Fall Seeding of Crested Wheatgrass Is Best on Dry Ranges

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Editor's Note: The information in this article will be of much interest to anyone attempting to establish crested wheatgrass on rangelands.

Success in establishing crested wheatgrass on dryland ranges in southern British Columbia has been very erratic because of the dry climate and irregular precipitation patterns (McLean and Bawtree 1980). Since timing of seeding is crucial to success, trials were conducted to determine the most reliable seeding time to maximize germination and seedling establishment (full details are given in McLean and Wikeem 1983).

Test plots were seeded at 2-week intervals from 1 April to 24 June and again in fall from 1 September to the end of October for three years at four sites. The sites represented a cross-section of soil types common to southern British Columbia grassland ranges. The driest and hottest site occurred on a Brown Chernozemic soil (400 m, 1300 ft. elevation) and the coolest and moistest site (850 m, 2800 ft) was on a Black Chernozemic soil. Two sites, with climates and elevations intermediate between the other two, occurred on Dark Brown Chernozemic soils.

Seedling establishment the year following seeding was highly variable among years and sites. Fall seedings, from mid-September to mid-October, were consistently most successful on Brown and Dark Brown soils. If germination did not occur in the fall, it did so the following spring. On the high elevation site, late April seedings tended to be most reliable but early September seedings produced at least moderately good stands. Generally, fall seedings produced larger plant populations than spring ones (Fig. 1). Spring seedings later than mid-May were risky for all sites with June seedings virtually always failing to develop a satisfactory stand.

Sometimes successful germination during the seeding year occurred over only a short time span, especially on the drier sites. For example, in one year, only the 1 September seeding emerged at the Brown soil site during the seeding year but all fall seedings were well represented the following spring.

Soil moisture was the factor that most affected germination on the seeding trials. Seeds sown in early spring germinated following snow melt if winter moisture reserves persisted until the soil temperature increased sufficiently to permit germination. In some years germination followed May rains.

The poor performance of late June seedings may be attributed to adverse soil moisture conditions. Eighty percent of the seedlings which emerged during the summer from these seedings died before fall. Apparently soil moisture was sufficient to initiate germination but evaporated quickly before the seedlings could develop adequate root systems.

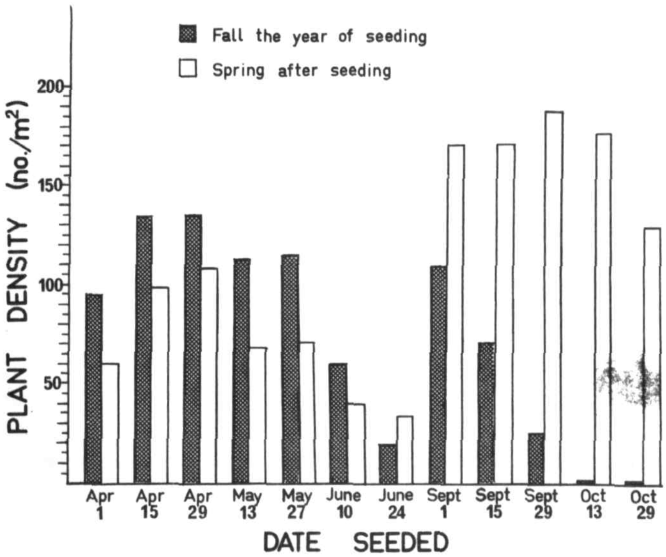

Fig. 1. *Crested wheatgrass density in fall of the year of seeding and in spring the year following seeding for the 12 seeding dates. One square meter (m^2) is slightly larger than one square yard.*

The climate of southern British Columbia rangelands typically is dry during the spring months until mid-May through June, when showers are common. Precipitation is low during July and August with most rain showers too short-lived to improve soil moisture. Heavier rains, which promote fall germination or regrowth, may occur in late August but are unpredictable. Fall, i.e., September and October, typically is dry. Areas with different precipitation patterns may not observe the same response as we did from the various seeding times. For example, late spring-early summer seedings may fare better in areas of higher summer rainfall.

Precipitation did not relate as well as percent soil moisture to germination and establishment. Since precipitation data were collected weekly, time, intensity and duration of each shower was unknown. Also the effectiveness of precipitation was dependent upon such factors as wind, interception and prevailing temperatures. For example, at one low elevation site, 1.9 cm (0.7 inch) of rain raised the soil moisture content from 4 to 22% in mid-June whereas in August, 2.3 cm (0.9 inch) of precipitation increased soil moisture from 5% to only 12%.

Although soil moisture strongly influenced germination, seeds germinated over a wide range of soil moisture values. No seedlings emerged when soil moisture fell below 6% and

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Fig. 2a. *Excellent crested wheatgrass stands are present on fall-seeded plots ten years after seeding on this low-elevation site. High crested wheatgrass densities the spring following seeding minimized establishment of weedy species.*
Fig. 2b. Pasture sage is evident on June-seeded plots from the same location as Fig. 2a. Poor crested wheatgrass establishment following seeding allowed invasion of this undesirable plant.

at least some emerged when soil moisture exceeded 21%. Emergence was unpredictable at values between these extremes.

Duration of adequate soil moisture appears critical, with a period of at least 2 weeks under a favourable moisture regime required to ensure successful establishment. Many times during the study a particularly heavy shower immediately before or after seeding might raise the soil moisture content for a short while but a stand would not develop unless the moisture persisted.

Factors other than soil moisture appeared to affect emergence, since germination sometimes was inconsistent despite favourable moisture conditions. Temperature appears to be one such factor. Poor germination the year of seeding sometimes occurred in early spring or late fall seedings when soil moisture was adequate but temperatures were low.

Cold fall and winter temperatures may actually have benefited fall seedings the following spring by the process of stratification. Stratification, or exposure of seeds to cold and moisture for a long period of time, can speed up germination following soil thaw. Stratified seeds can thus benefit more from favourable soil moisture conditions in early spring than can freshly sown and slower germinating seed.

Our studies show that high initial crested wheatgrass densities declined within 8 to 10 years after establishment. Differences between excellent and moderate stands tended to disappear with time. Densities and forage yields in poor stands remained low, allowing invasion of undesirable species such as pasture sage, big sagebrush and diffuse knapweed (Fig. 2). These undesirable species usually were not present in initially well-established stands.

Several points relating to management have emerged from this study. Annual and site variability is so great there is no seeding time guaranteed to result in excellent stands. Fall seedings have the least risk because if favourable germination conditions are absent that fall, germination can occur early the following spring when the soil is moist. Overwintering in the soil may hasten the rate of germination. Late-spring and early-summer seedings are the most risky because soil moisture rarely persists long enough to allow seedling establishment. Early-spring seedings can fare well, especially on the higher, less arid sites, but are highly dependent on spring precipitation. Success of spring seedings cannot be predicted from soil moisture conditions at seeding time because moisture must persist several weeks after emergence for the seedlings to survive. Initial seeding failures remain evident after many years by low densities and yields of crested wheatgrass stands and by abundance of invasive weeds. This further emphasizes the importance of initial success following seeding. Plant populations from fall seedings were generally higher than spring seedings a year after seeding but considerable thinning of the densest stands occurred within 8 to 10 years. This implies that fall seedings could be sown at lower rates than spring ones.

Literature Cited

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