Interseeding for Range Improvement in the Northern Great Plains[1]

WALTER R. HOUSTON[2] AND ROBERT E. ADAMS

Range Scientist, Plant Science Research Division, Agricultural Research Service, U. S. Department of Agriculture; and Range Conservationist, Bureau of Land Management, U. S. Department of the Interior, Miles City, Montana.

Highlight

A heavy-duty range interseeder is described that uses mostly commercially available parts. A rapid increase in yield of native forage species, particularly western wheatgrass, found following furrowing alone was sufficient for success of the interseeding practice. Seeding adapted grasses and legumes further increased forage production. Orenberg alfalfa was the most successful species interseeded in the Northern Great Plains. A parallel increase in the undesirable fringed sagewort may require control measures. Interseeding is a cheap and profitable method of range improvement.

El Mejoramiento de los Pastizales en los Planos del Norte de E.U.A. por la Intersiembra

Resumen[3]

Encontraron que la intersembradora fabricada no era bastante fuerte para la intersiembra. Una intersembradora mas fuerte hecha por los autores usando principalmente refacciones comerciales es descrita. El aumento en la producción de forraje nativo por causa de los surcos hechos por la intersembradora fué suficiente para justificar la intersiembra. Pero, la intersiembra de gramíneas y leguminosas aumentó mas la producción. Orenburg alfalfa fué la especies más exitosa. La intersiembra es recomendable para mejorar la condición del pastizal.

Range interseeding has shown promise of significantly increasing productivity and the proportion of desirable forage species on depleted ranges. When ranges are to receive deferment from grazing for improvement, interseeding may considerably reduce the time required.

During the drought of the 1930's limited contour furrowing of rangelands was used to hold rainfall, reduce soil blowing and prevent deposition of sediment on lower areas. The accompanying destruction of native vegetation led to development of seeding attachments to the furrowing machines.

Since the early 1950's interseeding has become more widespread as a range improvement practice, and improved machines have been developed (Becker et al., 1956; Dudley et al., 1966; Hervey, 1960; Schumaker, 1964). Ryerson et al. (1970) describes several interseeding machines developed for use on clubmoss (*Selaginella densa* Rydb.) dominated rangelands in Montana. However, most machines lack strength and durability for dense clay or rocky soils.

The principle of range interseeding is that of planting in a scalped furrow from which all native vegetation has been removed. The furrows are prepared by undercutting about 2 inches below ground level and usually placing the turned-over sod strips to the side. The width of strips is important to seeding success through reduction of competition for moisture. Wider furrows are required in regions of low precipitation.

Since 1964 the Agricultural Research Service and the Bureau of Land Management have cooperated in development of an interseeding machine suited to rough topography and clayey soils in the Northern Great Plains. In order to minimize supply problems, maximum use was made of commercially available, off-the-shelf parts. This report describes the resulting machine as well as the results of research on adaptability and limitations of interseeding and species responses to the practice.

Equipment Development

The first model interseeder was constructed in 1964 of Allis-Chalmers[4] double-disk seeders and 18-inch sweep blades on a single tool bar with 3-point hitch. Mower blade sections were mounted upright 7 inches apart on the upper surface of the sweep blades in order to create a furrow, and other sections horizontally on the outer edge of the blade to increase width of undercut to 20 inches (Fig. 1).

This first model was not strong enough. Bending and breaking of parts resulted, and the point of the sweep blade occasionally cut the tractor tires.

The machine was redesigned in 1966 by using 2 parallel-mounted, solid, 2 × 2-inch, steel tool bars with middlebuster bottoms mounted on the front bar and seeder units on the rear bar (Fig. 2). Stronger, 1 × 3-inch steel shanks and standards were used. In 1967 gauge wheels were changed to a sealed-bearing type.

Some custom modification was necessary. A brush guard was mounted over the seeder chains, and wings were added above the furrower bottom to reduce damage to the seeder mechanism from chunks of sod and brush thrown up by the operation. A breakaway with a shear pin was added to the furrower bottoms to reduce damage on rocky sites. The furrower bottoms were mounted with strengthened steel fittings to keep bottoms aligned. Seeder arms were modified

[1] Contribution of U. S. Department of Agriculture, Agricultural Research Service, Plant Science Research Division, and U. S. Department of the Interior, Bureau of Land Management. Received January 5, 1971.

[2] Present address is Crops Research Laboratory, Colorado State University, Fort Collins, Colorado.

[3] Por Donald L. Huss y Benjamín López, Dep. de Zootecnia, I.T.E.S.M., Monterrey, México.

[4] Mention of a particular manufacturer does not imply endorsement by the U. S. Department of Agriculture or exclude products of other manufacturers which may also be suitable.

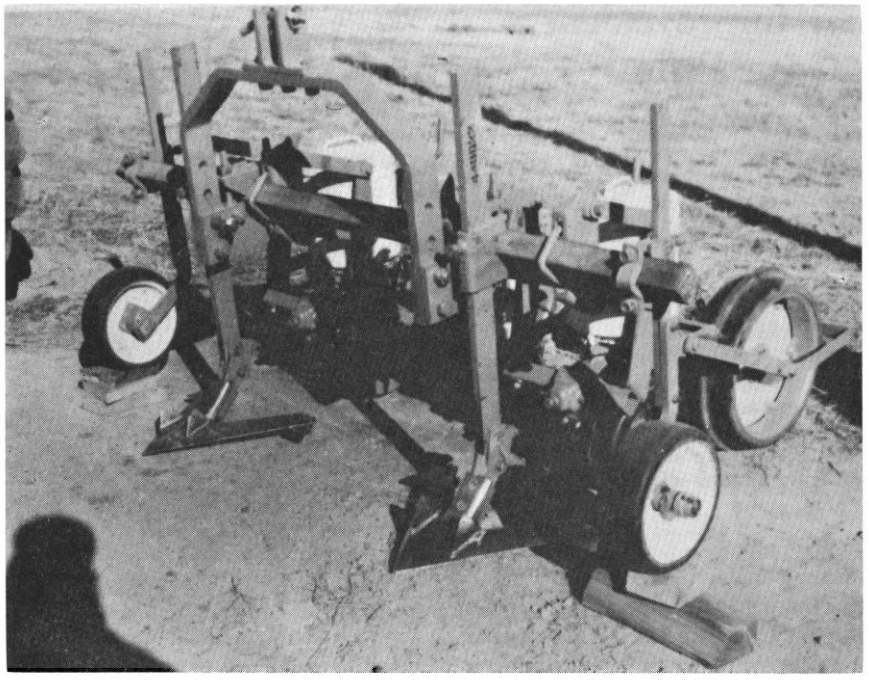

FIG. 1. First model interseeder showing modified sweep blades.

to provide higher lift on turns and to clear brush and other obstacles. Drag chains were added for better seed coverage.

Acceptable field performance of the interseeder in 1967 and 1968 indicated that basic development was complete.[5] The finished machine is similar in several respects to the Bushland Interseeder (Dudley et al., 1966). It is stronger and has better adaptability to brush-covered, rocky, and dense clay range sites.

Seeding Methods

A series of seedings was established in the fall of 1965 on native range near Ismay, Montana, using the modified sweep blade. With this blade the sod strips were undercut but left in place with a small 6-inch furrow in the center. Some plots were furrowed but not seeded. Furrows were spaced 54 inches apart, center-to-center. Species and treatment combinations were assigned at random in each of 3 replicates. Plot size was 60×60 feet. In both spring and fall of 1966, species and treatments were repeated using a 22-inch commercial middlebuster furrower that turned over the sod strips and placed them outside the furrow.

The experimental area was fenced in the spring of 1966 to exclude livestock. Stand establishment of seeded species was evaluated in August of 1966 and 1967. Herbage yields of the more successful treatments were determined from 1967 through 1969. Four 1×4-feet plots located in each quarter on each species plot were harvested in early August each year.

Native vegetation was typical of mixed pan spot and clayey range sites. The major species were western wheatgrass (*Agropyron smithii* Rydb.) and blue grama (*Bouteloua gracilis* (H.B.K.) Lag.). Small amounts of green needlegrass (*Stipa viridula* Trin.) and buffalograss (*Buchloe dactyloides* (Nutt.) Engelm) were present. Big sagebrush (*Artemisia tridentata* Nutt.) and plains pricklypear (*Opuntia polyacantha* Haw.) plants were thinly scattered over the area. Forbs and annual species were initially only a minor component of plant cover.

Weather

Precipitation was 10 to 20% below normal in 1966, the first growing season after the seeding study began (Fig. 3). Spring precipitation varied during the following

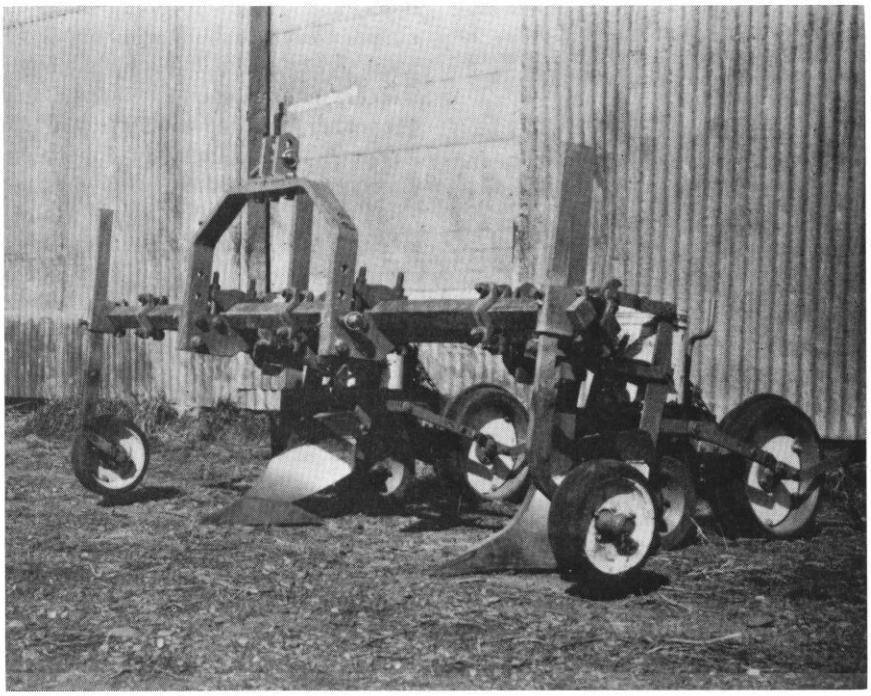

FIG. 2. The Miles City interseeder. Note heavy construction and middlebuster furrowers.

[5] Parts list available from either author.

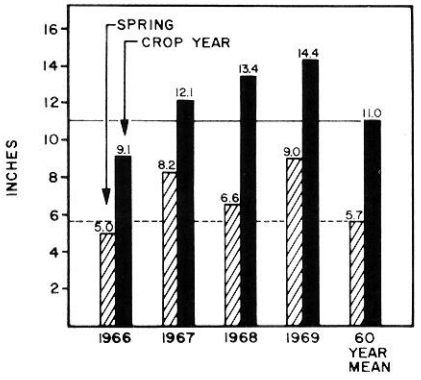

FIG. 3. Spring (April–June) and crop-year (preceding September–current July) precipitation at Mildred, Montana, for the period 1966–69, with long-term means. Experimenaal area located 8 miles southeast.

FIG. 4. One-year-old Orenberg alfalfa stand from interseeding, in September 1967.

years from 15 to nearly 60% above average. Crop-year moisture increased from 10% above average in 1967 to 30% above in 1969, the last year of the study.

Seeding Results

Stand Establishment

Three grass species from the 1965 fall interseeding and three legumes from the 1966 interseedings had successful stands in September 1967 (Table 1).

White prairie clover (*Petalostemum candidum* (Willd.) Michx.) from the 1966 spring interseeding and Orenberg alfalfa (*Medicago sativa* L. cultivar Orenberg) (Fig. 4) from the fall interseeding had the best stands in September 1967. The 1966 spring interseeding of Orenberg alfalfa was rated a failure in 1967, showing the severe effects of the low precipitation of 1966 on establishment of this species.

Other species seeded in the fall of 1965 and spring and fall of 1966 did not establish successful stands. These included western wheatgrass, bluebunch wheatgrass (*A. spicatum* (Pursh) Scribn. and Smith), Indian ricegrass (*Oryzopsis hymenoides* (Roem. and Schult.) Ricker), fourwing saltbush (*Atriplex canescens* (Pursh) Nutt.), Nuttall saltbush (*A. nutallii* S. Wats.), winterfat (*Eurotia lanata* (Pursh) Moq.), and Teton cultivar of alfalfa.

Table 1. Species, season, and year interseeded; with stand ratings (percent of full stand) in 1966 and 1967.

Species	Season and year interseeded	Stand rating			
		June 1966	July 1966	June 1967	Sept. 1967
Green needlegrass	Fall 1965	15	20	13	8
Thickspike wheatgrass[1]					
(Ekalaka source)	Fall 1965	10	45	10	10
(Havre source)	Fall 1965	15	43	11	20
Orenberg alfalfa	Spring 1966	75	43	2	T
Orenberg alfalfa	Fall 1966	—	—	35	45
Rambler alfalfa	Spring 1966	90	40	17	T
White prairie clover	Spring 1966	40	80	42	25

[1] *Agropyron dasystachyum* (Hook.) Scribn.

Herbage Yields

The most rapid vegetational changes from interseeding occurred between the furrows from the native vegetation already present. Yield of western wheatgrass increased faster in response to the range furrowing treatments than any other species observed (Table 2). The species rapidly invaded the furrows. The greatest response was on the 1965 furrowing treatment of plots furrowed but left unseeded. On this treatment, yield of western wheatgrass increased approximately 650% in 1967 (Fig. 5) and 1968 and nearly 300% in 1969. On the plots where white prairie clover and Rambler cultivar of alfalfa were seeded in the spring of 1966, yields of western wheatgrass increased 265–575%.

Blue grama yields decreased greatly after furrowing. The reductions in blue grama yield averaged 46–48% in 1967, and ranged as high as nearly 90% in 1968 and 70% in 1969.

The change in composition from interseeding to more of the cool-season western wheatgrass and less of the warm-season blue grama provides more early and late-season

Table 2. Herbage yield (lb./acre, air-dry) of major species and plant groups from interseeding treatments applied in 1965 and 1966 and harvested in 1967, 1968, and 1969.

Year and plants harvested	Interseeding treatments and date of treatment									
		Fall 1965				Spring 1966			Fall 1966	
	Control	Furrowed only	Green needle	Thick-spike-H	Thick-spike-E	Furrowed only	Prairie clover	Rambler alfalfa	Furrowed only	Orenberg alfalfa
1967										
Seeded species	—[1]	—	20a[2]	30a	10a	—	20a	20a	—	[3]
Western wheat.	130d	980a	620bc	350cd	440bcd	220d	760ab	730ab	340cd	[3]
Blue grama	690a	310de	330cde	570ab	320cde	510abc	350cde	260e	480bcd	[3]
Annual & forbs	4d	40cd	170ab	100bcd	80bcd	130abc	80bcd	40cd	200a	[3]
1968										
Seeded species	—	—	280a	150ab	130ab	—	20c	60bc	—	160ab
Western wheat.	110c	790a	580b	350bc	280bc	200bc	720a	430b	520b	200bc
Blue grama	380a	50e	110de	190cde	200bcd	270abc	160de	120de	200bcd	310ab
Annuals & forbs	260abcde	100e	470a	120de	210bcde	320ab	150cde	280abcd	310abc	190bcde
1969										
Seeded species	—	—	270b	240b	260b	—	50b	80b	—	650a
Western wheat.	230e	900ab	450de	370de	650bcd	230e	1160a	830abc	520cde	310de
Blue grama	570a	160d	340b	250bcd	240bcd	350b	190cd	310bc	160d	300bcd
Annuals & forbs	160c	140c	150c	50c	70c	160c	140c	290b	430a	80c

[1] Species or plant group not present.
[2] Means in the same species-row followed by the same letter are not significantly different at the 5% level (Duncan, 1955).
[3] Not harvested in 1967.

forage thus lengthening the grazing season. This may be important on heavily grazed ranges or on ranges grazed mostly during spring where western wheatgrass and other cool-season species are commonly greatly reduced.

Herbage yield of most interseeded species increased rapidly during the study and further increased total yield. The grasses seeded in 1965 contributed only 1–3% of total herbage in 1967. The contribution increased to 15–19% in 1968, and to 21–25% in 1969. The legumes interseeded during the spring of 1966, native white prairie clover and Rambler alfalfa, responded slowly. Their contribution to total herbage yield has averaged less than 6% throughout the study. However, yield of Orenberg alfalfa interseeded in the fall of 1966 increased to 16% of total herbage yield on the plot in 1968, and to 47% in 1969. In 1969 yields of perennial herbage on the plots seeded to legumes were 50 to 100% higher than yields on either the control or furrowed only treatments.

FIG. 5. Increased stand of western wheatgrass from range furrowing on left. Undisturbed control area on right.

Increased yields of native annuals and perennial forb species were found in 1967 on most interseeding treatments. These species were able to take advantage of the soil disturbance. The most abundant species of this group in 1967 was common sunflower (*Helianthus annuus* L.) closely followed by Russian thistle (*Salsola kali* L.) and, in 1968, blue lettuce (*Lactuca pulchella* (Pursh) DC.).

By 1969, yield of annual and forb species was declining on most treatments in response to increasing cover of perennial grasses.

Table 3. Protein content (%) of species and plant groups from interseeding treatments applied in 1965 and 1966 and harvested in 1967 and 1968.

Year and plants harvested	Treatments and date of application				
		Fall 1965	Spring 1966		Fall 1966
	Control	Furrowed only	Furrowed only	Rambler alfalfa	Furrowed only
1967					
Seeded species	—[1]	—	—	8.6	—
Western wheat.	—	6.9	10.0*[2]	6.9	7.7
Blue grama	7.1	6.7	6.2	6.5	6.6
Perennial herbage	7.1	6.9	6.7	6.9	7.3
Annuals & forbs	9.8	8.7	11.2*	8.5	9.9
Total herbage	7.1	7.0	7.8*	6.9	7.9*
1968					
Seeded species	—	—	—	9.7	[3]
Western wheat.	—	5.5*	7.2	6.6	[3]
Blue grama	7.2	—	6.3	—	[3]
Perennial herbage	7.2	5.5*	6.6	6.4	[3]
Annuals & forbs	4.8	—	4.6	4.8	[3]
Total herbage	6.3	5.5	6.0	5.7	[3]

[1] Species or plant group not present or in inadequate amounts for analysis.
[2] *Significantly higher or lower than control treatment or other treatments of same species at 5% level (Duncan, 1955).
[3] Not sampled in 1968.

Fringed Sagewort

An increase in fringed sagewort (*Artemisia frigida* Willd.) was found on most interseeding treatments. This undesirable species sprouts from adventitious roots when disturbed. The species may decrease in time with increased competition as the plant cover increases. However, it may become necessary to control the species with herbicides. This is usually not difficult (Hyder, 1971; Ryerson et al., 1970).

Plant Protein

Increased plant protein was found in 1967 on the two furrowing treatments of 1966 (Table 3). In 1968, evidence of reduced protein level was observed on the 1965 furrowed only treatment.

It appears that range furrowing treatments may temporarily increase plant protein as a result of increased nitrogen availability from the soil stirring operation. The increase may be of short duration. Reduced protein levels may be found several years after treatment as the available nitrogen is temporarily bound in the increased herbage yield.

Discussion and Conclusions

Observations over a period of years, of this and other interseeding machines and their effectiveness, have indicated that the type and brand of equipment and design of furrower were not critical. The most important considerations were strength, durability, and ease of transport and use. In this study the two types of furrower bottoms used were about equally successful.

The rapid increases in yield from the native species already present indicate that a successful stand of the interseeded species is not necessary for success of the practice. The rapid increase in yield of the desirable native western wheatgrass from the furrowing operation alone is enough to indicate success for the range improvement practice.

Stand establishment from interseeding was successful only for a few of the most adapted native grasses, the native white prairie clover, and Rambler and Orenberg cultivars of alfalfa on the clayey soils of the study site. These species rapidly increased and further increased total forage yields from interseeding.

The low moisture of 1966 limited initial alfalfa stands. However, later germinating seed was able to provide a successful stand of the Orenberg alfalfa. Severe weather effects on limiting stands of interseeded alfalfas have been shown in South Dakota studies (Rumbaugh and Thorn, 1965).

The continuing low productivity of the legumes from the 1966 spring seedings may indicate that late-fall seeding (October–November) of legumes is superior to spring seeding. This has been commonly observed with grass seedings.

The low cost of interseeding, estimated at $2.50 to $4.00 per acre (exclusive of seed costs and 1- to 2-year deferment but including a prorated share of machine costs), indicates that the practice is a cheap method of range improvement.

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