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RANGE AND PASTURE MANAGEMENT RESEARCH INTERSEEDING NATIVE PRAIRIE

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Interseeding Techniques Trials

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. Early attempts at interseeding in western North Dakota were inconsistent in successful establishment and they disturbed a very large percentage of the area. Research to develop techniques to successfully establish alfalfa into native range sod has been conducted at the Dickinson Experiment Station since 1976 (Nyren et al. 1981). Some of these techniques showed greater potential than others but none of the techniques showed consistent successful results. Additional work on development of interseeding techniques was needed.

Alfalfa varieties with predominantly fibrous root systems (pasture types, Medicago falcata) can tolerate grazing pressure more successfully than varieties with tape root systems (hay types, M. sativa). The pasture types have not received as much attention from plant breeders as the hay types and as a result the pasture types have not kept pace with the hay types in the development of seedling vigor. The establishment of pasture type alfalfas has generally been more difficult than hay type alfalfas primarily because of seedling vigor and the pasture type seedlings have been less tolerant of low soil moisture conditions than hay type alfalfas.

The primary purpose of this research project was to continue the work on the development of interseeding techniques that successfully establish alfalfa into rangeland on a relatively consistent basis. This study was designed to initially study the effects of interseeding on several alfalfa varieties and the effects of different furrow widths, different row spacings, different seeding times and fertilization with nitrogen and phosphorous on stand establishment. This paper presents the interseeding techniques research trials that have been conducted at the

Dickinson Experiment Station from 1983 to 1985.

Procedure

Dickinson Experiment Station is locate in the mixed grass prairie of western North Dakota. The mean monthly temperatures vary from the coldest of 11^{o}F in January to the warmest of 69^{o}F in July with a mean annual temperature of 44^{o}F. The mean annual precipitation is 16 inches. The soils of the interseeding techniques study plots are predominantly fine sandy loams. The plant species composition on the native range is dominated with blue grama (Bouteloua gracilis), sun sedge (Carex heliophila), prairie junegrass (Koelerin pyramidata), western wheatgrass (Agropyron smithii), and needleandthread (Stipa comata).

Each of the several factors of the 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 a 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 (Chisolms et al. 1980).

The alfalfa variety testing trial 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. Alfalfa plant density counts were collected annually and plant heights were collected in 1985.

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 tandem 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 seeded 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 1/4m^2 frames centrally placed between the furrows of each treatment. Ten pin point frame data for species composition was collected annually.

The effects of row spacing 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 phosphorous 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.

Results

All of the varieties included in variety testing trials performed similarly (table 1). The desired plant density of 1 to 2 plants per foot of row was not reached by any of the varieties in 1984 or 1985. The 0.5 lbs PLS/acre seeding rate may be too low for interseeding available alfalfa varieties into native range. One variety (Travois) had a density greater than 0.5 plants per foot of row. There was very little difference in the plant densities of the other varieties. The mean plant height varied form 3.4 to 4.5 inches.

Grass basal cover (table 2) for the 2 and 3 inch chisel plow shovels was very similar to the control plots in all 3 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 plants per foot of row (table 3) for all of the furrow widths in the furrow width trial I were below the desired 1 to 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 were above the desired 1 to 2 plants per foot density in 1985 (table 4). There was very little difference in plant densities between the 2, 3, 4 and 6 inch chisel plow shovels. There also was very little difference in plant densities between the 6, 12 and 16 inch cultivator sweeps

behind coulter pairs. The sweeps had greater plant densities than the chisel plow shovels. 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 cultivator sweeps. The mean plant heights (table 4) were not very different for any of the treatments but were greater for the 12 and 16 inch cultivator sweeps.

The mean above ground herbage production for the row spacing trial (table 5) was collected from frames centrally placed between the furrows of each treatment. The distance between the frame and the furrows varied with the different row spacings. The 2, 3, 4 and 5 foot row spacings appeared to have some increase in herbage production from the effects of furrowing in the first three years of the study. The three foot row spacing had the greatest increase (18%) in herbage production at the center between the furrows. No effect in herbage production was detected from the center of the 8 and 10 foot row spacings. This apparent effect from the furrowing could be from added increase in water infiltration into the soil or the release of nutrients from the decaying vegetation in the disturbed portion of the sod. Very little effect from the furrows extended beyond 1.5 feet and probably no effect extended to 2 feet from the furrows.

The grass and forb basal cover (table 6) 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 and third year after treatment. The 5, 8 and 10 foot row spacings had grass densities about equal to or slightly greater than the control plots in the second and third year. The mean percent area disturbed (table 7) in the row spacing trial for the furrow was generally greater than the calculated area of disturbance. The percent area of removed sod was less than calculated the first year and increased in succeeding years as the sod chunks eroded.

The mid April seeding time had the greatest densities of alfalfa plants per foot of row for the time of seeding trial (table 8). The dormant seeding of mid November had the greatest mean plant height (table 9). The addition of nitrogen increased the plant densities and plant heights for all of the seeding dates in this trial. The addition of phosphorous did not increase the plant densities but it did increase the plant heights above the controls of no fertilizer added for all of the seeding times of the trial.

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. 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 possible 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 to 2 feet from the furrows. The percentage of 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.

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 could be done on fall seeding dates. The addition of nitrogen increased plant densities and plant heights. The addition of phosphorous increased the plant heights. Nitrogen and phosphorous probably should be applied during interseeding operations but care should be

taken that the fertilizer and seeds were placed at different levels.

We still do not have an interseeding technique that has proven consistent successful results but we do know several factors that appear to be beneficial for stand establishment. 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 at row spacings greater than five feet and fertilizing with nitrogen and phosphorous at a different level than the seed.

Table 1. Number of Alfalfa Plants Per Foot of Row - Alfalfa Variety Trial

Variety	1983	1984	1985	Height in inches
Anik	21.8	0.1	0.3	3.4
Drylander	17.3	0.1	0.3	3.7
Kane	14.3	0.2	0.3	3.5
Prowler	9.7	0.3	0.2	3.6
Rangelander	11.4	0.3	0.3	3.8
Spredor II	11.8	0.3	0.3	4.3
Travois	17.5	0.6	0.6	4.1
Vernal	8.9	0.1	0.4	4.5

Table 2. Percent Basal Cover - Furrow Width Trial I

Furrow	1983	1984	1985

width									
	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
2"	40.9	2.5	43.3	25.6	1.9	27.5	25.8	1.3	27.1
3"	38.3	1.8	40.1	26.8	2.2	29.0	24.9	1.8	26.7
4"	31.5	2.0	33.5	21.2	2.8	24.0	18.4	1.3	19.7

Table 3. Number of Alfalfa Plants Per Foot of Row - Furrow Width Trial I

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

Table 4. Number of Alfalfa Plants Per Foot of Row and Mean Plant Height - Furrow Width Trial II

Furrow width	1985	
	Plants/foot	Height in inches

2" Straight chisel	5.2	1.5
3" Twisted chisel	4.5	1.6
4" Twisted chisel	4.3	1.4
6" Twisted chisel	4.9	1.1
6" Sweep behind coulter pair	7.6	1.5
12" Sweep behind coulter pair	9.1	1.8
16" Sweep behind coulter pair	8.8	1.8
14" Lister blade	23.0	1.5

Table 5. Mean Herbage Production - Row Spacing Trial

Row spacing	lbs/acre				% above control
	1983	1984	1985	Mean	
0	1421	790	1044	1085	
2"	1290	955	1260	1168	8
3"	1396	843	1591	1277	18
4"	1329	899	1414	1214	12
5"	1447	867	1107	1140	5
8"	1212	643	1287	1047	-4
10"	1523	763	1066	1117	3

Table 6. Percent Basal Cover - Row Spacing Trial

Row spacing	1983			1984			1985		
	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
2"	38.4	3.6	42.0	20.1	2.5	22.6	18.7	1.6	20.4
3"	42.6	3.7	46.3	21.9	3.2	25.1	20.7	1.4	22.1
4"	34.5	2.7	37.2	22.4	3.9	26.3	20.9	3.3	24.2
5"	52.4	5.0	57.4	25.1	4.1	29.2	24.2	2.5	26.7
8"	42.9	2.9	45.8	25.2	4.1	29.3	23.7	2.6	26.3
10"	56.9	5.5	62.4	24.7	3.5	28.2	26.8	2.5	29.3

Table 7. Percent Area Disturbed - Row Spacing Trial

Row spacing	Calculated			1983			1984			1985		
	Furrow	Sod	Total	Furrow	Sod	Total	Furrow	Sod	Total	Furrow	Sod	Total
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

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
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
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
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
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

Table 8. Number of Alfalfa Plants Per Foot of Row - Seeding Time Trial and Fertilization Trial

Seeding time	1985			
	Fertilizer treatment			
	Control	60 lbs N	50 lbs P	100 lbs P
Mid November	0.9	2.1	1.0	0.9
Mid April	1.7	3.4	1.6	1.8
Mid May	1.2	1.5	1.0	1.2

Table 9. Mean Plant Height in Inches - Seeding Time Trial and Fertilization Trial

Seeding time	1985			
	Fertilizer treatment			
	Control	60 lbs N	50 lbs P	100 lbs P

Mid November	1.6	2.3	1.8	1.5
Mid April	1.1	1.7	1.2	1.5
Mid April	0.5	1.0	0.7	0.9

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