plant at right shows the prolific production of white hairy seeds.

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was used in this study primarily as a standard for comparision of winterfat performance.

Winterfat is a low-growing, cool-season shrub that makes its major growth in the spring and summer (Figure 1). It grows on slightly alkaline or alkaline-free soils and occurs in pure stands or as a component of arid and semi-arid grasslands or shrub types. It is highly palatable to livestock and game and is particularly valuable on winter ranges where it furnishes an abundance of palatable and nutritious forage during this critical season of the year. Winterfat is a prolific seeder and produces a high percentage of viable seeds. The seeds are light in weight and subtended by hairy bracts. As a consequence they are widely dispersed by wind and water and by adhering to the wool of sheep. Winterfat seeds collected in the fall may germinate at once when placed in a suitable environment but germination declines rapidly within the first year.

These characteristics of high palatability, high nutrient content, high viability of seeds, effective method of seed dispersal, and adaptability to various kinds of soil and climatic conditions makes winterfat a desirable species for range seeding.

Methods

Plantings of crested wheatgrass and winterfat were made in the Soil Conservation Service Plant Materials Center greenhouse, in 20x14x4-inch metal flats with four treatment replications. The soil was a sandy loam (65 percent sand, 23 percent silt and 12 percent clay) with a moisture equivalent of 14.7 percent. Flats were rotated daily to counteract light and temperature variation. After planting, moisture was applied at a high level (4000 ml per flat) to bring soil moisture up to field capacity and at a low level (2000 ml per flat) to induce moisture stress. Subsequent waterings were made at one week intervals at the rates of 2000 ml per flat for the high moisture rate and 1000 ml per flat for the low rate. Soil samples were taken with a tube after the initial watering and just prior to subsequent waterings and analyzed gravimetrically to determine soil moisture levels and trends. These tests showed that at no time were plants under moisture stress at the high rate of water application while at the low rate the moisture level had declined to near or slightly below the wilting coefficient just before watering.

Soil compaction treatments consisted of compaction with a hydraulic press at 4 psi before planting, 4 psi after planting, and no compaction. To make the before-planting compaction, the flat was filled with soil to the desired level of planting and compacted. The seed was then planted on the compacted surface and covered to the desired depth with loose soil. In the compaction after planting, the seeds were planted at the desired depth and the soil compacted. Plantings were made at depths of 0, 0.5, 1.0 and 1.5 inches. To reduce soil disturbance during waterings, the flats were covered with a cheese cloth and the water was applied with a fine sprinkler.

Results

Seedling emergence varied by species and was influenced by moisture level and depth of planting (Figures 2 and 3).

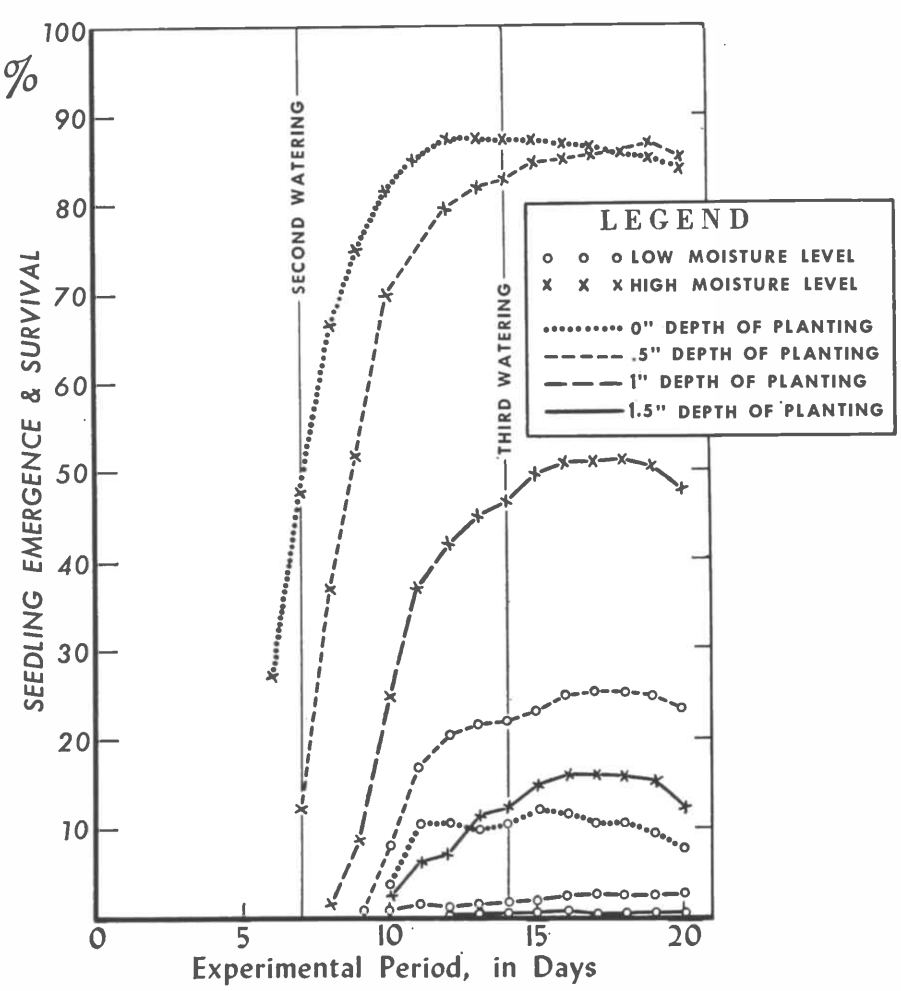

Figure 2. Effects of moisture application and planting depth on the emergence and survival of crested wheatgrass.

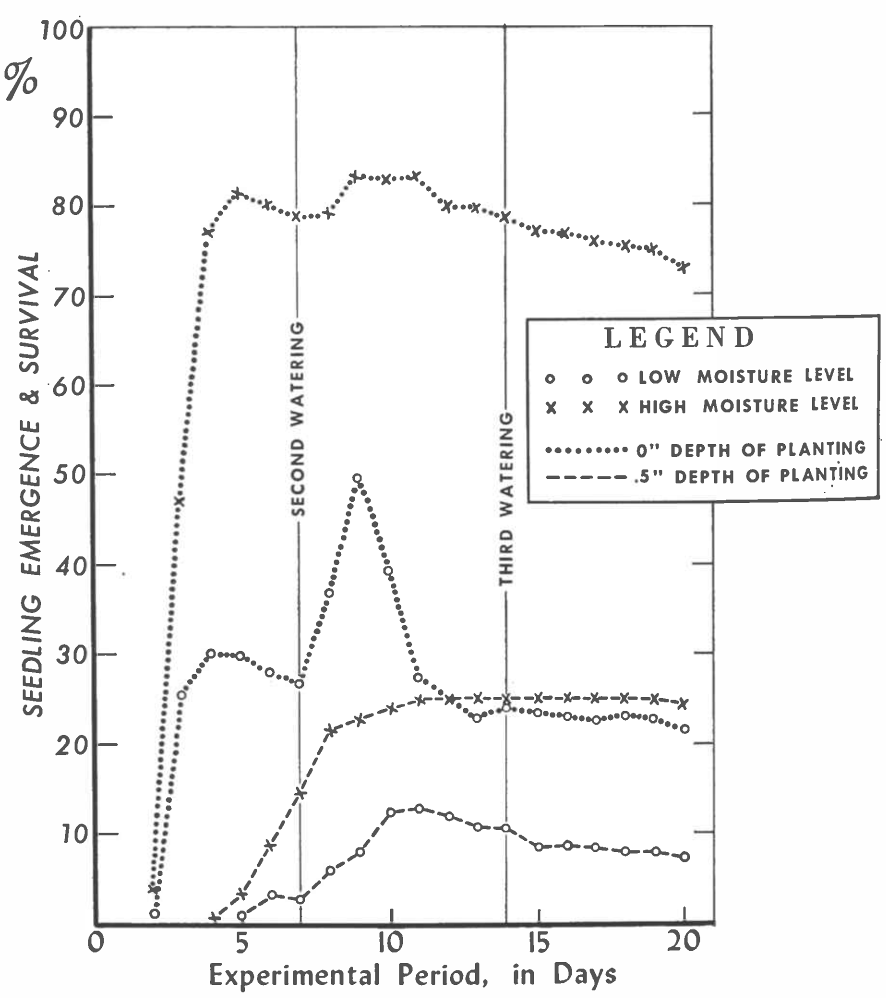

Figure 3. Effects of moisture application and planting depth on the emergence and survival of winterfat.

Initial emergence of winterfat occurred 2 to 5 days after planting as compared to 6 to 12 days for crested wheatgrass. This was 3 to 8 days earlier for winterfat at the same moisture level and depth of planting.

Moisture stress delayed initial emergence of crested wheatgrass 2 to 4 days at the same depth of planting, but had no significant effect on winterfat.

The effect of depth of planting on initial emergence varied with moisture level. At the high moisture level earliest emergence of crested wheatgrass occurred at the surface and was delayed 1 to 2 days later for each consecutive increase in planting depth. In contrast, at the low moisture level, wheatgrass emergence occurred first at the 0.5 inch depth, occurred 1 day later at both the surface and 1 inch depths, and occurred 3 days later at the 1.5 inch depth.

Initial emergence of winterfat occurred at the surface at both moisture levels, but was delayed 2 to 3 days at the 0.5 inch depth, depending on moisture level. The delay was somewhat later than for wheatgrass and was probably due to the greater difficulty that winterfat had in penetrating the soil. There was no emergence of winterfat from the 1- and 1.5 inch depths of planting.

Total emergence for both species was about equal, 83 percent for winterfat and 87 percent for wheatgrass, but varied with moisture level and depth of planting. At the high moisture level there was no significant difference in total emergence of wheatgrass at the surface (87 percent) and 0.5 inch (86 percent) depths of planting, but emergence was much less at the 1 inch (51 percent) and 1.5 inch (16 percent) depths of planting. Total emergence of wheatgrass was drastically reduced by moisture stress and was greater at the 0.5 inch depth of planting (25 percent) than at the surface (12 percent). There was practically no emergence at the 1- and 1.5 inch depths.

In contrast to wheatgrass, maximum emergence of winterfat at both high and low moisture levels, 83 and 50 percent, respectively, occurred at the surface planting. Also, there was a marked reduction in emergence at the 0.5 inch depth at both high and low moisture levels, 25 and 13 percent, respectively. However, under moisture stress maximum emergence of winterfat (50 percent) exceeded wheatgrass emergence (25 percent). Also, winterfat reached maximum emergence sooner, on the 5th day as compared to the 12th day for wheatgrass. Similar to wheatgrass there was no emergence of winterfat from the 1- and 1.5 inch depths of planting.

Mortality of crested wheatgrass seedlings after emergence was negligible regardless of moisture stress or planting depth (Figure 2), but mortality of winterfat seedlings was significant (Figure 3). The greatest loss of winterfat seedlings occurred 7 to 9 days after germination and 2 to 4 days after the second watering with seedlings planted on the surface at the low moisture level. One of the reasons for the higher seedling survival in the wheatgrass was the differences in root systems of the two species. The roots of crested wheatgrass at the end of the study were about twice as long and had numerous lateral roots, while the winterfat was almost devoid of lateral roots. This probably enabled the wheatgrass to better utilize the available moisture and survive moisture stress.

Analyses of compaction data (Table 1) showed that compaction had no effect on emergence of crested wheatgrass but did have a significant effect on emergence of winterfat. Compaction before planting significantly increased average emergence of winterfat over no compaction while compaction after planting decreased emergence. It appears that compaction before planting improved the plant-soil moisture relations below the seed while compaction after planting had a detrimental effect, probably by restricting seedling emergence.

Table 1. — Effect of soil compaction on emergence of crested wheatgrass and winterfat at two moisture levels.

Species	*Moisture level*	*Compaction treatment*	*Emergence in per cent. Average of all depths on days after planting*		
			6	17	20
Crested Wheatgrass	**High**	**None**	7	55	58
		Before planting	7	58	58
		After planting	7	55	56
	Low	**None**	0	7	7
		Before planting	0	7	7
		After planting	0	11	11
Winterfat	**High**	**None**	21	26	24
		Before planting	26	30	27
		After planting	20	23	22
	Low	**None**	7	9	7
		Before planting	10	12	10
		After planting	7	6	5

Conclusions

The controlled greenhouse study showed that crested wheatgrass should be planted at 0.5 inch depth and winterfat on or near the surface for best seedling emergence under favorable or moisture stress conditions. Soil compaction before planting significantly increased emergence of winterfat but not crested wheatgrass. Compaction after planting did not increase emergence of either species.

This study emphasizes the importance of planting seeds at the proper depth, especially on dry ranges. It also explains the value of water conservation treatments such as pitting, mulching and soil compaction for increasing the emergence and establishment of seedlings. Finally, it points up the need for planting those species that have physical or physiological attributes which enable them to survive drouth conditions. These characteristics include early germination and emergence, rapid root development, and the physiological ability to endure desiccation.