Effect of Post-Emergence Weed Control on Grass Establishment in North-Central Colorado[1]

WILLIAM J. McGINNIES

Range Scientist, Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Fort Collins, Colorado.

Highlight

Winter-fallowing, planting grass into a clean seedbed, and controlling weeds during the seedling year, has been a particularly successful range-improvement practice in north-central Colorado. During the 3-year period (1964–1966), season-long hand weeding and spraying with 2,4-D when weeds were 6 to 12 inches high produced good stands in a year of average precipitation. However, neither spraying at later dates nor mowing the weeds at any date reduced competition from weeds sufficiently to produce a satisfactory grass stand. In a wet year, weed control in the seedling stand was not beneficial. In a year of extreme drouth, satisfactory stands were not obtained with any level of weed control. It was concluded that a technique of planting into a clean seedbed and spraying to control broadleaf weeds during the seedling year of the grasses offers the best chance for a successful seeding if wind erosion does not become a serious problem.

The elimination of competition from undesirable plants before seeding rangeland is a standard procedure, and its importance cannot be overemphasized (Hull et al., 1958). On the drier sites of north-central Colorado, various fallow treatments have also been reported to be beneficial (Bement et al., 1965). In the course of establishing many small experimental plantings at this location, a highly successful seeding technique has been developed. In this technique, perennial vegetation is killed by moldboard plowing in the summer or fall preceding planting. The area is left moderately rough to reduce wind erosion and to increase snow accumulation during the winter-fallow period. In the spring, as early as weather permits, the area is smoothed and planted. The smoothing process involves light cultivation which also kills any weed seedlings that germinated in the preceding fall or very early spring. This procedure provides an excellent seedbed, and good stands of grass seedlings are obtained in all but the driest years. However, this same seedbed is also near optimum for establishment of annual weeds. On the experimental plots, the weeds have been eradicated as a routine procedure by a combination of mechanical and chemical control measures.

The importance of post-planting weed control in establishing the grass stand has not been thoroughly evaluated. McGinnies (1966) determined whether shade (such as might be produced by weeds), or the sudden removal of this shade (to simulate the mowing of a weed overstory), would have any beneficial or harmful effects on the grass seedlings. Neither the shade nor its sudden removal had any noticeable effect on seedling survival. The present study evaluates the importance of weed control in seeded stands and compares mowing to a selective herbicide for this control. The results of this study are related to observations from numerous experimental plantings in the research program at this location.

Experimental Procedure

The study area is on a sandy loam soil located just west of Fort Collins, Colorado. Average annual precipitation is 14 inches. Native vegetation was shortgrass.

The entire study area was plowed in the summer of 1963 and fallowed until the plots were staked out in the spring of 1964. The experimental design was a randomized complete block with five replicates planted each year. The plots planted in 1965 and 1966 were kept weeded with a cultivator until they were planted. The individual plots were 9 × 20 ft and each contained 9 rows, spaced 12 inches apart. Nordan crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) was seeded at a rate of 25 seeds/ft of row. Planting dates were April 16, 1964; April 8, 1965; and March 31, 1966.

Treatments applied each year were as follows:

1. No weed control (check treatment).
2. Hand weeded to keep plots free of weeds all season.
3. Mowed when weeds 6 to 12 inches tall.
4. Mowed when weeds 18 inches tall.
5. Mowed when weeds 24 inches tall.
6. Sprayed with 2,4-D when weeds 6 to 12 inches tall.
7. Sprayed with 2,4-D when weeds 18 inches tall.
8. Sprayed with 2,4-D when weeds 24 inches tall.

A rotary mower was used to clip the weeds and grass to about a 1.5-inch stubble; all mowed material was removed from the plots. The amine formulation of 2,4-D (2,4-dichlorophenoxyacetic acid) at a rate of 3 lb acid equivalent in 60 gal water/acre was applied with a hand sprayer. (This heavy rate of application is probably excessive, but it was used intentionally to insure a rapid kill at the desired growth stages of the weeds.)

No reliable evaluation of grass stands could be made during the year of seeding because of the dense weed cover. The plots were mowed to remove old weed and grass material from the previous year before growth started in the spring of the year following seeding. Stand ratings were made after grass growth was far enough along to be certain that the plants were well established. The rating system used to evaluate the stands is based on the distribution and number of plants and has a 0-to-10 scale, on which "0"

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Table 1. Effects of weed control treatments on stand ratings of crested wheatgrass seedings in "average," "wet," and "dry" years.

Planting year and treatment number	Height of weeds on treatment date (in.)	Treatment date	Treatment[a]	Average stand rating[b]
1964 (average year)				
1			None	2.4
2			Hand weed	8.0
3	6–9	June 18	Mow	3.2
4	16–18	July 14	Mow	5.2
5	20–24	Aug. 13	Mow	3.8
6	6–9	June 18	Spray 2,4-D	7.4
7	16–18	July 14	Spray 2,4-D	3.2
8	20–24	Aug. 13	Spray 2,4-D	2.4
1965 (wet year)				
1			None	8.6
2			Hand weed	9.6
3	4–8	June 1	Mow	8.8
4	12–18	June 24	Mow	9.2
5	20–26	July 20	Mow	9.4
6	4–8	June 1	Spray 2,4-D	8.8
7	12–18	June 24	Spray 2,4-D	9.6
8	20–26	July 20	Spray 2,4-D	8.8
1966 (dry year)				
1			None	.6
2			Hand weed	4.4
3	2–6	June 10	Mow	.4
4	12	July 26	Mow	.6
5	12	Aug. 30	Mow	.8
6	2–6	June 10	Spray 2,4-D	1.0
7	12	July 26	Spray 2,4-D	.4
8	12	Aug. 30	Spray 2,4-D	.4

[a] Mowing was at a height of 1.5 inches, with the mowed vegetation removed; an amine formulation of 2,4-D was applied at a rate of 3 lb/acre.

[b] Rating made in spring of year following planting. Rating of 0 = no stand; rating of 10 = perfect stand.

equals no seeded plants in the plot, and "10" equals the best stand the plot can be expected to support. In general, a rating of "6" or above is considered to be a satisfactory stand.

The spring of 1964 was slightly drier than "normal," but it was still within the range of what can be called an "average year." However, the summer was particularly dry. Precipitation in 1965 was slightly below normal in the early spring, but it was adequate for good germination of seeded grasses and weeds. June, with over 5 inches of rain, and July were wet. The winter of 1965–66 was dry, and 1966 was one of the driest years of record throughout the entire season.

Because of the wide differences in climatic conditions, it it was not possible to follow the study plan with regard to weed height at times of treatment. Weed heights at the time of treatment and dates of treatment are shown in Table 1.

Results and Discussion

Moderately dense stands of weeds developed on the plots in 1964 and 1965; in 1966 the weeds were sparse, scattered, and lacked vigor. The predominant weeds were sunflowers (*Helianthus* sp.), Russian-thistle (*Salsola kali* var. *tenuifolia* Tausch), Belvedere summercypress (*Kochia scoparia* (L.) Schrad.), and prairie pepperweed (*Lepidium densiflorum* Schrad.).

The early spraying (weeds 6 to 12 inches high) was effective in all years because most weeds had emerged by that date; these plots remained almost free of weeds for the rest of the growing season. In 1964 and 1966, the weed reduction from 2,4-D on the 18- and 24-inch treatments was moderate to poor because of dry soil and poor growing conditions. In 1965, spraying killed weeds on both of the later treatment dates.

Early mowing (6 to 12 inch height) set the weeds back but did not kill many. The later mowing dates appeared much more harmful to the weeds, and, although many of the weeds were not killed, their growth was substantially retarded for the remainder of the season. No damage from mowing to the grass seedlings was observed at any time.

In 1964, the most nearly "average" year of the three, the differences due to treatments were greatest (Table 1). Hand weeding produced an excellent stand. The early spraying eliminated the weeds before they could deplete the soil moisture supply, and a very good grass stand resulted. The other treatments (with the possible exception of mowing when weeds were 16 to 18 inches high) provided no worthwhile benefit as compared to no weed control.

The early moisture in 1965 was sufficient to give good seedling emergence, and the heavy June and July rains provided adequate moisture for both grass and weeds. Because of the abundance of moisture, weed control produced no benefit to grass stand establishment.

In the extreme drouth of 1966, no satisfactory stands were obtained. A fair stand was obtained by using hand weeding, but this varied greatly between plots. Although early spraying killed weeds, the weeds had already depleted the limited moisture supply. Thus, in a year as dry as 1966, even the most intensive weed-control treatment did not produce a satisfactory stand, and the less intensive treatments resulted in failures. Furthermore, these poor grass stands were not a consequence of inadequate germination and emergence, because good seedling stands of grass were observed in mid-May before the weeds depleted the soil moisture.

Bement et al. (1965) reported that severe weed competition accompanied spring planting, and the weeds caused some seedling losses. Late summer seeding following summer fallow produced good

stands and eliminated the weed problem because the weed seeds did not germinate at that season. However, at Fort Collins, satisfactory seedling stands from late summer plantings have not been obtained, but early spring plantings consistently produced good seedling emergence. The success of the spring plantings is not unexpected because, on the average, spring is the period of greatest precipitation in this area.

Plummer et al. (1955) reported that Russian-thistle and other summer-growing annuals "make their growth after the grass seedlings are fairly well established, and so do not need to be eliminated." In north-central Colorado, crested wheatgrass seedlings will remain green and will continue growing throughout the summer of the seedling year, provided sufficient moisture is available, rather than become dormant in midsummer as do the mature plants. Therefore, it would seem advisable to eliminate even the summer-growing weed species, so that more soil moisture will be available for the grass seedlings.

No evidence of damage to seedlings of crested wheatgrass, intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.), pubescent wheatgrass (*A. trichophorum* (Link) Richt.), or Russian wildrye (*Elymus junceus* Fisch.) from mowing or from spraying with 2,4-D has been observed in the present study, or in other plantings at this location.

Although no seedling damage was observed from the heavy rate of application in this study, 3 lb/acre of 2,4-D is generally considered to be an excessive rate. However, determination of the most effective herbicide for local conditions or of optimum rates of application was beyond the scope of the present study. Further research is needed before specific recommendations concerning herbicides and rate of application can be made.

The only serious problem encountered so far in using the weed-free seeding method described here has been with wind erosion which sometimes blows the seed out. Wind damage has been held to a minimum by using the strip-planting technique described by Bement et al. (1965). Establishment of stubble for erosion control (Hull et al, 1958) has been intentionally avoided, because the moisture that is needed to establish the cover crop which is to be cut for stubble would utilize soil moisture and thus defeat the purposes of the fallowing (Bement et al., 1965). Methods for controlling wind erosion on clean seedbeds are being investigated. However, until better methods are developed, the strip-planting system should be used.

Where downy brome (*Bromus tectorum* L.) is present, most of its seed germinates in the fall or very early spring if sufficient moisture is available. The small amount of spring cultivation needed to smooth the seedbed has usually eliminated this very competitive weedy grass, at least for the remainder of that particular year.

Conclusions

If one is willing to accept the risk of a blow-out loss from wind, or if wind erosion can be controlled, then early spring planting on a clean, fallowed seedbed, followed by thorough weed control in the seedling stand, appears to offer the highest probability of successful grass establishment in north-central Colorado. Assuming that mechanical weeding is impractical on a range seeding, the broadleaf weeds can best be controlled with 2,4-D when they are still small, but spraying should be delayed until after most of the weed seeds have germinated. In average years, spraying will improve stands substantially because it will eliminate most of the weeds before they can deplete the soil moisture. If the soil moisture during the growing season is more than adequate, there probably will not be any benefit from spraying, but no harm will have been done. If the year turns out to be exceptionally dry, probably no treatment will produce a satisfactory stand, but this is one of the hazards of range seeding in semiarid zones where failures must be expected in some dry years in spite of good seeding techniques.

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