Emergence and Yield of Six Range Grasses Planted on Four Dates Using Natural and Treated Seed

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ALVIN T. BLEAK AND WESLEY KELLER

Highlight: *Six range grasses were compared by sowing natural and treated seed at four dates. Seedlings from treated seeds emerged sooner in all species except Russian wildrye for the first three planting dates. The fourth planting was a failure for both treated and natural seeds. The advantages of faster emergence from treated seeds did not result in more plants at 35-46 days nor in higher yield. Intermediate wheatgrass emerged first, followed by Russian wildrye and Siberian, crested, beardless, and fairway wheatgrasses. Intermediate wheatgrass yielded most, followed by crested, Siberian, and fairway wheatgrasses, Russian wildrye, and beardless wheatgrass.*

Seeding is generally regarded as the most effective means of improving depleted semiarid rangeland after desirable forage species have been lost.

In the western United States, the area that can be improved by seeding has been variously estimated at between 16 and 40 million ha. Tests have shown that many species are widely adapted for seeding those rangelands.

The semiarid range is, by name, deficient in moisture and the incidence of seeding failure is high. A major objective of range research is to find methods of seeding that will minimize failure.

In the intermountain region McGinnies (1959) found that soil moisture was favorable for germination longer below the bottoms of relatively small furrows than below a flat surface. Hyder et al. (1961) devised a wheel-track planter that rolled over sprayed sagebrush (*Artemisia tridentata* Nutt.) and covered seeds on a firm, undisturbed seedbed. Bement et al. (1961) showed that an asphalt emulsion mulch could improve seedling emergence. Hull et al. (1963) summarized all available data and reported broadcasting pelleted seed from an airplane an entirely unsatisfactory practice. Bement et al. (1965) obtained good stands of cool season grasses sown on summer-fallowed land. Hyder and Bement (1969) devised a ridge roller that, following plowing, provided a favorable environment for seedling establishment. McGinnies (1972) advocated a combination furrow and surface seeder to meet a wide range of field conditions. Herbel (1972) made successful range seedings in the hot southern fringe of the western range by using plowed creosotebush (*Larrea tridentata* (DC.) Cov.) to shade the ground, thus reducing soil temperature and extending the period of favorable soil moisture. Keller and Bleak (1968) undertook preplanting seed treatments, based on early work of McKee (1935), to induce more rapid germination and seedling establishment. In a field test using Nordan crested wheatgrass[1], Bleak and Keller (1970) obtained a modest but significant advantage from treatment, in both rate of emergence and early yield.

This study was carried out to answer the following questions: (1) would species other than crested wheatgrass respond to preplanting seed treatment, (2) would the initial advantage of more rapid seedling emergence carry over into better stands and greater forage yields, and (3) would treated seeds provide satisfactory stands under environmental conditions where natural seeds fail.

Materials and Methods

We chose six species that are known to be adapted to semiarid ranges. Treatment of each species consisted of placing 200 grams of seed on a screen suspended 6 or 7 mm above the bottom of a plastic box and wetting the seeds with tap water. Treatment at 17°C was continued until approximately 5% of the seeds had produced visible radicles. The seeds were then spread out and air dried.

The grasses studied, percentage of germination, and duration of the preplanting treatment were reported in Table 1. The field planting was a split-split plot within a 4 X 4 latin square. The large plots indicated dates of planting in 4 replications; the small plots, species; and the smallest, treated vs untreated seeds. The 3-m rows spaced 30.5 cm apart were planted at a depth of 17 mm with a cone seeder. Each species plot contained five rows of treated seed adjacent to five of natural (untreated) seed. The location of each species within a block and of the treated and natural rows was at random.

Seeding dates were April 23, May 15, June 12, and July 3 in 1968. At six intervals within 35 to 46 days after planting, we made counts of seedling emergence and survival. Seedling count on the first planting was made as early as 8 days after planting. A final count, called early survival, was taken 35 to 46 days after planting, after which single plant identification was difficult. The entire planting was harvested in May, 1969, and dry-weight yields were determined.

The study site was at the Central Experimental Farm of the Utah Agricultural Experiment Station about one mile north of Logan. The soil is a deep, highly calcarious silt loam, having a water holding capacity of about 25%. No supplemental water was applied to the study area. Most precipitation comes as winter

The authors are range scientist and agronomist, Agricultural Research Service, U.S. Department of Agriculture, Logan, Utah.

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[1] Scientific names of all species in this study are presented in Table 1.

Table 1. Grasses studied with year and place seed produced, percentage of germination in the spring of 1968, and duration (hour) of preplanting treatment at 17.2°C.

Species	Accession	Seed produced Year	Place	Germination (%)	Preplanting treatment (hour)
Fairway wheatgrass (*Agropyron cristatum* (L) Gaertn.)	Commercial	1966	N. Dakota	93	51
Crested wheatgrass (*A. desertorum* (Fisch.) Schult.)	Nordan	1965	Utah	91	52
Beardless wheatgrass (*A. inerme* (Scribn. and Smith) Rydb.)	Whitmar	1966	Washington	84	49
Intermediate wheatgrass (*A. intermedium* (Host) Beauv.)	Commercial	1967	Wyoming	93	33
Siberian wheatgrass (*A. sibiricum* (Willd.) Beauv.)	P-27	1967	Idaho	92	59
Russian wildrye (*Elmus junceus* Fisch.)	Vinall	1967	N. Dakota	85	59

Table 2. Early emergence, early survival, and yield (mean of 6 species) for natural and treated seed sown at four dates. Each value for emergence and survival is a mean of 120 rows and of 24 3-row plots for yield.

Item	Planting dates 4-23	5-15	6-12	7-3	Mean[1]
Early emergence/100 seeds					
Days to count	13	12	8	12	
Natural seeds	22.5	20.0	8.7	1.4	13.2 a
Treated seeds	30.4	25.5	10.6	.8	16.8 b
Mean[1]	26.5 a	22.8 a	9.7 b	1.1 c	15.0
Treatment diff. (%)	35.1	27.5	21.8	−42.9	27.3
Early survival/100 seeds					
Days to count	44	46	35	35	
Natural seeds	52.1	37.3	29.1	1.2	29.9 a
Treated seeds	52.6	40.3	28.2	.8	30.5 a
Mean[1]	52.4 a	38.8 b	28.6 c	1.0 d	30.2
Treatment diff. (%)	1.0	8.0	−3.1	−33.3	2.0
Yield (g dry wt)					
Natural seeds	1463	1282	937	156	960 a
Treated seeds	1463	1265	959	143	958 a
Mean[1]	1463 a	1274 ab	948 b	150 c	959
Treatment diff. (%)	0.0	−1.3	2.4	−8.3	−0.2

[1] Duncan's test at the 1% level. The mean column compares natural with treated seeds. The mean rows indicate differences due to dates of planting. Values followed by the same letter do not differ significantly.

snow or spring and fall rains. Average annual precipitation is 40 cm (16 inches). Summer nights are cool, but daytime temperatures frequently exceed 30°C.

Results

Effect of Treatment and Date of Planting

Early emergence, early survival, and yield of natural and treated seeds sown on four successive dates are presented in Table 2. Treated seeds were superior to natural only in early emergence and only for the first three planting dates. By the fourth planting date all seedings failed. Early emergence, early survival, and yield were all greatest at the first planting date and decreased at each succeeding date. Temperatures, precipitation, and soil moisture in the seed zone are presented in Figure 1. Minimum and maximum air temperatures generally increased until about August 1. Precipitation generally maintained soil moisture in the seed zone above 9% until mid-June. Between June 14 and August 3 soil moisture in the seed zone was below 9% except for a brief period following a 3-mm rain. This explains the failure of the fourth planting.

Species Differences

Species differed significantly in early emergence, early survival, and yield (Table 3). In early emergence, treated seed was superior to natural except with Russian wildrye. In early survival, intermediate wheatgrass was highest, followed by Russian wildrye, crested, Siberian, beardless, and fairway wheatgrasses.

Yield of intermediate wheatgrass was highest, followed by crested, Siberian, and fairway wheatgrasses. Russian wildrye and beardless wheatgrass had the lowest yields. Seed treatment altered the

Table 3. Species differences in early emergence, early survival, and yield for natural and treated seeds (mean for 3 planting dates). Each emergence and survival is based on 60 rows; each yield on 12 three-row plots.[1]

Item	Intermediate wheatgrass	Crested wheatgrass	Siberian wheatgrass	Fairway wheatgrass	Russian wildrye	Beardless wheatgrass
Early emergence/100 seeds						
Natural seeds	32.6 a	12.4 cd	16.3 c	8.4 e	22.3 b	10.4 d
Treated seeds	36.1 a	19.4 c	25.7 b	11.6 d	21.6 bc	18.3 c
Treatment diff. (%)	10.7 *	56.4 **	57.7 **	38.1 *	−3.1	76.0 **
Early survival/100 seeds						
Natural seeds	65.0 a	40.5 b	37.0 b	24.5 c	41.6 b	28.8 c
Treated seeds	62.4 a	41.2 b	39.5 b	25.6 c	38.0 b	35.1 b
Treatment diff. (%)	−4.0	1.7	6.8	4.5	−9.5	21.9
Yield g/3-row plot						
Natural seeds	1837 a	1335 b	1194 bc	1182 bc	986 cd	829 d
Treated seeds	1769 a	1398 b	1260 bc	1132 cd	904 d	916 d
Treatment diff. (%)	−3.7	4.7	5.5	−4.2	−8.3	10.5

[1] To compare differences between species within a given treatment. One or two asterisks (*) after values in the treatment difference row for early emergence denote significant differences between natural and treated at the 5 and 1% levels, respectively. Values followed by the same letter do not differ significantly at the 1% level.

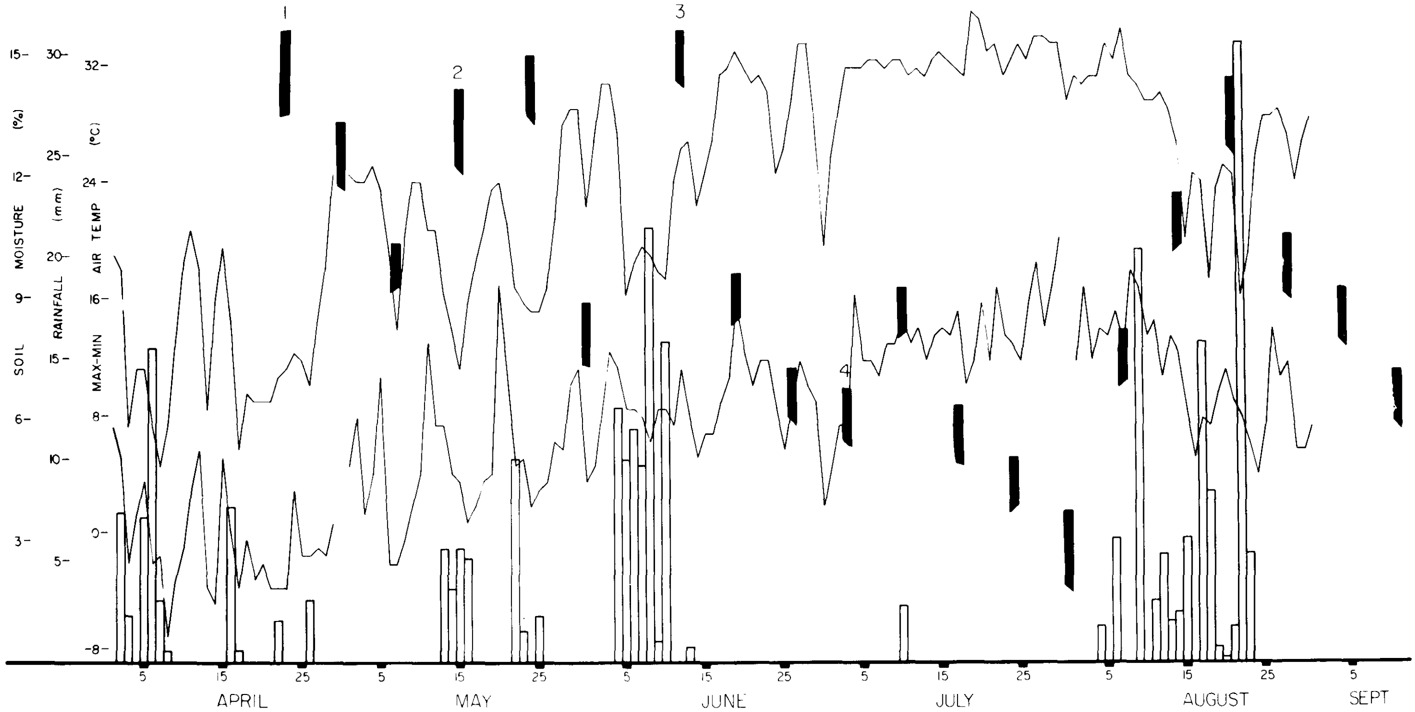

Fig. 1. *The climate of the experimental plot in 1968: maximum and minimum air temperatures (solid lines extending across the figure from left to right); precipitation (hollow columns); and soil moisture (solid suspended columns). Numerals 1 to 4 above the solid columns indicate when each planting was made.*

above relationships, but only in early seedling emergence were the effects significant.

Discussion

Previous studies have shown that preplanting seed treatment will hasten germination and emergence of Nordan crested wheatgrass and other range species (Bleak and Keller, 1972). The pretreated seed of Nordan can be dried and stored several months before planting (Keller et al., 1970). Evidence in the present study indicates that accelerated emergence is not necessarily accompanied by increased plant establishment or higher yield.

Treated seed will have an advantage under conditions where a good emergence from natural seeds is not possible but where the added boost of pretreatment is adequate to improve emergence. Such conditions may be impossible to predict in advance.

Wilson (1972, 1973) has shown that a preplanting seed treatment may result in emergence 12 days earlier than from natural seeds when germinated at 5°C. This suggests that the principal advantage of preplanting seed treatment may be temperature related rather than drought related. It appears from our data that, regardless of the rate of emergence, pretreatment must result in a better stand if it is to increase yield. During the 1968 season conditions for seedling emergence were favorable enough for the first three planting dates that natural seeds eventually gave stands as good as those from pretreated seeds.

This area received 56 cm (22.33 inches) of precipitation during the 12-month period between seeding and harvest. This very high precipitation may have obscured benefits from seed treatment that might have appeared in an average or below average rainfall year. We have encountered no significant negative effects of preplanting seed treatment, with the possible exception of the behavior of Russian wildrye.

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