

Emergence of Cheatgrass and Three Wheatgrasses from Four Seeding Depths¹

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Cheatgrass (*Bromus tectorum* L.) is a vigorous, introduced annual. Its merits and its ecological role have been discussed by Stewart and Hull (1949), Hulbert (1955), and others. It is a strong competitor with perennial grass seedlings, and many plantings on cheatgrass-infested land have failed. Some competitive relations between cheatgrass and seeded perennial grasses were shown by Hull and Stewart (1948).

Because cheatgrass plants establish well from seeds that fall on the soil surface, depth of seed covering might be a factor in seeding on cheatgrass areas. Rogler (1954) found that seedling emergence decreased as planting depth increased for a wide range of seed weights of fairway (*Agropyron cristatum* (L.) Gaertn.) and crested (*A. desertorum* (Fisch.) Schult.) wheatgrasses. Decreased emergence was not significant until about the two-inch seeding

depth. McKenzie *et al.* (1946) found that ½-inch was the best

seeding depth for fairway wheatgrass and that emergence decreased with increased depth of seeding. Hulbert (1955) found a similar pattern for cheatgrass. The present paper reports the emergence of cheatgrass and three wheatgrasses, used for seeding cheatgrass lands, when seeded at four depths for two years.

Table 1. Percent germination of cheatgrass and three wheatgrasses in the laboratory.

Symbol ^a	Species	Days to first germination	Germination				
			4 days	8 days	12 days	32 days	
Bte	Cheatgrass	2	100	100	100	100	
Asi	Siberian wheatgrass	4	12	80	86	87	
Ade	Crested wheatgrass	4	21	81	84	84	
Acr	Fairway wheatgrass	4	12	75	78	80	

^aSymbols used in figures 1-4.

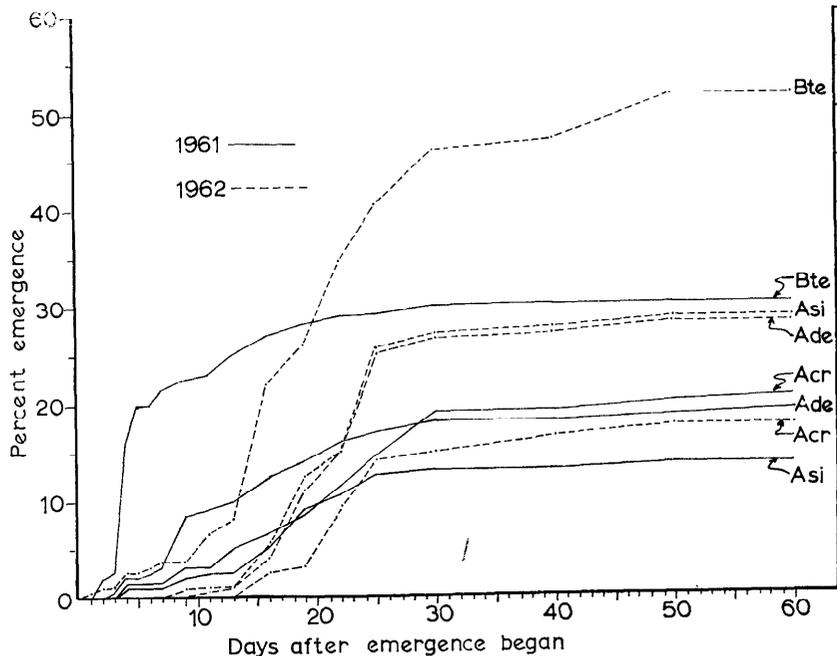


FIGURE 1. Rate of emergence of cheatgrass and three wheatgrasses seeded on the surface, 1961 and 1962.

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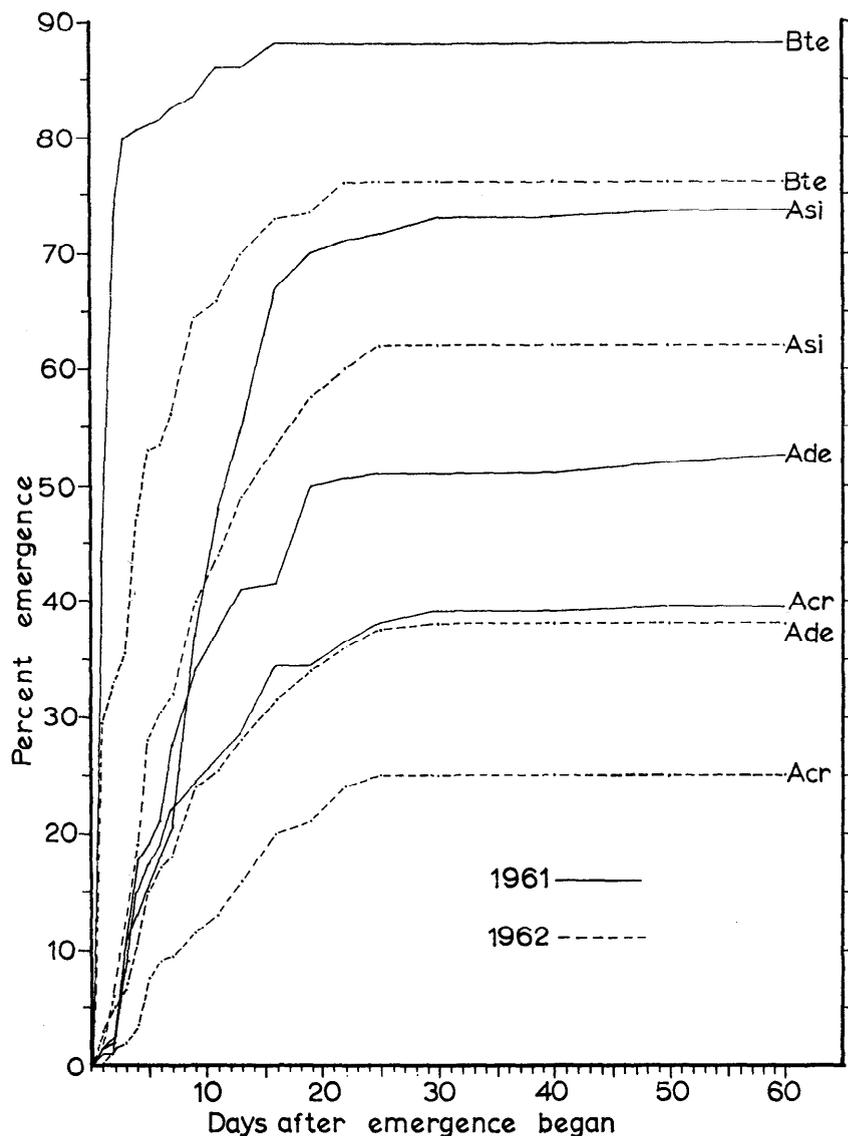


FIGURE 2. Rate of emergence of cheatgrass and three wheatgrasses seeded $\frac{1}{2}$ inch deep, 1961 and 1962.

Procedures

Four species were seeded in 1961 and 1962. The cheatgrass seed was collected from plants growing near Burley, Idaho. Fairway wheatgrass seed was grown at Saskatoon, Canada. Crested wheatgrass seed was the Summit variety, grown at Saskatoon. Siberian wheatgrass (*Agropyron sibiricum* (Willd.) Beauv.) seed was grown at Pullman, Washington, as Soil Conservation Service accession P-27. The plant material used was assumed to be typical of cheatgrass and the three wheatgrasses.

Germination tests were run on all species (Table 1).

Table 2. Seedling emergence from 100 seeds of cheatgrass and three wheatgrasses seeded at four depths, 1961 and 1962.

Species	1961				1962			
	0	$\frac{1}{2}$ "	1"	2"	0	$\frac{1}{2}$ "	1"	2"
Cheatgrass	30 w*	88 w	85 w	26 w	51 w	76 w	47 w	3 w
	b*	a	a	b	b	a	b	c
Siberian wheatgrass	14 x	74 x	58 x	8 x	28 x	62 x	31 x	2 w
	c	a	b	c	b	a	b	c
Crested wheatgrass	19 wx	53 y	42 y	9 x	28 x	38 y	27 x	1 w
	b	a	a	b	a	a	a	b
Fairway wheatgrass	20 wx	40 y	17 z	2 z	17 x	25 z	5 y	0 w
	b	a	b	c	a	a	b	b

*Any 2 means with the same letter are not sufficiently different at the 1 percent level. Letters a, b and c (across) refer to differences between seeding depths. Letters w, x, y, and z (down) refer to differences between species.

One hundred seeds of each species were placed at each of zero-, one-half-, one-, and 2-inch soil depths in wooden flats with eight replications. Additional flats were used to determine root growth. Flats were placed on the ground outside the greenhouse on the west side. Water was applied to bring the soil to saturation. Subsequently the flats received moisture only from normal snow and rainfall.

The soil used, a sandy loam obtained near Bliss, Idaho, had the following characteristics: pH (paste) 7.3; saturation extract ($EC \times 10^3$) 1.0; phosphorus 114 pounds P_2O_5 per acre; organic matter 1.1 percent; and moisture at saturation 38 percent, at $\frac{1}{3}$ atmosphere 16 percent, and at 15 atmospheres seven percent.

Both years a thermograph recorded air temperature four inches above the ground and in 1962 at soil depths of one-half, one, and two inches. Gypsum blocks were used to determine soil moisture potential at one-half, one, and two inches in 1962.

Plants were marked with colored toothpicks to record the date of emergence. Significance of results at the one-percent level was determined by Duncan's (1955) multiple range test.

Results

The 1961 plantings were made March 16. Weather remained cold until March 29. Air temperatures four inches above the

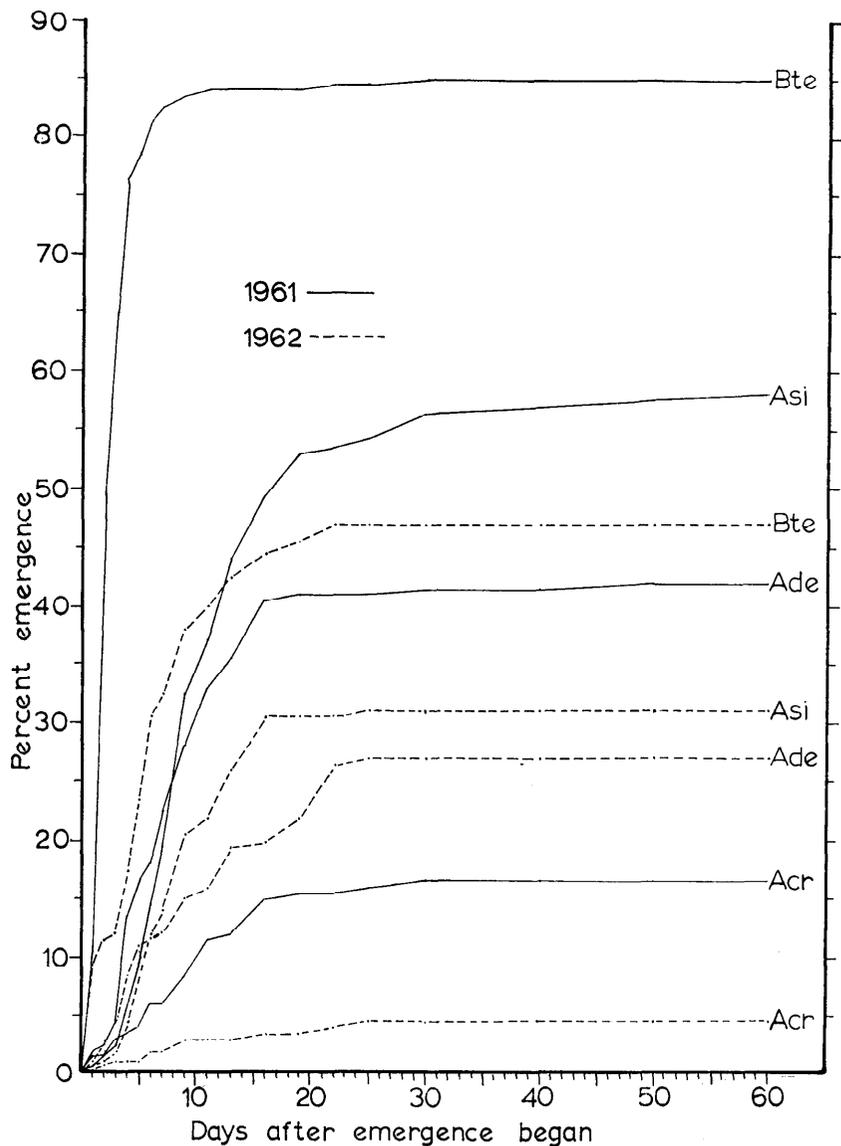


FIGURE 3. Rate of emergence of cheatgrass and three wheatgrasses seeded one inch deep, 1961 and 1962.

ground ranged from 28° to 39° F. minimum at night and from 46° to 68° maximum during the day. On March 30 it was warmer. On April 1, with a maximum of 68° and a minimum of 47°, all four species began emergence from the one-half-inch depth and three from the one-inch depth. Most of the emergence at the one-half- and one-inch depths occurred during the next 16 days when maximum temperatures ranged from 56° to 77° F. (Table 2, Figures 1-4). The symbols used in the figures are listed in Table 1.

In 1962 plantings were made

March 20. Snow and cold weather followed seeding (Figure 5). Soil temperatures at the one-half-inch depth were intermediate between those at one-half and two inches and are not shown in Figure 5. Emergence from the one-half- and one-inch depths began on April 9 for three species and on April 10 for fairway wheatgrass. Most of the emergence from the one-half- and one-inch depths occurred during the next 20 days.

In this study cheatgrass had the most rapid and the highest percent seedling emergence from all depths in both 1961 and in

1962. It was usually followed by siberian, crested, and fairway wheatgrasses in that order. Emergence was highest from one-half-inch and poorest from two inches. Emergence was slow from the surface and two inches.

Observations during 1961 showed that soil at the one-half-inch depth was dry three times, but at one and two inches it was always moist. In 1962 on April 16-18 and again on May 8-12 soil at one-half inch dried to the wilting point. On May 10-12 soil at one inch also dried to that point. Other than this, soil moisture was always above the wilting point. Thus even with adequate moisture, emergence was poor from the two-inch depth.

Discussion

Cheatgrass and wheatgrass seed germinates and seedlings readily emerge from shallow depths when moisture and temperature are favorable. In 1961 the weather was cold for two weeks following planting and in 1962 for almost three weeks. With the coming of warm weather all species began emergence at the one-half and one-inch depths within one day of each other. These species thus responded similarly to moisture and temperature. Hull (1960) found that seeds of intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.) germinated and emerged from one-half inch at soil temperatures of 31° to 35° F., but that germination and emergence were slow. It is believed that cheatgrass and the three wheatgrasses would react similarly and begin germination at the coldest temperatures which occurred during this study, but that germination and emergence would speed up with higher temperatures.

Cheatgrass with its vigorous germination, emergence, and growth is a strong competitor with seeded grasses. These results indicate that competition with cheatgrass cannot be

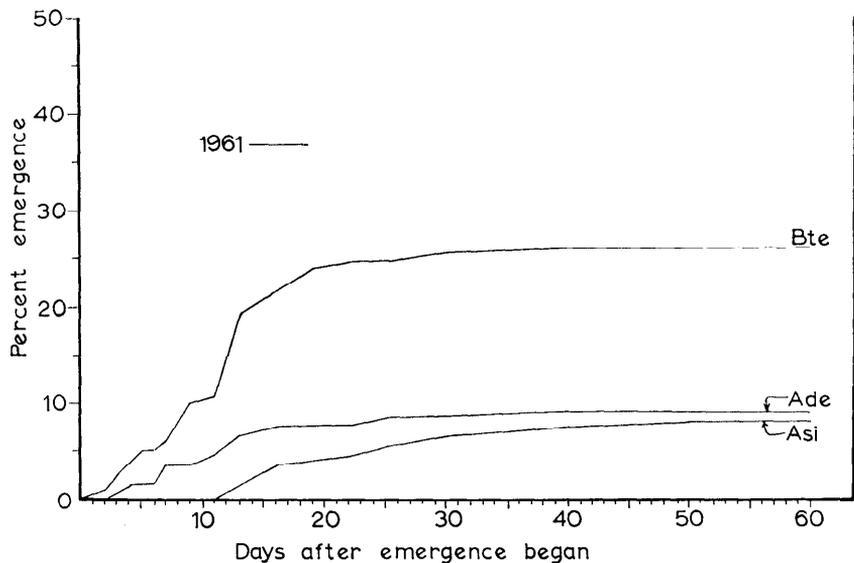


FIGURE 4. Rate of emergence of cheatgrass and two wheatgrasses seeded two inches deep, 1961. Species not shown did not exceed three-percent emergence.

avoided by regulating the depth of seeding wheatgrasses. They also indicate that cheatgrass seed must be buried deeper than two inches to reduce emergence and

thus effectively reduce competition.

Plants from surface seedings came mainly from seeds which rain washed into cracks along

the sides of flats or dividers. Emergence from the surface in the field would undoubtedly be only a fraction of the emergence obtained in this study.

Summary

Cheatgrass and three wheatgrasses were seeded at depths of zero, one-half, one, and two inches in March 1961 and 1962. In this study one-half inch was the best seeding depth for all species and two inches was the poorest. Cheatgrass had the highest and the most complete emergence from all seeding depths in each year. It was usually followed by siberian, crested, and fairway wheatgrasses in that order. Cheatgrass with its rapid emergence and vigorous growth is a strong competitor with seeded grasses. Competition with cheatgrass cannot be avoided by varying depth of seeding of wheatgrasses.

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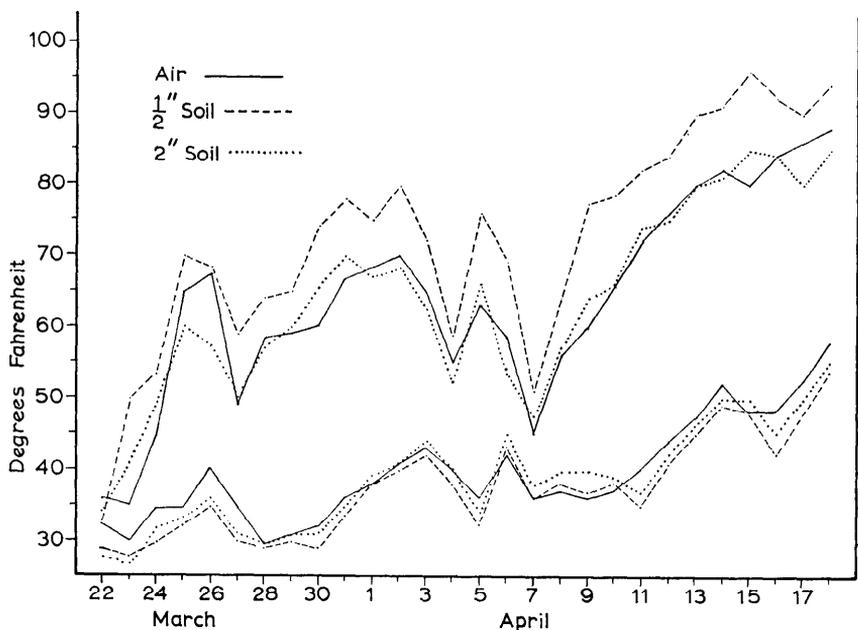


FIGURE 5. Daily maximum and minimum temperatures of air and soil before and after seedling emergence on April 9, 1962.