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Technical Note

Mowing of Annual Colonizers to Enhance Revegetation after Surface Mining

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Abstract

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Mowing of first-year erect, annual, colonizing vegetation (especially Kochia scoparia *and* Salsola collina*) was beneficial in the growth and establishment of wheatgrasses (*Agropyron caninum, A. smithii *and* A. elongatum*) on restored mined land in western North Dakota. Sample plots containing primarily* Kochia, Salsola *and* Agropyron *spp. were mowed in mid- and late-July and mid-August during the first year of growth after re-contouring, replacing topsoil, fertilizing with N, P and K, and seeding with a mixture of grasses and legumes.* Kochia *densities were reduced to about 2% and biomass to one-third that of the control when the area was mowed in mid-August.* Agropyron *spp., however, showed an increase of 860% in biomass production over the control due to mowing in mid-August. The mowing of* Kochia *just before seed-set apparently reduced interspecific competition between* Kochia *and* Agropyron *spp. during the following growing season. We recommend mowing for hastening the re-establishment of grasses following surface mining in grassland regions.*

Management practices to accelerate the revegetation of western mined lands often cease after fertilization and seeding. Although mowing has been shown to benefit agricultural, prairie and wildlife re-seedings when herbicides are not used for weed control (Burger, 1973; Rock, 1977), mowing has not been greatly

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used in the revegetation process on western mined lands. From an economic standpoint, a year gained in the revegetation process by enhancing the establishment of planted grasses and hastening the decline of weedy pioneers could result in earlier bond release to the mining companies. This note describes the effects of mowing of first-year colonizers on the establishment of grasses from North Dakota surface-mined coal lands.

For North Dakota surface coal mines that were re-contoured, topsoil replaced, fertilized and seeded, Iverson and Wali (1981, 1982a) showed that the annual colonizer *Kochia scoparia* (L.) Schrad. (Chenopodiaceae) often completely dominated first-year growth. *Kochia* acts as a nurse crop, for it germinates in early spring and protects emerging plants from high heat loads, reduces the effect of erosion by wind and water, and enhances snow retention in the first winter. Toward the end of the first growing season, however, large *Kochia* plants (up to 2 m in height) apparently cause a reduction in grass tillering due to shading (Iverson and Wali, 1982a). *Kochia* densities often exceed 10 000 plants m^{-2} during the second year after mining, which is detrimental to the growth and establishment of the planted species.

The study reported here was conducted during the summers of 1976 and 1977, and was designed to document the effect of mowing the large, first-year *Kochia* plants at various stages of growth before seed set on the growth of major planted and volunteer species in the second year. The experiment was conducted with the assistance of Knife River Coal Company, near Beulah, North Dakota.

Consistent with the reclamation procedures used by the mining company at that time, the research area was re-contoured, 20 cm of topsoil replaced, fertilized (225 Kg ha^{-1} of NPK as $N_{14}P_{10}K_{10}$) and drill-seeded in September 1975 with a mixture of species; primarily wheatgrasses (*Agropyron smithii* (6.7 kg seed ha^{-1}), *A. caninum* (4.5), *A. trichophorum* (2.3), *A. elongatum* (2.3), *Stipa viridula* (5.6), *Bouteloua curtipendula* (2.3), *Schizarhyrium scoparium* (2.3) and *Melilotus officinalis* (1.1)). Four plots, 15×60 m, were selected from a large homogeneous area for experimental manipulation. The vegetation on three of these plots was mowed to a height of 15 cm with a rotary mulching mower at one of three dates during the first growing season (15 July, 28 July or 18 August 1976). The fourth plot was not mowed and was used as a control. *Kochia* dominated all plots at the time of mowing, with an average density of 50 plants m^{-2} and an average height of 1 m.

The following year (second year after seeding), the four plots were sampled for biomass, density and plant size on 10 August 1977. Six replicate samples were taken in each of the four plots for plant height and density; plants were clipped and separated by species for biomass determination. The major species groups sampled were (1) planted *Agropyron* grasses, (2) *Kochia* and (3) *Salsola collina* (Russian thistle, another important colonizing chenopod). Other species present contributed little to density and biomass. Statistical evaluation

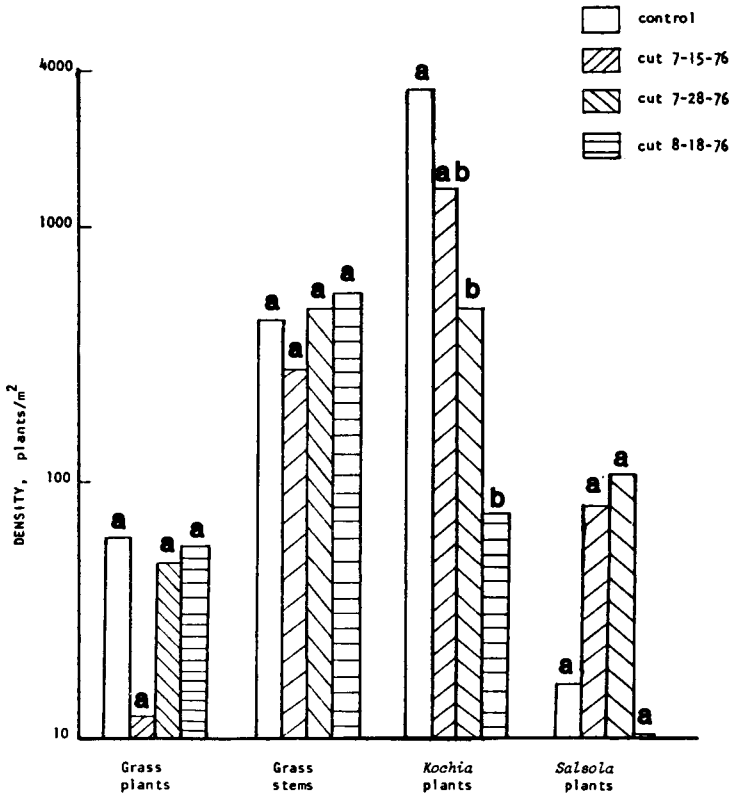

Fig. 1. Effect of mowing at different dates in 1977 on plant density. Columns within a species with the same letter are not significantly different.

of the data included analysis of variance with Tukey's HSD procedure (Steel and Torrie, 1980).

Kochia growth at the time of mowing was typical for the first year after mining in North Dakota (Iverson and Wali, 1982a). Second-year *Kochia* growth was also typical, as sampling showed an average density of 3360 *Kochia* plants m^{-2}, accounting for 166 g of biomass m^{-2} on the non-mowed control (Figs. 1 and 2). However, mowing reduced the density of *Kochia* plants in the second year; significantly so when mowed in late July and mid-August. Density of *Kochia* plants when mowed before seed-set the previous mid-August was only about 2% that of the control (Fig. 1). *Kochia* biomass values were also lower in mowed plots (Fig. 2). *Agropyron* spp. biomass, conversely, increased significantly when mowed in August of the preceding year (Fig. 2); the August-mowed plot had 8.6 times more grass biomass than the non-mowed control. *Salsola collina* was not abundant and showed no significant trends with mowing (Figs. 1 and 2).

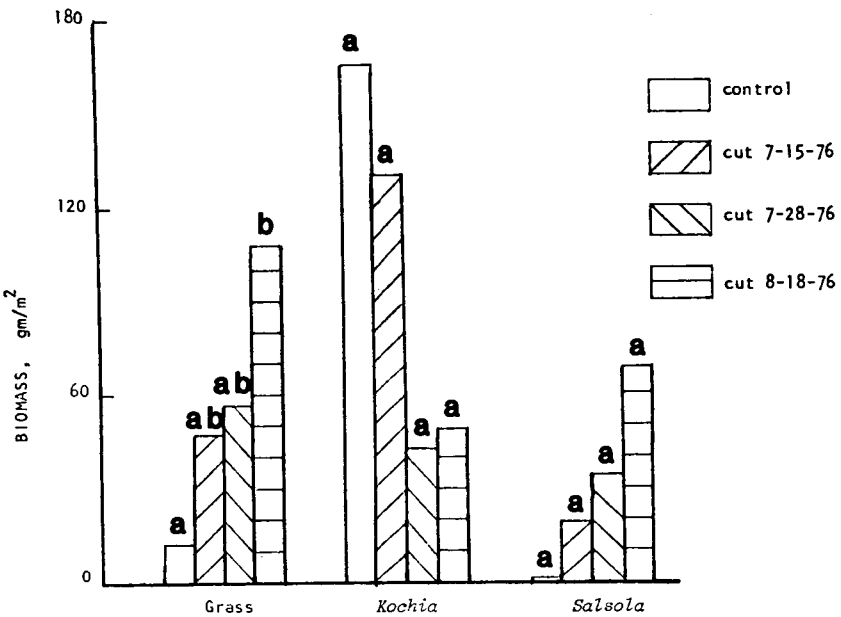

Fig. 2. Effect of mowing at different dates in 1977 on the biomass of *Agropyron* spp., *Kochia scoparia* and *Salsola collina*. Columns within a species with the same letters are not significantly different.

These findings provide information on a management practice that may hasten the revegetation process on surface-mined lands. Results showed that mowing of annual weeds, primarily *Kochia*, during the first year accelerated grass establishment. *Kochia* is capable of producing large numbers of seeds during the first year (up to 50 000 seeds/plant), which profoundly affects its density in the second year. Its seeds, however, are fairly short-lived in the seed bank (Iverson and Wali, 1982b; Iverson and Brophy, 1982). Mowing large *Kochia* plants just before seed-set (early-to-mid-August for North Dakota) substantially reduced its density in the second year, resulting in greater wheatgrass yields (Figs. 1 and 2). Mowing of erect annual weeds has been shown to reduce seed production if mowing occurs prior to the seeds becoming viable (Gill, 1983; Derscheid and Schultz, 1960; Klingman and Ashton, 1975). However, observations indicated that if mowed too early (i.e. before 1 August in North Dakota), *Kochia* often grows back and produces large numbers of seeds.

In summary, the reduction in *Kochia* populations may have resulted in one or more of the following mechanisms reducing competition in the growth of *Agropyron*. For example, only 2.3% of photosynthetically active radiation penetrated a dense first-year *Kochia* stand (Iverson and Wali, 1982a); mowing of this dense canopy would allow more light to penetrate to young grass seedlings. Light penetration would also be greater during the year after mowing, as dead

Kochia stocks from the previous year, if left intact, tend to shade the young grasses. Increased light penetration after mowing may allow the soil surface to warm earlier the next spring, aiding rapid grass growth. Another factor that may have had a major influence on grass establishment was water availability as related to *Kochia* density. Reduced *Kochia* density, as a result of mowing, should reduce transpirational water loss leaving more of the limited water supply for uptake by grasses. In addition, the stalks of *Kochia* that remained after mowing may have increased snow retention, thus enhancing water availability the second year. Results of the experiment strongly indicated that mowing should be considered as a management practice in revegetating mined lands.

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