Interseeding into Native Grassland with a Two-Row Lister Machine

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The first native grassland interseeding techniques study at the Dickinson Research Extension Center was conducted by Dr. Harold Goetz and Dr. Warren C. Whitman from 1969 to 1978. The objective was to determine the feasibility of interseeding native and tame grass species and legume species by mechanical treatment into native grassland to increase herbage production.

The established vegetation was mixed grass prairie on Morton fine sandy loam soil. The species interseeded included western wheatgrass (*Agropyron smithii*), green needlegrass (*Stipa viridula*), crested wheatgrass (*Agropyron cristatum*), Russian wildrye (*Elymus junceus*), smooth bromegrass (*Bromus inermis*), Ladak, Vernal, and Travois alfalfa (*Medicago sp.*), Eski sainfoin (*Onobrychis sp.*), and Emerald crown vetch (*Vicia sp.).* Two additional treatments were included in the study: check-plowed, plots receiving mechanical treatment with no seeding, and check-control, plots receiving no mechanical treatment and no seeding (Goetz and Whitman 1971).

The interseeded species were seeded October 1969 in 40-inch rows on 50 X 150 foot plots replicated three times. Interseeding was performed with a two-row lister machine mounted on a farm tractor by a standard three-point hitch (figure 1). Two 14-inch lister blades opened two furrows by scalping the sod from 35% of the land area, rolling the sod back in strips or chunks and depositing the sod clods onto the unplowed portion on both sides of each furrow. The overturned sod covered the remaining intact plant community at some percentage close to but probably less than 35%; the result was a damaged and chaotically undulating landscape. Seed from individual seed boxes that utilized a fluted seed metering wheel was gravity-fed through stationary seed tubes mounted behind the shank of each blade and was deposited near the center of the seedbed. The seed was covered and the seedbed firmed by metal pack wheels. All of the interseeded species were handled satisfactorily by this machine; however, the small-seeded legumes were planted at a higher-than-normal seeding rate. The legumes were seeded at 8 lbs/acre and the grasses at 15 lbs/acre (Goetz and Whitman 1978). No fertilizer was applied to these plots.

Forage yield data were collected during August from 1971 to 1978. Nine 12 X 80 inch frames per plot were placed across the rows and clipped. Percent composition of the individual species was estimated for each frame. The forage material was separated into grasses, forbs, and interseeded species and oven dried at 150°F (Goetz and Whitman 1978).

Germination and seedling establishment of the interseeded species were generally high early in the first growing season (1970). A week of hot weather later that spring caused a high mortality of seedlings, however, and extensive reduction of seedlings on the western wheatgrass, Russian wildrye, Eski sainfoin, and Emerald crown vetch treatments terminated data collection for those species. Stand establishment was poor during the first two growing seasons (1970 and 1971) for the other interseeded species except Travois and Vernal alfalfas (Goetz and Whitman 1971).

Travois, Ladak, and Vernal alfalfas, smooth bromegrass, and crested wheatgrass had large increases in herbage weight during the third growing season (1972). The herbage weight of fringed sage and annual forbs increased greatly during the third growing season. Populations of invading grass species, primarily western wheatgrass and smooth bromegrass, increased substantially and became established in all the plowed areas of the treatment plots. The release of nitrogen by the decaying organic matter in the overturned sod, the reduction in competition from short grasses, and the increase in availability of water allowed the invading grasses and forbs to increase and become established in the plowed treatments (Goetz and Whitman 1972).

Travois alfalfa had the greatest herbage production of the interseeded species throughout the eight years of data collection (table 1). The eight-year mean total herbage production was not different among the three alfalfa treatments. Travois, Ladak, and Vernal alfalfa treatments had significantly greater herbage production than the interseeded grasses and control treatments (Goetz and Whitman 1978, Nyren et al. 1978, Nyren et al. 1981).

Smooth bromegrass had the greatest herbage production of the interseeded grasses throughout the eight years of data collection (table 1). The eight-year mean total herbage production did not differ among the three interseeded grasses. The total herbage production on the smooth bromegrass, crested wheatgrass, and green needlegrass treatments did not differ from the herbage production on the check-plowed and control treatments (Goetz and Whitman 1978, Nyren et al. 1978, Nyren et al. 1981).

The plant species that invaded the plowed treatments produced an average of 206 pounds of herbage per acre (tables 1 and 2). The quantity of herbage produced by the invader plants did not differ from the quantity of herbage produced by the interseeded smooth bromegrass and crested wheatgrass plants (Goetz and Whitman 1978, Nyren et al. 1978, Nyren et al. 1981). The intact native plant community produced 813 pounds of herbage per acre on the same amount of land area plowed by the mechanical interseeding treatment and occupied by the invader plants.

The portion of the land area that remained as an intact plant community was affected by the ecological changes the mechanical treatment caused. Plants in different biotype categories on the intact community did not all respond the same. Mid grasses and annual forbs increased, while short grasses and perennial forbs decreased.

Mid grass herbage production averaged 20.6% greater on the interseeded treatments than on the control treatment (tables 1 and 2). Crested wheatgrass was the only treatment with a decrease in mid grass yield. Short grass herbage production on all interseeded treatments decreased greatly and averaged 52.0% lower than the short grass herbage production on the control treatment (tables 1 and 2). Most perennial forb species decreased; the exception was fringed sage, which increased. Perennial forb herbage production averaged 13.8% greater on the crested wheatgrass and green needlegrass treatments than on the control treatment because the increase in fringed sage was greater than the decrease in the other perennial forbs. Perennial forb herbage production averaged 25.9% lower on the smooth bromegrass and three alfalfa treatments than on the control treatment because the decrease in the perennial forbs was greater than the increase in fringed sage (Goetz and Whitman 1972). Annual forb herbage production averaged 32.4% greater on the interseeded treatments than on the control treatment. Annual forb herbage production averaged 15.0% lower on the smooth bromegrass and Ladak alfalfa treatments than on the control treatment (tables 1 and 2) (Goetz and Whitman 1978, Nyren et al. 1978, Nyren et al. 1981).

The results from this study showed that establishing native grass species by interseeding was difficult and that native grasses established by interseeding produced less herbage than the previously intact native plant community. Establishing Russian wildrye by interseeding was shown to be difficult. Smooth bromegrass and crested wheatgrass were readily established by interseeding; however, the quantity of herbage produced was not greater than that produced by the previously intact native plant community, and the study indicated that those two tame grasses could and would invade native plant communities following mechanical disruption. Sainfoin and crown vetch were far more difficult to establish by interseeding than alfalfa. Alfalfa could be interseeded and established readily into native grassland, and the quantity of alfalfa herbage along with the quantity of herbage produced by the remaining plants was 32% (Nyren et al. 1978) to 36% (table 2) (Goetz and Whitman 1978) greater than the quantity of herbage produced on the control treatment.

The combined herbage production of the grasses and forbs from the intact plant community on the interseeded treatments that had 35% of the established plant community mechanically removed averaged 8% to 9% below the herbage production of the grasses and forbs from the intact plant community on the undisturbed control treatment (table 2). Production of nearly as much herbage on 65% of the land area as the average quantity of herbage produced on the undisturbed control treatment required an increase of 30% to 45% in herbage biomass production from the intact grasses and forbs on the mechanically disturbed treatments. This important scientific finding indicates that if the correct combination of ecological disturbances that increase available nitrogen and soil water infiltration is applied through biologically effective management, intact native grassland plant communities have the potential to increase herbage production 30% to 45% above the level of herbage production typical on traditionally managed grasslands.

The purpose of the interseeding procedures was to directly seed into established plant communities grass or legume species that would produce greater herbage biomass than that produced on the area before the established plant community was destroyed during the execution of the treatments. Production from the interseeded species needed to offset the herbage loss caused by the interseeding sod control technique in order to be successful. None of the interseeded grass

species reached that level of herbage production. The interseeded alfalfa varieties in combination with the grasses and forbs on the intact portion of the treatments had mean total herbage production 32% to 36% greater than the mean herbage production of the control treatment.

The lister interseeding machine achieved excellent sod control, reducing the competition from the established plants and opening a furrow that presumably decreased runoff and aided water infiltration. The overriding disadvantage of this mechanical treatment was that it scalped a large portion of the land area, causing major destruction to the established plant community, physically exposing the soil surface to wind and water erosion, and creating an extremely rough land surface.

The terrain on the study plots was too rough to drive across 35 years after the mechanical treatments had been conducted. The plowed areas were vegetated, but the furrows had depths ranging between two and six inches. The study plots had lost almost all of the native plant component and were dominated by smooth bromegrass with a subdominant of crested wheatgrass. Alfalfa grew on some plots at about a plant per meter of row. Some remnant native plants remained on the unplowed control plots and alleyways between the replications.

The long-term results from interseeding into native grassland with a lister machine did not meet the desired goals of the study. The ecological processes that were changed by the mechanical treatments in autumn 1969 had not recovered 35 years later. The perennial forb and short grass species were diminished greatly, and their reduction created open spaces for invading species to increase and replace the native plant component. The short-term increase in herbage production on the alfalfa treatments did not persist.

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Table 1. Mean dry weight yields in lbs/acre for native grassland interseeding study, 1971-1978.

	Grasses			Forbs					
Treatments	Mid	Short	Total	Perennial	Annual	Total	Grasses and Forbs	Interseeded Species	Total Production
Check control	1179	787	1966	327	30	357	2323	NA	2323
Check plowed	1333	415	1748	320	38	358	2106	206	2312
Crested wheatgrass	1095	478	1573	355	52	407	1980	250	2230
Smooth bromegrass	1584	358	1942	239	23	262	2204	260	2464
Green needlegrass	1326	456	1782	389	60	449	2231	79	2310
Vernal alfalfa	1540	373	1913	221	30	250	2163	934	3097
Ladak alfalfa	1641	375	2016	283	28	311	2327	855	3182
Travois alfalfa	1436	192	1628	226	47	273	1901	1292	3193

Data from Goetz and Whitman 1978

Table 2. Percent increase or decrease in herbage yield on interseeded treatments compared to herbage yield on the control treatment.

	Grasses			Forbs					
Treatments	Mid	Short	Total	Perennial	Annual	Total	Grasses and Forbs	Interseeded Species	Total Production
Check control	1179	787	1966	327	30	357	2323	-	2323
Check plowed	+13.06	-47.27	-11.09	-2.14	+26.67	+0.28	-9.34	+8.87	-0.47
Grasses	+13.23	-45.28	-10.19	+0.20	+50.00	+4.39	-7.95	+4.69	+0.50
Alfalfas	+30.54	-60.18	-5.78	-25.59	+16.67	-22.13	-7.96	+398.54	+35.92

Summary of data from Goetz and Whitman 1978

Fig. 1. Two-row lister machine.

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