INTERSEEDING INTO NATIVE RANGELAND TECHNIQUES TRIALS

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Grazing of established alfalfa interseeded native range pastures has been shown by Manske et al. (1984) to be very beneficial for livestock production in western North Dakota during non-drought years. Techniques to establish alfalfa into native rangeland that show consistent successful results are lacking for the Northern Great Plains.

The primary purpose of this research project was to develop interseeding techniques that successfully establish alfalfa into rangeland. This study was designed to study the effects of interseeding on several alfalfa varieties and the effects of different furrow widths, different row spacings, different seeding times, fertilization with nitrogen and phosphorus, different seeding rates, different inoculation processes and different seed packing techniques on stand establishment. This summary paper presents the interseeding techniques research trials that have been conducted at the Dickinson Experiment Station from 1983 through 1986.

Procedure:

Each of the several factors of interseeding that were studied were set up as separate trials. All of the treatments in this study were replicated three times in a randomized block design. Control plots of no treatment were included with each trial. Travois alfalfa was used as the standard test variety in all of the trials. The seeding rate for all of the trials was 0.50 lbs. PLS/row/acre. This seeding rate was about the equivalent of solid seeding 12 lbs. PLS/acre which was about twice the recommended rate for the region for hay type alfalfas. The desired established stand plant densities was 1 to 2 plants per foot of row. The machine used to interseed was built from plans designed at South Dakota State University (Chisholms et al. 1980). Several modifications have been incorporated since the initial construction.

The alfalfa variety testing Trial I was seeded in late April 1983 with three foot row spacings using 3 inch twisted chisel plow shovels to open the furrows. The varieties included were: Anik, Drylander, Kane, Prowler, Rangelander, Spredor II, Travois, and Vernal. A second alfalfa variety Trial II was seeded in mid April 1986 with ten foot row spacings using the combination of coulter pairs, followed by 3″ twisted chisel plow shovels followed by 12″ cultivation sweeps to open the seed furrows. The varieties included were Anik, Drylander, Kane, Ladak, Mandan A1801, Rangelander, Spredor II, and Travois. Alfalfa plant density counts were collected annually and plant heights were collected in 1985 and 1986.

The effects of furrow width trial was conducted on two separate sets of plots. The first set of plots were seeded in late April 1983 with 3 foot row spacings using 2 inch spike, 3 and 4 inch twisted chisel plow shovels to open the furrows. Alfalfa plant counts per row and ten pin point frame data for species composition have been collected annually. The second set of furrow width plots were seeded in mid April 1985 with 10 foot row spacings using 2 inch spike, 3, 4 and 6 inch twisted chisel plow shovels, 6, 12 and 16 inch cultivator sweeps behind tandom coulters spaced 3 inches apart and a 14 inch lister plow spaced 3 feet apart. The lister seeding rate was about 1.5 lbs. PLS/row/acre which was about three times greater than the other treatments. Alfalfa plant density counts and plant heights were collected monthly.

The effects of row spacing trial was started in late April 1983 using 4 inch twisted chisel plow shovels to open the furrows with 2, 3, 4, 5, 8 and 10 foot row spacings. Herbage production data was collected from clipping ¼m^2 frames centrally placed between the furrows of each treatment. Ten pin point frame data for species composition was collected annually.

The time of seeding trial was seeded in mid November 1984, mid April and mid May 1985 with 10 foot row spacings using 3 inch twisted chisel plow shovels to open the furrows. The fertilization trial with nitrogen applied at 60 lbs./acre and phosphorus (P_2O_5) applied at 50 and 100 lbs./acre was conducted on split plots of the time of seeding trial. Alfalfa plant density counts and plant heights were collected monthly.

A trial to test the improvements in techniques indicated from previous trials was started in mid April 1986. The factors included were seeding rate, fertilization rate, inoculation process, seed packing and presence of tip on undercutting sweep. Previous trials have indicated that narrow furrows with undercut sod in place have advantages over removal of the sod in wide furrows. Modifications were made that included a pair of coulters spaced three inches apart to cut sod, followed by a three inch twisted chisel plow shovel to kick out the 3″ strip of sod, followed by alfalfa seed tube and seed packer, followed by twelve inch cultivator sweeps to undercut adjacent sod placed one inch above seed bed followed by fertilizer tube. Alfalfa seedling densities per foot of row and plant heights were collected monthly.

Results:

All of the alfalfa varieties included in both variety testing trials performed similarly (Tables 1 and 2). The desired plant density of 1 to 2 plants per foot of row was not reached by any of the varieties in the first trial in 1984 to 1986. The 0.5 lbs. PLS/row/acre seeding rate may be too low for interseeding available alfalfa varieties into rangeland. There was very little difference in the plant densities of the varieties. Travois had slightly greater densities than the other varieties in both trials. The plant heights have also been very similar.

Grass basal cover (Table 3) for the 2 and 3 inch chisel plow shovels was very similar to the control plots in all 4 years of the furrow width Trial I. Grass basal cover for the 4 inch twisted chisel plow shovel was consistently below the control and other furrow widths. The mean number of alfalfa plant per foot of row (Table 4) for all of the furrow widths in the furrow width Trial I were below the desired 1 or 2 plants per foot of row density. There was very little difference in plant densities between the different furrow widths.

The plant densities for all of the furrow widths in the furrow width Trial II (Table 5) were above the desired 1 or 2 plants per foot density in 1985 but the densities of all the chisel plow shovels dropped below this level in 1986. There was very little difference in plant densities between the 3, 4 and 6 inch chisel plow shovels. There also was very little difference in plant densities between the 12 and 16 inch cultivator sweeps behind coulter pairs. The sweeps had greater plant densities than the chisel plow shovels. The 2 inch chisel and the 6 inch sweep were intermediate of the twisted chisels and the larger sweeps. The 14 inch lister blade was seeded at about three times the seeding rate of the other treatments. The plant densities for the lister blade were greater than 3 times the densities of the chisel plow shovels but not for the two larger cultivator sweeps. The 14 inch lister blade disturbs a large portion of range sod compared to the undercutting cultivator sweeps. The mean plant heights (Table 5) were not very different for any of the treatments.

The mean above ground herbage production for the row spacing trial (Table 6) was collected from frames centrally placed between the furrows of each treatment. The distance between the frames and the furrows varied with the different row spacings. After the initial treatment year, the 2, 3, and 4 foot row spacings appeared to have some increase in grass herbage production from the effects of furrowing. The 3, 4, 5 and 8 foot row spacings appeared to have an increase in forb herbage production from furrowing. The 2 foot row spacing had very dynamic forb production. The 5, 8 and 10 foot row spacing had very little effect from furrowing on grass herbage production and the 10 foot row spacing had very little effect on forb herbage production.

The grass and forb basal cover (Table 7) for the treatments in the row spacing trial generally increased during the first year of treatment. The grass densities of the 2, 3 and 4 foot row spacings decreased below the control plots in the second, third and fourth year of treatment. The 5, 8 and 10 foot row spacings had very little change in grass densities and very similar to the control plots for 1984-1986.

The mean percent area disturbed (Table 8) in the row spacing trial for the furrow was generally greater than the calculated area of disturbance. The percent area of the removed sod was less than calculated the first year and increased the second year as the sod chunks eroded and decreased during the succeeding years as these areas revegetated.

The mid April seeding time had the greatest densities of alfalfa plants per foot of row the first year of the seeding time trial (Table 9). The mid November and mid April seeding times had similar plant densities during the second year. Mid May seeding time had extremely low plant densities the second year. The dormant seeding of mid November had the greatest mean plant height the first and second years of the trial (Table 10). The addition of nitrogen increased the plant densities the first and second years of the trial at the three seeding dates. Nitrogen increased plant heights the first year but had very little difference the second year except for the mid May seeding date where the plants appeared to be under greater stress. The addition of 50 and 100 pounds of P_2O_5 per acre had very little effect on plant densities the first year. The 50 lbs. of P_2O_5 rate had very little effect on density the second year but the 100 lbs. P_2O_5 rate appeared to have some effect on plant density the second year for the three seeding dates. Both the 50 and 100 pound rates appeared to have some effect on plant height the first and second years of the trial.

Doubling the seeding rate increased plant density (Table 11) but did not double it in the technique improvement trial. Seeding rate did not effect plant height. Addition of nitrogen and phosphorus increased plant density and plant height. No difference in the 30 pound or 60 pound rates was observed during a year with favorable precipitation. Seed coating to inoculate rhizobium to each seed showed no advantage over conventional mixing rhizobium and seed during favorable precipitation conditions. The addition of the seed coat reduced the seeding rate to .33 lbs. PLS/row/acre which was two thirds of the control seeding rate. The plant densities of the seed coated treatment were two thirds of the control for May and August sample dates. The seed coating treatment did appear to increase plant height over the control. Using a pack wheel to pack seed only had a slight increase in plant density over using a drag chain to pack seed. There was no difference in plant height due to seed packing method. The cultivator sweep used to undercut sod adjacent to the seed furrow follows the seeding tube one inch above the seed bed. The tip of the sweep serves no practical purpose under these conditions and may disturb the seed. The treatment with the tip removed did show an advantage over the treatment with the tip present in increased plant densities. No difference in treatment was seen in plant height.

Discussion and Summary:

The major pasture type alfalfas that were available for interseeding were very similar in stand establishment. The seeding rate of 0.5 lbs. PLS per row per acre may be too low for interseeding to reach a desirable density of 1 to 2 plants per foot of row during years of less than favorable conditions. Work needs to be done by plant breeders to improve the seedling vigor of pasture type alfalfas. Research on proper grazing management of hay type alfalfas may be helpful. Previous grazing research on grass-alfalfa pastures has shown that Ladak alfalfa decreased in basal cover and percentage of total herbage production when grazed for periods of 45 to 73 days continuously per year (Whitman et al. 1963). Ladak alfalfa increased in percentage of herbage production when the grazing periods were 45 days or less per year (Rogler and Lorenz 1969).

There was very little difference in stand establishment between the 2, 3, 4 and 6 inch chisel plow shovels in either of the two furrow width trials. The use of 12 and 16 inch cultivator sweeps behind coulter pairs spaced 3 inches apart appears to show good promise as a technique to open the furrows.

Livestock performance was greatly reduced on alfalfa interseeded range pastures with 3 foot row spacings compared to untreated native range pastures during drought conditions (Manske et al. 1984). This indicates that it would be desirable to find the optimum combination of interseeded alfalfa and undisturbed native range to provide positive benefits to livestock production during both nondrought and drought conditions. It has been speculated from calculations of estimated values of production that the optimum level of alfalfa in native range pastures would be between 12 and 25 percent of the total herbage production.

The herbage production between the furrows was effected in the 2, 3, 4 and 5 foot row spacings. The effects from furrowing extends out about 1.5 feet from the furrows but probably does not extend beyond 2 feet from the furrows. The percentage increase in herbage production was below the percentage of area disturbed and taken out of production. The total grass basal cover was reduced on the 2, 3 and 4 foot row spacings compared to the control plots. The row spacings of interseeded alfalfa should probably be greater than 5 foot. Row spacings greater than 10 feet are probably impractical.

The mid April seeding time resulted in the greatest alfalfa plant densities of the three dates in the trial. Very early spring appears to be the best time to interseed alfalfa. Additional work should be done on fall seeding dates. The addition of nitrogen increased the plant densities and plant heights. The addition of phosphorus increased the plant heights. Nitrogen and phosphorus probably should be applied during interseeding operations but care should be taken that the fertilizer and seeds were placed at different levels.

This study indicates that the combination of factors that would give the best potential for successful stand establishment would be seeding Travois alfalfa at a seeding rate greater than 0.50 lbs. PLS per row per acre in mid April using 12 or 16 inch cultivator sweeps behind coulter pairs as furrow openers, fertilizing with nitrogen and phosphorus at a different level than the seed at row spacings of 8 to 10 feet.

Table 1. Number of Alfalfa Plants per Foot of Row and Mean Height in Inches
ALFALFA VARIETY TRIAL I

Variety	1983 Density	1984 Density	1985 Density	1985 Height	1986 Density	1986 Height
Anik	21.8	0.1	0.3	3.4	0.1	12.5
Drylander	17.3	0.1	0.3	3.7	0.2	14.9
Kane	14.3	0.2	0.3	3.5	0.1	14.4
Prowler	9.7	0.3	0.2	3.6	0.2	15.9
Rangelander	11.4	0.3	0.3	3.8	0.2	15.0
Spredor II	11.8	0.3	0.3	4.3	0.2	15.7
Travois	17.5	0.6	0.6	4.1	0.3	15.3
Vernal	8.9	0.1	0.4	4.5	0.2	15.9

Table 2. Number of Alfalfa Plants per Foot of Row and Mean Height in Inches
ALFALFA VARIETY TRIAL II

Variety	1986 Density	1986 Height
Anik	4.3	3.3
Drylander	5.3	3.2
Kane	7.5	3.5
Ladak	5.0	3.5
Mandan A1801	4.8	4.0
Rangelander	3.6	2.5
Spredor II	5.2	6.4
Travois	7.9	3.4

Table 3. Percent Basal Cover – FURROW WIDTH TRIAL I

	1983				1984				1985				1986		
Furrow Width	**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**
0	37.0	2.2	39.2		25.2	4.3	29.5		23.1	2.5	25.6		25.1	3.9	29.1
2″	40.9	2.5	43.3		25.6	1.9	27.5		25.8	1.3	27.1		17.5	2.7	20.1
3″	38.3	1.8	40.1		26.8	2.2	29.0		24.9	1.8	26.7		23.1	3.9	26.9
4″	31.5	2.0	33.5		21.2	2.8	24.0		18.4	1.3	19.7		21.7	3.0	24.7

Table 4. Number of Alfalfa Plants per Foot of Row – FURROW WIDTH TRIAL I

	1983			1984			1985			1986	
Furrow Width	**Jun**	**Aug**		**Jun**	**Aug**		**Jun**	**Aug**		**Jun**	**Aug**
0	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0
2″	8.7	0.3		0.8	---		0.1	0.03		0.1	0.1
3″	8.2	0.2		0.7	---		0.1	0.06		0.1	0.1
4″	6.7	0.3		0.6	---		0.2	0.02		0.1	0.1

Table 5. Number of Alfalfa Plants per Foot of Row and Mean Height in Inches FURROW WIDTH TRIAL II

		1985			1986	
Furrow Width		**Density**	**Height**		**Density**	**Height**
2″ Straight chisel		5.2	1.5		0.9	6.7
3″ Twisted chisel		4.5	1.6		0.5	5.7
4″ Twisted chisel		4.3	1.4		0.4	6.0
6″ Twisted chisel		4.9	1.1		0.4	5.7
6″ Sweep behind coulter pair		7.6	1.5		1.3	5.6
12″ Sweep behind coulter pair		9.1	1.8		2.1	6.2
16″ Sweep behind coulter pair		8.8	1.8		2.1	5.9
14″ Lister blade		23.0	1.5		6.1	6.1

Table 6. Mean Herbage Production – ROW SPACING TRIAL

	1983			1984			1985			1986	
Row Spacing	**Grass**	**Forb**		**Grass**	**Forb**		**Grass**	**Forb**		**Grass**	**Forb**
0	1026	396		714	76		880	164		1089	431
2′	998	291		844	111		1179	80		1666	461
3′	1106	291		746	98		1332	259		1272	368
4′	1016	313		733	165		1280	134		1672	322
5′	1176	271		736	131		859	247		1460	402
8′	947	265		552	91		1210	252		1283	435
10′	1071	452		697	66		926	140		1345	761

Table 7. Percent Basal Cover – ROW SPACING TRIAL

	1983				1984				1985				1986		
Row Spacing	**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**		**Grass**	**Forb**	**Total**
0	37.0	2.2	39.2		25.2	4.3	29.5		23.1	2.5	25.6		25.1	3.9	29.1
2′	38.4	3.6	42.0		20.1	2.5	22.6		18.7	1.6	20.4		17.9	2.0	19.9
3′	42.6	3.7	46.3		21.9	3.2	25.1		20.7	1.4	22.1		21.9	3.3	25.1
4′	34.5	2.7	37.2		22.4	3.9	26.3		20.9	3.3	24.2		19.1	2.1	21.9
5′	52.4	5.0	57.4		25.1	4.1	29.2		24.2	2.5	26.7		24.3	3.3	27.5
8′	42.9	2.9	45.8		25.2	4.1	29.3		23.7	2.6	26.3		22.9	2.3	25.3
10′	56.9	5.5	62.4		24.7	3.5	28.2		26.8	2.5	29.3		25.7	3.3	29.0

Table 8. Percent Area Disturbed – ROW SPACING TRIAL

Row Spacing	Calculated				1983				1984				1985				1986		
	Furrow	Sod	Total		Furrow	Sod	Total		Furrow	Sod	Total		Furrow	Sod	Total		Furrow	Sod	Total
0			0.0				0.0				0.0				0.0				0.0
2′	16.5	16.5	33.0		23.3	14.1	37.4		17.8	22.0	39.8		22.1	14.4	36.5		19.7	12.1	31.7
3′	11.0	11.0	22.0		15.9	10.3	26.2		13.3	14.0	27.3		18.6	11.7	30.3		13.7	9.5	23.1
4′	8.3	8.3	16.6		10.5	4.1	14.6		5.3	12.1	17.4		14.0	6.3	20.3		8.4	3.7	12.1
5′	6.6	6.6	13.2		9.3	4.3	13.6		8.5	11.1	19.6		11.4	8.9	20.3		10.7	8.1	18.9
8′	4.1	4.1	8.2		6.4	3.1	9.5		6.4	5.6	12.0		8.3	7.3	15.6		4.8	1.8	6.6
10′	3.3	3.3	6.6		6.3	3.9	10.2		5.8	7.9	13.7		8.7	5.9	14.6		3.6	3.5	7.1

Table 9. Number of Alfalfa Plants per Foot of Row
SEEDING TIME AND FERTILIZATION TRIALS

	Fertilizer Treatment								
	Control		60 lbs. N		50 lbs. P_2O_5		100 lbs. P_2O_5	
Seeding Time	**1985**	**1986**	**1985**	**1986**	**1985**	**1986**	**1985**	**1986**
Mid November	0.9	0.13	2.1	0.71	1.0	0.17	0.9	0.25
Mid April	1.7	0.08	3.4	0.60	1.6	0.10	1.8	0.18
Mid May	1.2	0.01	1.5	0.18	1.0	0.02	1.2	0.07

Table 10. Mean Plant Height in Inches – SEEDING TIME AND FERTILIZATION TRIALS

	Fertilizer Treatment							
	Control		60 lbs. N		50 lbs. P_2O_5		100 lbs. P_2O_5	
Seeding Time	**1985**	**1986**	**1985**	**1986**	**1985**	**1986**	**1985**	**1986**
Mid November	1.6	7.0	2.3	6.7	1.8	7.3	1.5	6.6
Mid April	1.1	5.6	1.7	5.9	1.2	5.9	1.5	7.4
Mid May	0.5	3.3	1.0	4.4	0.7	6.8	0.9	6.4

Table 11. Number of Alfalfa Plants per Foot of Row and Mean Height in Inches
TECHNIQUE IMPROVEMENTS TRIAL

	Density					Height			
Treatment	**May**	**Jun**	**Aug**	**Mean**		**May**	**Jun**	**Aug**	**Mean**
Seeding Rate:									
0.5 lbs. PLS/row/acre	12.1	6.5	5.0	7.9		1.2	4.0	5.1	3.4
1.0 lbs. PLS/row/acre	18.7	9.6	6.8	11.7		1.2	4.3	4.6	3.4
Fertilizer Rate:									
0 lbs. N, 0 lbs. P_2O_5/acre	8.8	3.9	4.5	5.7		0.7	2.9	5.1	2.9
30 lbs. N, 30 lbs. P_2O_5/acre	12.1	6.5	5.0	7.9		1.2	4.0	5.1	3.4
60 lbs. N, 60 lbs. P_2O_5/acre	11.9	6.6	5.2	7.9		1.4	4.0	5.0	3.5
Inoculation Process:									
Mix rhizobium and seed	8.8	3.9	4.5	5.7		0.7	2.9	5.1	2.9
Seed coated	6.0	3.6	3.0	4.2		0.8	3.9	5.6	3.4
Seed Packing:									
Drag chain	10.5	5.8	5.4	7.2		1.2	4.5	4.5	3.4
Pack wheel	12.1	6.5	5.0	7.9		1.2	4.0	5.1	3.4
Tip of Sweep:									
Present	8.4	4.7	3.2	5.4		1.2	4.6	5.3	3.7
Removed	12.1	6.5	5.0	7.9		1.2	4.0	5.1	3.4

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