1977
ANNUAL REPORT
DICKINSON EXPERIMENT STATION
DICKINSON, NORTH DAKOTA

REPORT OF

AGRONOMIC INVESTIGATIONS

AT THE

DICKINSON EXPERIMENT STATION

DICKINSON, NORTH DAKOTA

1977

by
Thomas J. Conlon

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GROWING CONDITIONS-1977

Remarkably good production of small grain crops seeded on summerfallow was the result of surface soil water conditions that were sufficient for germination and early growth, followed by exceptionally good rainfall beginning the last week in May and extending thru June. Cropland with little or no residual moisture, eg. continuous cropping or second cropping was not in good condition early in the spring because of unsuitable surface soil water conditions. Spring tillage for weed control or seedbed preparation further dried out an already deficient surface soil layer resulting in spotty and uneven germination in many instances. Weeds, particularly wild oats were diffeicult to control under these conditions and yields were no more than average and in some cases less than average. Conditions prevailing during the hot, dry spring period demonstrated the value of residual soil water in summfallow. As usual, severe wind and hail storms caused considerable localized loss where they occurred. An extended period of wet weather beginning the middle of August, before harvest was completed, caused considerable loss of grain in windrow because of sprouting.

Oat stem rust was the most damaging disease present on cereal grains and caused severe damage on isolated late seeded fields. Early seeded fields generally escaped severe damage. Rusts and leaf spotting diseases were generally present but did not develop serious proportions primarily because weather conditions did not favor such development. However, the potential threat of diseases of small grains was obvious in 1977.

Precipitation recorded at the Dickinson station for the period Septembe1976 thru August 1977, and temperatures recorded for the growing season April thru August are shown in table 1.

Table 1. Weather Data-1977.

	Precipitation-inches	
	1976-1977	84 year average
September-December	3.23	2.98
January-March	2.11	1.57
April-June	8.11	7.40
July-August	2.60	3.91
Total	16.05	15.86

	T emperature-degrees F.		
	Avg. Max.	Avg. Min.	Avg. Mean
April	62	32	47
May	76	48	62
June	78	52	65
July	83	54	69
August	76	46	61

AGRONOMIC PROCEDURE

Winter wheat trials were seeded at Hettinger and Bowman on September 8 at Beach on September 9 and at Glen Ullin on September 10. Winter rye was seeded with a John Deere deep furrow drill equipped with 10 cm spear point shovels spaced 25.4 cm apart. The drill is equipped with pneumatic rubber tire packer wheels. Fall germination and growth was very good at all locations. Severe winter killing occurred only at Glen Ullin where Centruk winter wheat produced only 470.4 kg/ha, in contrast with 3696 kg/ha at Beach. Roughrider winter wheat, the more hardy NDSU release produced 1612.8 kg/ha at Glen Ullin. Average winter wheat production for seven varieties at four locations in southwestern North Dakota was 2121.5 kg/ha.

Variety trials with spring wheat grain was sown at Hettinger April 19, Bowman Spril 20, Beach Spril 22, Glen Ullin April 26, Beulah April 27, and Killdeer April 29. Spring wheat and durum was seeded at Dickinson April 25, barley was seeded on April 26 and oats on April 28. Production of all spring seeded grain was excellent at all locations and exceptionally good at Beach and Killdeer.

All trials with spring grain were seeded with a double disk press drill.

Seeding rates in kg/ha were: rye 63; winter wheat 56; spring wheat 67; barley 67 and oats 54.

Soil fertility tests were so similar at all locations it was possible to make a uniform application of 56 kg/ha of an 18-46-0 commercial formulation for a yield goal of 2688 kg/ha.

Weed control was accomplished with Mondak, following recommended rates and application procedure.

Table 2. Hard red spring wheat variety trial.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Chris	28.1	60.5	6-22	30
Waldron	30.0	59.0	6-19	29
Era	38.2	60.0	6-27	23
Olaf	34.1	61.0	6-23	26
Ellar	24.5	61.0	6-17	27
Protor	36.0	62.5	6-17	23
Prodax	38.8	57.0	6-17	23
Wared	42.6	61.0	6-27	24
Profit 75	35.8	61.5	6-17	23
KItt	30.3	58.5	6-27	23
Sinton	26.4	60.0	6-23	29
W.S. 25	37.4	61.5	6-17	25
Butte	25.3	61.5	6-17	25
Coteau (ND 538)	35.2	60.0	6-27	31
ND 543	34.7	59.5	6-23	25
ND 547	34.4	62.0	6-19	28
Lew	33.6	62.0	6-24	30
Newana	39.3	62.0	6-25	24
Angus (II-64-27)	25.0	62.0	6-30	23
ND 549	30.3	61.5	6-27	27
ND 550	29.7	61.0	6-27	27
ND 551	29.7	59.5	6-28	28
ND 552	23.9	54.0	6-27	28
ND 553	24.8	60.0	6-24	26
ND 554	17.9	61.0	6-17	24

Table 2. Hard red spring wheat variety trial continued.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
ND 555	24.8	60.0	6-25	24
SU 28-1	30.3	60.5	6-26	27
S7003	26.4	58.5	6-23	27
Eureka (SD 2185)	28.1	60.5	6-19	27

L.s.d. @ 5% = 4.10 bushels per acre

Table 3. Long term yield comparison-hard red spring wheat.

Variety	Yields in bushels per acre 1974	1975	1976	1977		4-yr. Avg.
Waldron	34	37	41	30		35.5
Ellar	33	36	40	25		33.5
Olaf	38	42	42	34		39.0
Wared	41	46	52	43		45.5
Era	42	51	52	38		45.8
Prodax	37	48	53	39		44.3
Protor	36	37	57	36		41.5
Butte	33	41	41	25		35.0
Profit 75		37	45	36		
Coteau		42	45	35		
Kitt		40	34	30		
Newana			50	39		
Sinton			37	26		
Lew			47	34		
Angus				25		
Eureka				28		
L.s.d. @5%	6.4	5.4	5.3	4.1		

Table 4. Hard red spring wheat variety trial-Dickinson and off-station sites.

Variety	Yield in Bushels per Acre							
	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Profit 75	35.8	55.3	33.3	34.4	44.6	24.8	68.8	42.4
Butte	25.3	53.9	32.2	31.9	35.2	24.5	60.5	37.6
WS 25	37.4	62.2	34.9	34.4	45.9	26.7	69.0	44.4
Lew	33.6	55.8	35.5	38.0	44.3	30.0	58.3	42.2
Newana	39.3	62.2	36.3	41.0	50.6	31.9	74.5	48.0
Waldron	30.0	49.8	27.5	35.5	34.7	16.0[1/]	53.4	35.3
Olaf	34.1	55.8	33.8	40.7	47.3	23.7	66.3	43.1
Wared	42.6	64.6	41.3	40.2	55.3	33.8	74.3	50.3
Protor	36.0	64.6	34.4	40.7	39.9	27.5	66.0	44.2
Prodax	38.8	69.6	38.5	36.3	48.7	30.5	72.1	47.8
L.s.d. @ 5%	4.1	8.8	4.0	4.0	3.2	4.6	6.8	2.04

1/ Because of stiff straw characteristic, Waldron was damaged proportionally more by late hail storm.

Table 5. Hard red spring wheat variety trial-Dickinson and off-station sites.

	Test weight per bushel							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Profit 75	61.5	64.5	60.5	57.5	59.5	59.5	62.0	60.7
Butte	61.5	63.5	62.0	57.0	59.5	59.0	62.5	60.7
WS 25	61.5	63.7	60.0	57.0	59.0	58.5	62.5	60.3
Lew	62.0	64.5	61.0	58.0	60.5	60.0	63.0	61.3
Newana	62.0	64.0	62.0	56.0	57.5	58.0	61.5	60.1
Waldron	59.0	62.0	59.5	56.0	56.5	56.0	61.0	58.6
Olaf	61.0	63.0	60.5	57.0	57.5	57.0	61.0	59.6
Wared	61.0	64.0	60.5	53.0	56.0	55.5	61.5	58.8
Protor	62.5	64.0	60.5	59.0	60.0	58.0	62.0	60.9
Prodax	57.0	62.5	58.0	54.0	58.5	54.5	59.5	57.7

Table 6. Hard red spring wheat variety trial-Dickinson and off-station sites.

	Protein percent @ 14% moisture							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Profit 75	14.4	14.5	13.9	14.6	15.2	17.1	14.0	14.8
Butte	15.8	13.5	15.4	15.2	16.2	16.6	15.4	15.4
WS 25	16.0	12.4	13.9	15.1	15.5	16.9	13.7	14.8
Lew	15.7	13.4	14.8	15.7	15.9	17.0	15.7	15.5
Newana	14.9	12.7	14.5	15.0	15.2	16.8	13.7	14.7
Waldron	16.3	16.0	17.1	15.8	16.8	18.5	17.5	16.9
Olaf	15.6	15.0	15.2	15.5	16.1	17.3	15.6	15.8
Wared	14.5	12.0	13.7	15.6	15.4	16.6	13.4	14.5
Protor	15.0	14.3	15.4	15.6	16.9	17.0	15.4	15.7
Prodax	16.1	13.5	15.0	15.8	15.7	17.6	14.4	15.4

Table 7. Off-station winter wheat variety trials.

	Yields in bushels per acre					
Variety	Beach	Bowman	Hettinger	Glen Ullin		4-yr. Avg.
Froid	45.6	36.2	21.2	20.6		30.9
Winoka	53.2	39.7	24.6	17.5		33.8
Agate	54.7	35.5	19.2	16.5		31.5
Centurk	54.7	40.0	19.4	7.4		30.4
Roughrider	48.1	40.7	20.0	24.3		33.3
Gent	46.6	36.4	21.2	15.7		30.0
Eklund	47.9	33.6	19.8	20.6		30.5
L.s.d. @5%	3.9	5.0	2.9	4.8		

Table 8. Off-station winter wheat variety trials.

	Test weight per bushel					
Variety	Beach	Bowman	Hettinger	Glen Ullin		4-yr. Avg.
Froid	59.5	59.0	61.5	60.0		60.0
Winoka	63.0	61.5	64.0	61.0		62.4
Agate	63.0	61.0	60.0	59.5		60.9
Centurk	61.0	60.5	62.0	58.0		60.4
Roughrider	64.5	61.0	63.0	60.5		62.3
Gent	58.5	60.5	62.5	60.0		60.4
Eklund	60.5	59.5	61.5	59.5		60.3

Table 9. Off-station winter wheat variety trials.

	Protein percent @ 14% moisture					
Variety	Beach	Bowman	Hettinger	Glen Ullin		4-yr. Avg.
Froid	12.6	13.8	14.6	13.3		13.6
Winoka	14.2	13.8	14.9	13.8		14.2
Agate	12.1	14.3	15.3	13.8		13.9
Centurk	11.9	13.6	15.1	12.7		13.3
Roughrider	12.5	14.5	15.6	13.6		14.1
Gent	12.9	14.9	15.4	13.2		14.1
Eklund	11.3	14.7	15.2	13.2		13.6

Table 10. Durum wheat variety trials.

Variety	Avg. yield bu/acre		Test weight		Heading date	Height inches
Rolette	34.9		62.5		6-17	29
Ward	38.8		62.5		6-23	31
Walooma	46.5		61.5		6-28	36
Crosby	36.6		63.0		6-21	30
Botno	39.6		62.0		6-19	28
Rugby	39.6		59.0		6-24	30
Cando	51.2		63.5		6-24	25
Coulter	43.5		60.5		6-21	30
Calvin (D7047)	42.1		64.0		6-22	24
Edmore (D7175)	36.9		61.5		6-22	29
D7233	37.7		63.0		6-21	29
D7266	44.6		64.0		6-25	24
D72114	33.6		61.5		6-18	27
D7224	44.3		63.0		6-24	27
Wells	38.2		62.0		6-24	32
D74110	39.6		62.5		6-22	33
D74111	38.2		62.5		6-23	27
D74112	41.5		61.0		6-23	29
DT354	40.7		62.5		6-23	34
D7307	35.5		61.5		6-26	29
D7327	38.2		61.5		6-23	28
D7368	34.7		62.5		6-28	25
D73106	34.7		61.0		6-18	24
D73121	39.1		62.0		6-25	24
D7475	44.3		60.0		6-28	29
D7489	37.4		59.0		6-28	34
D74164	38.5		61.5		6-20	35
L.s.d @ 5% = 7.8						

Table 11. Long term yield comparison of durum wheat varieties.

	Yields in bushels per acre					
Variety	1974	1975	1976	1977		4-yr. Avg.
Wells	34	42	32	38		36.5
Rolette	36	38	39	35		37.0
Ward	35	37	31	39		35.5
Wakooma	29	39	30	47		36.3
Crosby	34	37	30	37		34.5
Botno	33	33	31	40		34.3
Rugby	33	38	29	40		35.0
Cando	30	31	33	51		36.3
Calvin	32	37	32	42		35.8
Coulter		37	32	44		
Edmore			33	37		

Table 4. Durum variety trials-Dickinson and off-station sites.

	Yield in Bushels per Acre							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Ward	38.8	45.9	28.6	47.3	30.8	23.4	54.2	38.4
Rolette	34.9	28.6	25.9	41.5	30.3	17.9	53.4	33.2
Cando	51.2	52.3	32.5	54.7	33.6	24.8	67.4	45.2
Coulter	43.5	47.9	33.6	48.4	29.2	23.4	53.1	39.9
L.s.d. @ 5%	7.8	9.6	4.5	9.6	6.3	4.3	5.4	

Table 4. Durum variety trials-Dickinson and off-station sites.

	Test weight per bushel							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Ward	62.5	64.0	61.5	55.5	60.5	59.5	60.0	60.5
Rolette	62.5	64.5	61.0	61.0	61.0	60.0	62.5	61.8
Cando	63.5	64.0	62.5	59.5	61.5	59.5	60.0	61.5
Coulter	60.5	63.0	62.5	59.5	60.5	58.5	62.0	60.9

Table 14. Oat variety trial.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Kelsey	57.7	38.5	6-30	28
Cayuse	57.7	35.0	7-2	26
Lodi	52.0	34.5	6-30	35
Garry	50.5	36.0	6-27	33
Sioux	41.7	40.5	6-27	27
Harmon	44.8	36.0	7-1	31
Hudson	50.5	35.0	6-30	27
Random	48.9	35.0	6-28	28
Lang	44.3	38.5	6-17	24
Lyon	38.7	36.5	6-27	35
Otana	51.5	37.0	6-27	30
L.s.d. @ 5% = 4.5				

Table 15. Long term yield comparison-hard red spring wheat.

	Yields in bushels per acre					
Variety	1973	1974	1975	1976	1977	5-yr. Avg.
Kelsey	89	61	67	102	51	74
Cayuse	90	72	69	101	58	78
Lodi	85	48	65	95	49	68
Garry	85	59	71	91	42	70
Sioux	87	64	55	96	51	71
Harmon	87	55	59	99	52	70
Hudson			72	89	51	
Random			73	92	45	
Lang				83	44	
Lyon				86	39	
Otana					52	
L.s.d. @ 5% =	8.0	7.0	6.0	8.0	4.5	

Table 16. Oat variety trial-Dickinson and off-station sites.

	Yield in Bushels per Acre							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Kelsey	51.0	110.8	78.8	87.6	56.9	45.3	104.1	76.4
Cayuse	57.7	110.3	75.2	87.0	59.8	52.5	108.2	78.7
Harmon	44.8	99.4	64.4	77.3	40.1	34.1	96.8	65.3
Hudson	50.5	108.8	73.2	82.9	62.3	37.6	109.3	74.9
Otana	51.5	107.2	76.8	97.4	53.0	54.6	103.1	77.7
L.s.d. @ 5% =	4.5	23.8	5.4	7.4	9.2	7.2	10.2	

Table 17. Oat variety trial-Dickinson and off-station sites.

	Test weight per bushel							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Kelsey	38.5	41.0	40.5	35.0	37.0	36.5	40.5	38.4
Cayuse	35.0	40.5	36.5	32.0	37.0	32.5	39.0	36.1
Harmon	36.0	39.5	39.5	35.0	36.5	36.0	37.5	37.1
Hudson	35.0	40.5	37.5	33.0	33.0	35.5	36.0	35.8
Otana	37.0	41.7	41.0	36.5	40.0	37.5	41.0	39.2

Table 18. Barley variety trials.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Larker	34.7	52.0	6-30	23
Dickson	30.3	49.0	7-1	23
Karl	24.8	47.0	6-30	19
Hector	46.8	50.0	7-9	23
Summit	47.8	51.0	7-11	22
Park (ND 231)	32.7	50.0	6-30	24
Glenn (ND 718)	33.7	46.0	6-28	22
ND 1156	227.0	50.5	7-2	24
ND 1311	33.0	48.5	6-28	22
ND 1244	31.7	45.0	6-29	22
ND 1265	35.1	49.0	6-28	24
ND 2233	41.9	48.0	6-28	22
ND 2470	40.9	47.5	7-3	24
ND 2654	44.0	50.5	6-30	23
ND 2668	43.3	52.5	6-30	23
ND 2674	43.7	50.0	6-29	22
ND 2678	38.7	49.5	6-30	23
ND 2679	41.9	50.5	6-30	23
ND 1470	37.8	48.5	6-27	24
RPB 268-70	54.7	51.5	7-20	22
RPB 374-71	50.9	48.5	7-7	22
RPB 439-71	50.2	50.5	7-12	22
RPB 456-7	53.3	49.0	7-6	20

L.s.d. @ 5% = 6.3 bushels per acre

Table 19. Long term yield comparison-barley varieties.

	Yields in bushels per acre					
Variety	1973	1974	1975	1976	1977	5-yr. Avg.
Larker	64	36	50	73	35	51.6
Dickson	64	36	50	73	30	50.6
Glenn	65	41	52	77	34	53.8
Park	66	38	48	65	33	50.0
Hector		56	61	80	58	
Summit					48	
L.s.d. @ 5% =	3.1	7.1	8.2	7.3	6.3	

Table 20. Barley variety trials-Dickinson and off-station sites.

	Yield in Bushels per Acre							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Larker	34.7	54.3	44.0	56.0	27.5	26.1	60.5	43.3
Hector	46.8	65.7	60.5	69.4	46.8	40.6	76.7	58.1
Multum	50.9	74.2	61.6	64.6	44.4	40.2	88.4	60.6
Karl	24.8	52.6	34.4	39.2	22.4	23.7	66.4	37.6
Summit	47.8	74.9	57.4	67.4	38.9	38.2	89.4	59.1
L.s.d. @ 5% =	6.3	11.5	3.9	7.5	5.4	4.8	9.1	

Table 21. Barley variety trials-Dickinson and off-station sites.

	Test weight per bushel							
Variety	Dickinson	Beach	Beulah	Bowman	Glen Ullin	Hettinger	Killdeer	Average 7-sites
Larker	52.0	52.5	49.0	45.0	49.0	44.5	52.5	49.2
Hector	50.0	52.7	50.0	46.5	53.0	49.0	53.5	50.7
Multum	48.5	54.0	50.0	46.0	50.0	48.5	53.0	50.0
Karl	47.0	51.0	49.5	46.0	50.5	47.5	54.0	49.4
Summit	51.0	54.5	51.5	47.0	51.0	49.0	55.0	51.3

Table 22. Winter rye variety trials.

Variety	Avg. yield bu/acre	Test weight
Cougar	41.1	52.0
Rymin	37.8	52.5
Caribou	38.5	56.0
Puma	38.0	52.5
Frontier	35.4	55.0
L.s.d. @ 5% =	4.0	

L.s.d. @ 5% = 6.3 bushels per acre

NURSERY TRIAL WITH SMALL GRAIN

The cooperative nursery trials grown at Dickinson in 1977, and the leaders responsible for each trial included:

The Uniform Regional Hard Red Spring Wheat Nursery; Dr. R.E. Heiner, ARS-USDA, Institute of Agriculture, University of Minnesota, St. Paul, Minnesota.

The Uniform Regional Durum Nursery; Dr. James Quick, Department of Agronomy, North Dakota State University, Fargo, North Dakota.

The Uniform Early Oat and the Uniform Midseason Oat Nurseries; Dr. Howard Rines, ARS-USDA, Institute of Agriculture, University of Minnesota, St. Paul, Minnesota.

The Great Plains Barley Nursery; Dr. Phil B. Price, ARS-USDA, Agronomy Department, South Dakota State University, Brookings, South Dakota.

The Western Spring and Western Dryland Spring Barley Nurseries; Dr. E.A. Hockett, ARS-USDA, Plant and Soil Science Department, Montana State University, Bozeman, Montana.

The Uniform Regional Flax Nursery; Dr. James Hammond, Department of Agronomy, North Dakota State University, Fargo, North Dakota.

The Elite Yield and the Advanced Yield Winter Wheat Nurseries; Dr. John Erikson, Department of Agronomy, Department of Agronomy, North Dakota State University, Fargo, North Dakota. Data in tables 32 and 33, furnished by Dr. Erikson, is included in this report as a record of winter wheat performance at this station.

In addition to the uniform nurseries, an oat variety nursery and an interstate safflower yield nursery were also grown.

All nurseries were grown on clean fallow land which had received a broadcast application of 112 kg/ha of an 18-46-0 commercial fertilizer. Seeding dates were; April 21, Oat Variety Nursery; April 25, Uniform Hard Red Spring Wheat and Durum; April 26, Great Plains Barley Nursery; April 28, Uniform Early and Uniform Midseason Oats , and Western Spring Barley Nurseries; April 29, the interstate Safflower trial, and May 20, the Uniform Regional Flax Nursery.

A hot, dry spring period was responsible for unsuitable surface soil water conditions which resulted in spotty and uneven germination on part of the nursery. Rainfall coming the last week in May was no more than just in time to get the crop off to a fair start.

Table 23. Uniform regional hard red spring wheat nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Marquis	25.1	56.0	6-28	31
Chris	26.6	59.0	6-28	30
Waldron	31.0	58.2	6-18	30
Coteau (ND 538)	30.8	61.0	6-25	31
ND 547	37.6	61.0	6-20	30
ND 549	39.3	60.6	6-28	33
ND 550	36.5	60.2	6-27	33
ND 551	29.7	58.5	6-28	33
ND 553	34.3	60.3	6-27	32
ND 554	32.3	61.0	6-15	30
SD 2273	30.2	59.5	6-16	29
Eureka (SD 2185)	28.0	57.0	6-21	30
SD 2355	31.2	59.2	6-26	32
SD 2358	24.0	59.5	6-21	30
ND 543	32.5	60.5	6-25	27
ND 555	33.8	59.7	6-27	29
MT 749	39.0	60.3	6-24	29
MT 7416	43.3	59.2	6-21	28
Angus (MN II-64-27	38.5	61.3	6-25	27
MN 7086	31.7	58.2	6-26	26
MN 70170	33.7	59.3	6-25	25
MN 70202	36.5	61.8	6-16	25
MN 7125	39.3	59.0	6-17	25
MN 7155	29.8	59.0	6-27	28
MN 70181	37.3	56.5	6-21	27

Table 23. Uniform regional hard red spring wheat nursery continued

Variety	Avg. yield bu/acre		Test weight		Heading date	Height inches
MN 70197	39.7		58.0		6-23	26
MN 7222	32.7		57.7		6-17	25
IDO 153	36.5		57.2		6-20	26
Era	34.5		59.0		6-27	26
75S5511	28.0		60.0		6-16	26
75S5513	31.8		59.5		6-17	23
MP 54B	30.3		63.0		6-25	27
L.s.d. @ 5% =	11.1					

Table 24. Uniform regional durum nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Mindum	23.3	61.0	66	91
Rolette	23.2	62.0	54	66
Ward	33.7	61.0	61	78
Wakooma	27.8	59.0	65	85
Crosby	31.6	60.0	61	80
Botno	25.8	62.0	56	68
Rugby	26.2	61.0	62	71
Cando	25.6	60.0	62	57
D7047	31.5	63.0	60	57
Coulter	23.8	61.5	60	71
D7175	26.6	61.5	61	74
D7233	27.2	61.0	62	73
D7266	19.8	61.5	64	57
D72114	28.8	61.5	61	73
D7224	29.6	62.0	62	64
D7298	25.0	61.0	57	58
DT 354	23.8	61.0	63	76
D74110	31.2	61.5	57	72
D74112	26.6	62.0	59	70
D7307	27.6	62.0	61	70
D7327	28.2	62.0	59	73
D7368	26.3	61.0	63	63
D73106	29.2	62.0	56	63
D73121	29.3	61.0	58	62
D7475	27.0	61.5	64	75
D7489	24.9		62	57
D74164	24.6		56	68

L.s.d. @ 5% = n.s.

The c.v. = 18.3

Table 25. Uniform early oat performance nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Jaycee	41.3	37.0	6-13	25
IL 71-1158	43.0	36.8	6-13	24
IL 73-2186	47.0	36.2	6-12	21
Clintford	43.0	37.0	6-11	24
Multiline E77	42.7	33.5	6-23	30
Andrew	31.7	40.5	6-9	23
MO 06204	46.3	35.8	6-16	23
MO 06425	47.0	37.3	6-12	21
MO 06503	38.3	36.5	6-10	19
MO 06637	46.7	37.2	6-11	20
MO 06553	49.3	37.5	6-11	21
MO 0-205	37.0	40.3	6-14	14

L.s.d. @ 5% = 8.5s.

Table 26. Uniform midseason oat performance nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Lodi	54.1	35.8	7-1	36
2456-2	61.0	36.2	7-2	30
1839-1	52.7	36.2	7-2	33
3086-1	47.3	37.3	7-5	29
2795-2	59.3	38.8	6-29	32
2530-15	67.3	38.3	6-30	29
Dal	52.8	38.7	7-2	30
Lang	59.3	37.3	6-17	26
73-2664	69.7	37.2	6-28	28
73-2186	61.0	38.3	6-16	24
Orbit	56.3	37.2	7-2	28
Terra hulless	55.0	40.8	7-6	31
OA 338	55.0	39.5	6-21	30
6083-26	28.5	35.7	7-5	22
5740-11	49.7	38.5	7-1	29
OC-I-23	44.3	41.3	6-28	27
OC-I-36	49.3	39.5	7-2	20
Otee	36.7	42.7	6-20	24
Multiline E.M.	45.5	43.2	6-16	27
9095	51.0	41.7	6-21	28
740428	42.7	40.7	6-30	32
740677	43.3	41.0	6-16	28
Clintland 64	30.0	40.5	6-18	27
71211	52.0	41.0	6-29	30
73231	64.9	40.7	6-30	32
74230	46.7	37.7	7-2	30
74217	45.7	41.5	7-2	30
73217	45.7	41.3	6-30	31
Gopher	50.0	37.8	6-30	31
Purdue 666DI-42-2-4-5	40.3	39.5	6-29	25

L.s.d. @ 5% = 17.6.

Table 27. Oat variety nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Lang	37.7	36.0	6-12	22
Nodaway	46.8	39.3	6-10	27
Mariner	49.0	39.7	6-17	30
Spear	44.3	37.8	6-13	28
Kota	36.3	37.7	6-16	31
Garry	53.7	37.3	6-17	34
Kelsey	40.7	35.5	6-18	31
Random	52.0	34.3	6-17	29
Hudson	45.7	32.5	6-23	31
Froker	51.8	38.3	6-16	30
Lyon	40.3	36.5	6-16	34
Lodi	51.3	34.8	6-19	33
Dal	50.3	36.8	6-26	32
Rodney	40.3	36.5	6-23	30
Harmon	44.0	33.3	6-25	32
Otana	52.0	35.0	6-16	29
Menominee	49.5	37.7	6-24	30
MN 71211	43.3	35.0	6-15	27
73231	46.3	36.3	6-16	30
WI 1839-1	44.0	30.5	6-24	35
2456-2	45.0	33.2	6-30	27
MN 74230	50.3	36.3	6-13	26
WI 3086-1	43.3	33.7	6-29	26
MN 75102	46.1	38.3	6-13	29
ID 71716	46.7	31.8	6-20	24
ID 712506	43.0	32.2	6-20	27

L.s.d. @ 5% = 16

Table 28. Uniform great plains barley nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
Firlbecks III	38.2	48.2	7-10	25
Primus II	29.0	46.5	6-25	24
Larker	35.0	48.2	6-29	24
Galt	36.3	45.7	6-29	24
Beacon	28.4	46.0	7-2	25
Klondike	40.4	45.3	6-30	24
SD 69-1-1781	29.2	48.5	7-1	24
SD 71-672	38.8	49.5	7-3	26
SD 71-698	43.5	51.3	7-2	26
M-25	44.0	47.8	6-30	26
Br-YKQ-1	42.3	45.3	6-30	27
Br A 31-1	43.3	48.8	7-3	26
BrC 42-1	50.8	48.2	6-30	25
ND 1244	32.5	45.2	6-28	25
SD 76-1106	42.9	53.2	6-26	24

L.s.d. @ 5% = 12.8

Table 29. Western dryland spring barley nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
CI 6009	49.0	49.5	7-11	19
CI 10421	49.5	47.3	7-1	22
CI 11770	55.4	47.8	6-30	25
CI 15229	55.0	45.3	7-5	22
CI 13827	66.0	48.0	7-8	26
CI 9558	51.9	51.3	7-3	24
ID 711180	53.6	48.5	7-8	23
Mt 4524	36.9	51.5	6-16	20
ID 711767	69.7	47.3	7-2	25
ID 704504	43.1	45.8	6-29	23
WA 11313	42.1	45.5	6-29	22
UT 1009	58.8	44.2	7-5	26
CI 7130	54.4	51.0	7-3	22
MT 66	38.3	52.2	6-14	20
MT 65	53.6	51.3	6-17	21
MT 68	36.5	50.8	6-16	17
MY 67	34.6	53.2	6-15	20

L.s.d. @ 5% = 15.5

Table 30. Uniform western spring barley nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
CI 936	30.2	43.5	7-1	24
CI 15229	32.9	43.3	7-1	21
CI 13827	44.7	46.6	7-7	25
CI 11868	36.1	48.0	7-4	24
CI 10648	49.4	47.8	6-24	24
CI 15478	28.1	46.0	7-13	24
ID 714552	47.7	45.5	-	-
MT 13455	38.6	46.0	7-9	23
MT 267105	38.5	48.2	7-10	19
CA 73104	27.9	46.0	6-30	18
CA 73107	23.8	46.5	6-30	24
UT 484	26.1	43.5	6-27	23
WA 11301	27.3	43.5	6-16	19
WA 11312	30.0	44.5	6-15	21
WA 11313	21.9	45.0	6-24	19
UT 1068	29.2	46.2	6-21	19
UT 1009	35.9	41.8	7-3	25
ID 702378	34.7	43.0	7-2	20
MT 25131	40.8	50.3	6-16	20
MT 23666	43.8	45.5	7-7	19
CI 10114	46.1	45.8	7-20	22
MT 322	39.2	45.5	7-8	28
MT 321	42.3	45.8	7-7	26
MT 324	23.7	39.5	7-7	24
MT 323	27.1	41.8	7-13	23

L.s.d. @ 5% = 19.0

Table 31. Uniform regional flax nursery.

Variety	Avg. yield bu/acre	Test weight	Heading date	Height inches
CI 389	9.4	54.0	7-11	21
CI 2292	5.9	54.0	7-19	22
CI 2522	12.8	54.0	7-5	20
CI 2776	14.1	55.0	7-8	20
CI 2814	12.0	55.0	7-18	22
CI 2816	11.7	54.5	7-7	21
CI 2822	11.0	54.0	7-5	18
CI 2838	15.4	55.5	7-8	20
CI 2840	12.7	55.0	7-11	22
CI 2842	6.5	54.0	7-13	21
CI 2847	9.8	55.0	7-18	22
CI 2849	10.2	54.0	7-5	19
CI 2850	9.1	54.0	7-18	20
CI 2851	10.2	55.0	7-16	21
CI 2852	10.3	55.5	7-11	18
CI 2853	8.3	55.0	7-12	20
CI 2854	11.2	55.0	7-16	21
CI 2855	6.0	54.0	7-18	21
CI 2856	10.8	55.0	7-8	19
CI 2857	9.5	55.0	7-7	19
CI 2858	9.5	54.0	7-8	20

L.s.d. @ 5% = 3.0 bushels per acre

TABLE 33. CONTINUED

CULTIVAR OR LINE	SPRING SURVIVE PERCENT	SPRING VIGOR 0-5	JUNE HEAD DATE	LEAF RUST % RX	STEM RUST % RX	LEAF SPOT 0-9	PLANT HEIGHT	LODGE 0-9	YIELD BU/A	TEST WEIGHT LBS/BU
MEAN	40.	0.0	5.			0.0	65.	0.0	18.2	55.4
HIGH MEAN	77.	0.0	7.			0.0	71.	0.0	32.3	59.8
LOW MEAN	13.	0.0	3.			0.0	50.	0.0	6.3	51.2
COEFF. OF VARIATION	52.	0.0	24.			0.0	8.	0.0	34.9	5.0
LSD(.01 PERCENT)	44.	0.0	2.			0.0	11.	0.0	13.6	5.9
LSD(.05 PERCENT)	33.	0.0	2.			0.0	8.	0.0	10.3	4.5
NO. OF REP	3.	3.0	3.			3.0	3.	3.0	3.0	3.0

Table 34. Interstate safflower yield trial.

Variety		Avg. yield lbs/acre		Test weight		Percent oil
U.S. 10		1198.0		36.0		38.46

S-208		1573		36.4		41.96
Sidwell		1999		35.7		34.42
L.s.d. @ 5% =		226				

SUNFLOWER TRIALS

Sunflower seeded in trials at the station in 1977 had reached a height of about 12 inches when a violent windstorm, accompanied by small sized hail struck. Small grain crops were not severely damaged by this storm, but the sunflower trials were. Recovery was extremely poor and the trials were abandoned for this season. To give some idea of sunflower production in the area two growers were asked to accurately record their production. Mr. Robert Jurgens reported an average yield of 755 pounds per acre and Mr. James Barnhart reported yields of 850 pounds per acre.

CHEMICAL SUMMERFALLOW

Trials with chemical summerfallow were conducted in cooperation with the Shell Chemical Company. Chemicals applied included Bladex 80W and Paraquat. Probably because of hot, dry weather conditions at time of application the chemicals were ineffective in controlling weed growth in this trial. At the time of application, May 10, weeds had made good growth and a broad species spectrum including, dandelion, Russian thistle, Kochia, tansy mustard and wild buckwheat were present and growing vigorously. It should be pointed out that May 10 to June 10 is the approximate date range for first tillage of fallow in this area. Conventional fallowing by tillage in this trial resulted in satisfactory weed control.

At the suggestion of the Experiment Station, the following growers were also involved in chemical fallow trials:

1. Dr. Darryl Jalbert, Reeder, North Dakota
2. Mr. Darrel Oech, Beach, North Dakota
3. Mr. Kenneth Freitag, Bowman, North Dakota
4. Mr. Wayne Carter, Glen Ullin, North Dakota

Results of trials on the farms of these producers, all in southwestern North Dakota will be assessed in the season of 1978.

WHEAT PRODUCTION ON FALLOW, SECOND CROPPING AND CONTINUOUS CROPPING

In 1976, an excellent year for small grain production on stubble land, in southwestern North Dakota, yields on conventional summerfallow were 43 bushels per acre, on second cropping 27 bushels per acre and on continuous cropping 22 bushels per acre. In 1977, a year when hot, dry spring weather conditions were not particularly favorable to the germination and early growth of the crop, yields were appreciably reduced, even though rainfall in late May and June provided ample soil water for satisfactory crop growth. Yields on fallow were 26.9 bushels per acre, on second cropping 11.5 and on continuous cropping 5.5 bushels per acre. Relative differences between production methods were remarkably similar for both years.

MINIMUM TILLAGE & SEEDING, & DOUBLE DISKING AND CONVENTIONAL SEEDING ON SECOND CROPPING

In 1976 there was no significant difference in what production between minimum tillage and conventional tillage on second cropping. Growing conditions were excellent in 1976 and soil water and other environmental conditions were favorable for good germination and growth throughout the growing season.

in 1977, hot, dry spring weather conditions were not particularly favorable to germination and early crop growth because of dry surface soil. Because of the small diameter of the rotating coulters on the John Deere 1500 Power till seeder, it was not possible to place seed deep enough to get it into moist soil. As a consequence germination was spotty and delayed until later rainfall came. Excessive weed growth was also a problem on this treatment. Yields were very poor averaging 6.4 bushels per acre.

Penetration of the surface soil and satisfactory seed placement was not as difficult with the Melroe 107 minimum tillage drill. Germination and growth was satisfactory and production was double that for the Power till seeder.

Conventional disking and seeding was the best production method in this year's comparison.

Table 35. Minimum tillage and double disking for wheat production on recrop.

	Yield in bushels per acre							
Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6		Avg.
Mini-till and seeding 1500 Power till drill	6.2	6.9	8.9	4.8	4.1	7.6		6.4
Mini-till and seeding Melroe 701 drill	13.8	13.8	13.2	11.3	9.4	13.8		12.6
Double disk and conventional seeding	15.4	15.4	16.6	15.4	13.0	14.2		15.0

REPORT OF

LIVESTOCK INVESTIGATIONS

AT THE

DICKINSON EXPERIMENT STATION
DICKINSON, NORTH DAKOTA

1977

by James L. Nelson & Douglas G. Landblom

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FEEDLOT COMPARISON OF HEREFORD, ANGUS X HEREFORD, AND LONGHORN X HEREFORD STEERS

This trial was designed to study the performance of Longhorn X Hereford crossbred calves in comparison to either straight Hereford or Angus X Hereford calves.

Producers using Longhorn bulls on straight bred beef heifers are discounted when these calves are placed on the feeder market. Feeders are reluctant to buy these calves, since very little documented information is available as to how these crossbred calved perform in the feedlot. Again, there is almost no carcass information available on these cattle, especially when graded under the current grading standards.

In the first year of the trial, two sets of LH X H steer calves were purchased from the Harold Hanson Ranch of Reeder and the Bloom Ranch of Taylor, North Dakota. Hereford and BWF calves for comparison were wither raised at the Dickinson Experiment Station or were purchased through the local auction market. At the time these calves were purchased, there was approximately a five dollar per hundred weight discount on the LH X H steers. Calves were worked through our chutes for the usual branding, dehorning and vaccination. All the LH X H calves were dehorned which was not so with the BWF or the Hereford calves since they were naturally polled. During the second year of this trial the LH X H calves were raised at the Station and were sired by the same Longhorn bull that was made available to us by the Harold Hanson Ranch.

The steers were self-fed complete mixed rations according to the schedule shown in table 1. All of the calves received calfhood vaccinations for blackleg, hemorrhagic septicemia, malignant edema, and enterotoxemia types C and D prior to entering the feedlot. No other vaccinations were used since IBR, BVD, etc. have not been a problem at this station.

The steers were fed from November 22, 1976 until August 16, 1977 at which time they were shipped by truck to Flavorland Dressed Beef in West Fargo, North Dakota, a distance of 300 miles. The steers were sold on a grade and weight basis, with additional carcass information gathered with the help of the Department of Animal Science, NDSU.

The results of the trial are shown in table 2 and 3.

Table 1. Self fed ration changes, 1977.

	Warm-up ration	Dec. 1, 1976	Feb 22	May 17- to finish
Oats	25	50	75	50
Tame hay	72.5	47.5	22.5	22.5
Barley	-	-	-	-
Di-cal	.5	.5	.5	.5
Salt	2	2	2	2

Table 2. Feed comsumption per headm 1976-1977.

	BWF		Hereford		Longhorn X Hereford	
	1976	1977	1976	1977	1976	1977
Ingredients: [1/]						
Oats, lbs	9.98	13.30	9.49	12.70	9.08	11.59
Barley, lbs	3.32	2.20	2.97	2.12	2.83	1.79
Tame hay, lbs	5.92	7.20	5.57	6.80	5.29	6.36
Alfalfa, lbs	.99	-	.92	-	.88	-
Di-cal, lbs	.10	.12	.10	.11	.10	.10
Salt, lbs	.41	.46	.38	.44	.36	.44
Avg. daily consumption	20.72	23.28	19.43	22.17	18.54	20.28

[1/] The amounts shown are averages for the entire feeding trial and are not the amounts as they were fed each day.

Table 3. Feedlot data + carcass information, 2-years average.

	BWF	Hereford	Longhorn X Hereford
No. head	13	13	26
Days fed	291	291	291
Final wt. lbs	1086	1080	991
Starting wt. lbs	447	432	420
Feedlot gain, lbs	639	648	572
ADG, lbs	2.20	2.23	1.91
Pounds feed/lb gain	9.98	9.31	9.99
Cost/100 lbs gain, $	41.51	38.84	41.32
Total feed cost/head, $	265.27	251.66	236.35
Carcass trait:			
Avg. hot wt., lbs	644	638	578
Dressing, %	60	58.5	58.5
Kidney est. wt., lbs	24	19	25
Loin eye area, sq. in.	11.92	11.48	11.25
Fat cover, in.	.81	.61	.37
Cal. yield grade	2.9	2.8	2.04
Percent cut out	45.7	47.27	49.12
Difference	-3.42	-1.85	

Table 4. Analysis of costs and returns, 1976-1977.

	BWF		Hereford		Longhorn	
	1976	1977	1976	1977	1976	1977
Cost of calf, $	164.40	169.00	158.40	164.00	141.05	158.50
Cost of feed, $	269.13	261.41	251.82	251.51	240.49	228.07
Total cost, $	433.53	430.41	410.22	415.51	381.54	386.57
Carcass value, $	367.92	391.02	361.35	391.53	333.57	349.40
Net gain or loss, $	-65.61	-39.39	-48.87	-23.98	-47.97	-37.17
Avg. net loss, $	-52.50		-36.42		-42.57	

Discussion:

Soon after the calves were started on feed, during the first year of the study, an outbreak of shipping fever-pneumonia occurred throughout the majority of the lots at the station. Although numerousd Hereford and BWF calves were treated and cured, no problems were observed in either pen of LH X H calves. Although our sample numbers were small, it does appear that this LH X H is hardy and at least in this study showed some resistance to disease.

Summary:

Results of this study trial indicate that the LH X H steers gain about three tenths pound slower on slightly more feed; reach maturity at about 1000 pounds, and yield a high percentage of choice carcasses at slaughter. Although their rate of gain was less, their cost per hundred pounds of gain was $41.32, which is slightly less than BWF steers and two dollars and forty eight cents more than the Hereford steers.

A review of carcass information shows that the LH X H steers graded essentially the same as the Herford or BWF and the differences in dressing percentage were very slight. Both the BWF and Hereford steers had heavier carcasses, larger loin eye areas, and significantly thicker fat cover. The significant fat cover reduction among the LH X H steers resulted in an average calculated yield grade of two, compared to two and eighty five hundredths for the BWF and Hereford steers. The thinner fat covers also contributed to a higher calculated cutout percentage, which was 49.12% for the LH X H; 47.27% for the Hereford; and 45.7% for the BWF steers.

After feed, mixing and grinding, and calf costs were deducted from the gross return, the BWF steers had the greatest net loss of $52.50, followed by net loss of $42.57 for the LH X H crosses. More efficiency among the Hereford steers resulted in the least net loss of $36.42.

FEEDLOT PERFORMANCE COMPARISON OF BULLS & STEERS

This trial was designed to compare feedlot performance and market potential of bulls and steers under similar feeding and marketing conditions.

The feeding of bull calves to produce "bullock" beef at approximately 1050 pounds, or 16 to 18 months of age, has been demonstrated to be a very efficient method of producing good quality beef. However, to date, the meat trade has discounted "bullock" meat due to lack of sonsumer acceptance. Thus, the economics of producing "bullock" beef has suffered.

In this first year of the trial, weanling bull and steer calves of Hereford and Angus X Hereford breeding were allotted and started on trial December 1, 1975. The bull calves were all purchased, and it was difficult to find as uniform a group as we would have liked, because of lack of numbers on the market. The steers were mostly from yhr Station herd, with a few purchased animals added. The second year of the trial, a more uniform group of Hereford and Angus X bulls and steers were randomly selected from the Station herd and started on trial November 22, 1976. All groups, steers and bulls, were treated as uniformly as possible with regard to vaccinations, feeding, weighing, and handling. The animals were shipped for slaughter when they reached average lot weights of 1050 to 1100 pounds. The calves were all self-fed a mixed hay and grain rations including minerals according to the schedule shown in table 5. Average feed consumption is shown in table 6.

The cattle were shipped by truck to Flavorland Dresses Beef in West Fargo, North Dakota for slaughter. They sold on an individual grade and weight basis. Additional carcass information was gathered with the assistance of the meat's department, Department of Animal Science, North Dakota State University.

Feedlot performance and carcass data for two years trials is summarized in table 7 and 8.

Discussion:

Bulls, as expected, gain at a faster rate and are more efficient. As previously mentioned, the bulls fed the first year of this study were heavier at the start of the trial and therefore, finished considerably sooner than the steers. Finishing 85 days sooner is naturally more than should be expected from bull and steer calves started at an equal weight and age. Bulls fed in 1977 were started at more uniform weights and reached the target slaughter weight of 1050 and 1110 pounds 55 days sooner than the steers, which is more typical. In the experiment at this Station bulls and steers handled equally well. The numbers were small, however. Research conducted at other research facilities indicates that large numbers of bulls can be easily fed without excessive fighting provided that sorting or new individuals are not added to the pen during the feeding period.

Eighty percent of the bull carcasses were graded U.S.D.A. "Atag" since no market is readily available for the "bullock" grade. The remaining 20% of the bull carcasses, which were predominately Angus X Hereford crossbreds, received higher quality grades. The bull carcasses did not show the coarsness usually associated with bull beef in the past, and were described by meat's department personnel from North Dakota State University as being, "very desirable." In spite of this, the meat packers are reluctant to buy young bull beef; and when they do, the carcasses are discounted from 5 to 11 dollars per hundred weight. Bull beef has been characterized by the meat trade as being "dark-cutting" carcasses because the darker colored cuts, when intermixed with steer beef in meat cases, have not been readily accepted by the consumer.

Table 5. Rations as fed to bulls and steers.

	Dates Started			
Ingredients, %	Nov 22	Dec 2	Feb 23	May 17
Oats	25	50	75	50
Barley	-	-	-	25
Tame hay	72.5	47.5	22.5	22.5
Di-cal	.5	.5	.5	.5
Salt	2.0	2.0	2.0	2.0

Table 6. Average daily feed consumption.

Ingredients	BWF bulls	Hereford bulls	BWF steers	Hereford steers
Oats, lbs	14.60	13.28	13.30	12.70
Barley, lbs	1.20	1.07	2.20	2.10
Tame hay, lbs	8.10	7.30	7.20	6.80
Di-cal, lbs	.12	.11	.12	.11
Salt, lbs	.49	.44	.46	.44
Total, lbs	24.51	22.20	23.28	22.15

Table 7. Feedlot performance-two year average, 1975-1977.

	BWF bulls	Hereford bulls	BWF steers	Hereford steers
Days on feed	221	221	292	292
Finish wt., lbs	1091	1078	1087	1081
Starting wt., lbs	488	515	447	433
Gain, lbs	603	563	640	648
ADG, lbs	2.72	2.54	2.19	2.33
Feed/100 lbs gain	815	855	998	931
Feed cost/hd, $	200.61	197.22	265.27	251.67
Cost/100 lbs of gain	33.23	35.04	41.63	38.88
Carcass value, $	339.84	328.05	379.47	376.44
Carcass value less-Feed cost, $	139.23	130.83	114.20	124.77
Avg. difference, $	+15.54			

Table 8. Carcass data-two year average, 1975-1977.

Data on:		BWF bulls	Hereford bulls	BWF steers	Hereford steers
Hot carcass wt., lbs		635	637	644	639
U.S.D.A grade & carcass					
Value/cwt:	Choice	1@61.25	-	12$59.38	12@59.38
	Good	3@56.25	1@56.25	1@56.25	1@56.25
	Stag	7@51.00	11@51.00	-	-
Avg. Carcass value, $		339.84	328.05	379.47	376.44
Dressing %		58.2	59.1	59.2	59.0
Kidney knob est., lbs		13.6	15.3	24.0	19.2
Loin eye, sq. in.		13.9	13.3	11.9	11.5
External fat thickness, in.		.36	.34	.81	.61

Summary:

Hereford and Angus X Hereford bulls gained faster and were more efficient than steers fed and handled under similar conditions. In the 1977 trial the Hereford bulls gained .33 pounds per day faster than the BWF bulls gained .72 pounds per day faster than the steer comparisons.

Efficiency of feed conversion and rate of gain for the bulls was significantly greater than the steers and amounted to approximately eight dollars less feed per 100 pounds of gain for the BWF bulls and four dollars less feed per 100 pounds of gain for the Hereford bulls. Major carcass differences between bulls and steers were found in both fat deposition and muscle traits. The percent of internal fat (kidney knob), marbling, and fat cover were significantly greater for the steers. Bull carcasses yielded substantially larger loin eye areas, less trimable fat and therefore a higher percentage of red meat. Meat quality grades were significantly higher among the steer carcasses. Although measurements for color were not taken, the color of lean, according to the federal grades was somewhat darker and contributed heavily to the lower quality grades received among the bull carcasses.

Although the steers produced significantly higher meat quality grades the net return after feed costs were deducted favored bull feeding. The two year average net return for BWF bulls was $26.42 and $5.99 more for the Hereford bulls when compared to their steer counterparts.

GRASS FED BEEF

A beef production system using all or nearly all roughage rations has been evaluated at the Dickinson Experiment Station since 1974.

The trial was designed with three feeding phases: the calf wintering phase, the summer grazing phase, and the feedlot finishing phase.

In the calf wintering phase, Hereford and Angus-Hereford crossbred calves were self-fed a limited grain-high roughage growing ration to produce gains of 1.25 to 1.50 pounds per day. The wintering rations was compared of 20% ground oats and 80% chopped hay self-fed with minerals added at the rate of 10 pounds of di-calcium phosphate and 40 pounds of salt per ton of mixed feed. The three year results of the wintering phase are shown in table 9. The normal wintering phase lasted from early November until May, a period of approximately 160 days.

Table 9. Winter gains, calf wintering phase.

	1973-1974	1974-1975	1975-1976	3 Yr. Avg.
Initial wt. (Fall)				
BWF	367	367	475	403
Hereford	374	374	469	405
Spring wt. (May)				
BWF	551	621	707	627
Hereford	583	607	708	633
Days Fed	152	175	157	161
Avg. daily gain, lbs				
BWF	1.21	1.45	1.46	1.37
Hereford	1.37	1.33	1.52	1.41

Following the wintering phase, the steers were pastured from May until late October on a series of three pastures; crested wheatgrass, native range, and Russian wildrye. This pasture grazing period laster 196 days in 1974 and 1975, and 168 days in 1976. Results of the pasturing phase for three year period are shown on table 10.

Table 10. Average steer gains, pasture phase.

	1974	1975	1976	3 Yr. Avg.
Crested wheatgrass				
Days	55	56	53	54.7
Gain/lbs-BWF	84	68	56	69.3
Hereford	90	69	62	73.7
ADG/lbs-BWF	1.53	1.21	1.06	1.27
Hereford	1.64	1.23	1.17	1.35
Native range				
Days	71	57	46	58
Gain/lbs-BWF	130	129	52	103.7
Hereford	108	133	46	95.7
ADG/lbs-BWF	1.83	2.26	1.13	1.74
Hereford	1.52	2.33	1.00	1.62
Russian wildrye				
Days	70	83	69	74
Gain/lbs-BWF	37	33	67	45.7
Hereford	36	15	58	36.3
ADG/lbs-BWF	0.52	0.40[1/]	0.97	0.63
Hereford	0.52	0.18	0.83	0.51
Total pasture period, days	187			
Total gain, lbs-BWF	218.7			
Hereford	205.7			
ADG/lbs BWF	1.17			
Hereford	1.10			

1/ Gains low due to a snowstorm.

After the grazing period, the steers were randomly placed into two groups for the feedlot finishing phase. One half of each group was selected to be sold at 975 to 1000 pounds while the rest were to continue on feed until they reached normal slaughter weights of 1050 to 1100 pounds.

Each group was self-fed a chopped mixed hay ration of approximately 30% alfalfa and 70% brome-crested wheatgrass hay. This hay was very good quality, having good color, odor and abundance of fine stems and leaves. In addition to the chopped hay, one group of steers was hand fed oats and barley at the rate of one percent of their body weight.

Except for minerals free choice, the steers did not receive any additional feed additives, supplements or growth stimulants.

Upon reaching slaughter weights, all were shipped approximately 300 miles to Flavorland Dresses Beef in West Fargo, North Dakota. Individual carcass data was collected with the assistance of the Animal Science Department, North Dakota State University.

Average trial results for three years are summarized in tables 11 and 12.

Table 11. Weights and gains, carcass data and returns-short fed drylot phase 1974-1977.

	1% Grain ration		Chopped hay ration	
	BWF	Hereford	BWF	Hereford
Weights and gains				
Initial wt., lbs	865	846	858	854
Final wt., lbs	993	976	1004	1007
Days fed	62	62	116	116
ADG, lbs	2.62	2.53	1.31	1.37
Carcass information				
Hot carcass wt., lbs	539	526	540	530
Dressing %	54.2	53.4	53.7	52.7
U.S.D.A. grades	3 Cho			
	6 Gd	9 Gd	2 Gd	6 Gd
Selling price				
1974-1975	3/4/75 Cho $54.40	Gd $50.50	4/16/75 Cho $66.00	Gd $62.00
1975-1976	1/20/76	Gd $59.00	3/25/76 Cho $55.00	Gd $53.00
1976-1977	11/16/76 Cho $59.50	Gd $55.50	1/10/77 Cho $59.50	Gd $55.00
Avg. carcass value, $	303.46	290.73	320.02	303.24
Avg. feed costs, $	51.75	51.75	76.46	76.46
Return over feed, $	251.70	238.98	243.55	226.78

Table 12. Weights and gains, carcass data and returns-long fed drylot phase 1974-1977.

	1% Grain ration		Chopped hay ration	
	BWF	Hereford	BWF	Hereford
Weights and gains				
Initial wt., lbs	863	847	840	849
Final wt., lbs	1083	1045	1026	1030
Days fed	116	116	162	162
ADG, lbs	1.98	1.72	1.18	1.12
Carcass information				
Hot carcass wt., lbs	607	594	567	565
Dressing %	56	56.7	55.3	54.7
U.S.D.A. grades	1 Pr			
	5 Cho	3 Cho	8 Cho	2 Cho
	2 Gd	6 Gd	1 Gd	7 Gd
	1 Std			
Selling price				
1974-1975	4/16/75 Cho $66.00	Gd $62.00	6/11/75 Cho $81.00	Gd $73.00
1975-1976	3/25/76 Pr $56.00	Cho $55.00	5/12/76 Cho $61.50	Gd $59.50
	Std $51.00			
1976-1977	1/10/77 Cho $59.50	Gd $55.00	2/14/77 Cho $57.00	Gd $54.00
Avg. carcass value, $	356.93	344.29	374.53	354.77
Avg. feed costs, $	103.77	103.57	107.83	107.83
Return over feed, $	253.36	240.72	266.70	246.93

Discussion:

This trial has shown that calves can be wintered in good growing conditions using a self fed ration of approxiamtely 20% oats and 80% tame hay plus minerals.

As expected, pasture gains varied somewhat from year to year but the three pasture system did allow an extended grazing period. Results of the pasture grazing phase is shown in detail on page 10 of this report.

Performance of steers in dry lot was about as expected. Steers receiving grain at the rate of one percent of their body weight were marketed in less time, averaging 54 less days in the early selling and 46 less days in the normal selling groups.

Although the hay fed steers required more time to reach the same market weight, returns over feed were not appreciably different. The hay fed steers graded good to choice at the weights sold.

Over the years, the crossbred steers graded higher than the straightbred steers, largely because they expressed more marbling in the loin eye muscle.

Summary:

This trial has demonstrated that Hereford or BWF steer calves can be fed from weaning to slaughter on rations composed almost entirely of roughage, without the use of feed additives, supplements, or synthetic growth stimulants. When conditions of high grain price and normal roughage costs exist, this feeding system may well be utilized with good results.

LEAST COST COMPUTER RATIONS FOR BEEF CATTLE

Can the computer be used as a tool to aid the cattle producer in figuring how to prepare balanced rations for different classes of livestock, at the least possible cost?

The Cooperative Extension Service has accesss to a Michigan State University computer program, developed by two Michigan researchers, Dr. Roy Black and Dr. Daniel Fox, to so just that.

The program permits the stockmen, with the help of the County Agent or experiment station personnel, to load the computer with information on: the class of cattle being fed; performance desired; various feeds available and their price; and, percentage at which feeds can be used in the ration. Once these inputs have been made, the computer figures a balanced ration at the lowest possible cost for that particular class of livestock. Thus, in theory, the North Dakota stock producer has computer technology available to help him figure nutritionally balanced, economical livestock rations.

This trial was designed to see how the program worked in actual practice; and, to see what modifications would be needed for the Michigan program to make it fit North Dakota conditions. Working in cooperation with the Stark-Billings County Agent, the program was run according to recommended procedure, just as would be done for any individual area livestock producer, and a computer formulated ration was developed. An oats-barley-tame hay ration that has been successfully at the Station for several years was used as the control. Twenty four Angus X Hereford heofer calves from the Station herd were equally divided into four lots, two lots receiving the "computer" ration beginning on November 17, 1976.

All heifers were implanted with Synovex-H on December 3rd. As the heifers reached about 650 pounds the program was run again, and because of changes in nutrient requirements and feed prices the recommended ration was changed on February 11, 1977. On February 22 the control ration was also changed, as shown in table 15.

On May 31, 1977, after a feeding period of 195 days during which they had gained about 425 pounds, all were shipped to Flavorland Dressed Beef in West Fargo for slaughter on a grade and weight basis.

Weights, gains and feed costs are shown in table 16. Carcass data and returns are summarized in table 17.

Discussion:

As with any new procedure, using the computer program for the formulation of "least cost" rations required a combination of patience and study, and a good response is very rapid once the proper inputs have been made, results are dependent on the accuracy of information fed into the machine. Results of the first year's trial were about for both methods of feeding, with the computer ration utilizing some feeds not commonly used in feedlot rations in this area.

Although not shown in the data, the gains of all lots of heifers were well above two and one-half pounds until about the end of March then, for some unexplained reason, the computer fed heifers dropped to only about one person per head per day, while the control heifers continued to gain at from one and one-half to two pounds per head per day.

All four lots of heifers had satisfactory carcass weights and grades, witn no apparent differences between treatments.

Getting the computer fed heifers on feed did not prove to be any problem, although about 10 days were required to work them up to the full 50% wheat ration.

Table 13. Feed inputs and costs entered into the computer for least cost ration formulation.

Feed	Initial run	February, 1977 run
	Price/cwt as fed basis	
Barley	4.48	4.48
Corn	4.80	4.98
Oats	4.40	5.00
HRS wheat	4.50	4.50
Beet pulp	4.50	4.50
Linseed oil meal	9.00	9.00
Soybean oil meal	9.75	9.75
Alfalfa	2.75	2.75
Brome-alfalfa hay	2.25	2.25
Oat straw	0.90	0.99
Di-cal	13.00	13.00
Limestone	4.00	4.00
Trace mineral salt	3.80	3.80
Wheat straw	0.90	0.90
20% commercial supplement	9.10	9.10
30% commercial supplement	9.70	9.70

Table 14. Least cost computer rations as fed.

Ingredients	Initial computer ration	Second run
Barley, lbs	191	602
HRS wheat, lbs	502	166
Soybean oil meal, lbs	49	-
Alfalfa, lbs	50	-
Oat straw, lbs	199	233 1/
Limestone, lbs	7	6.36
Trace mineral salt, lbs	2.24	2.24
Total lbs	1000	1000

1/ Wheat straw used.

Table 15. Control ration as fed.

Ingredients	Initial control ration	Second run
Oats, lbs	500	750
Tame-hay, lbs	475	225
Di-cal, lbs	5	5
Trace mineral salt, lbs	20	20

Table 16. Weights, gains and feed costs.

	Control	Control	Computer	Computer
Initial wt., lbs	487	487	488	488
Final wt., lbs	923	940	914	876
Feedlot gain, lbs	436 1/	453 1/	425	388
Days fed	195	195	195	195
ADG, lbs	2.23	2.32	2.17	1.98
Pounds feed/lb gain	9.49	9.54	9.25	10.70
Feed cost/hd/$	175.39	182.97	167.34	175.36
Feed cost/cwt gain/$	40.24	40.36	39.37	45.25

1/ Feedlot gain of control heifers significantly better (P .05) than computer fed heifers.

Table 17. Carcass data and return.

	Control lots		Computer lots	
Hot carcass wt, lbs	543	556	543	524
Dressing %	58	59	59.4	59.8
U.S.D.A grades	4 Cho 2 Gd	3 Cho 3 Gd	4 Cho 2 gd	5 Cho 1 Gd
Carcass value, $	321.55	325.27	321.00	313.85
Return over feed, $	146.17	142.30	153.66	138.49
Two lot average, $	144.24		146.08	

HEI-GRO DEVICE FOR FEEDLOT HEIFERS

A relatively new non-chemical growth stimulant known as the Hei-Gro device is being marketed to livestock feeders by Agrophysics Inc. San Francisco, California. This device, composed of injection molded good grade nylon, looks somewhat like a miniature Christmas tree. It is inserted deep into a feedlot heifer's natural body mechanisms to produce faster growth.

According to company literature, when the device is used as recommended, it should produce additional returns of from seven to nine dollars per head. It is also reported to give faster growth, better feed conversion, reduced bulling, 99% retention, simpler feeding procedures and show no effects of breed or season.

A trial was started in the fall of 1976 to compare response from weaning to market of heifer calves with or without the device. Heifer calves used in this trial were Angus-Hereford crossbreds averaging about 485 pounds. Twenty four head were randomly allotted into four equal lots. Two lots served as controls and two lots were given the Hei-Gro device at the beginning of the trial on December 3. All heifers were implanted in the ear with a Synovex-H implant at the start of the trial. The heifers were self-fed completely mixed grain-roughage rations designed to produce gains of from two and one-fourth to two and one-half pounds per head per day.

Feedlots used in this trial were at least 50 feet from lots where steers or bulls were being fed, as recommended by Agrophysics, Inc.

All heifers were sold on a grade and yield basis at a slaughter weight of approximately 920 pounds.

Results of the trial are summarized in table 18.

Summary:

First years' results using the Hei-Gro device do not indicate any improvement in rate of gain or feed efficiency.

The device was not difficult to insert and there were no restrictions or market clearances required.

Table 18. Weights, gains and feed costs, carcass data and returns.

Data on:	Control	Hei-Gro treatment
Initial wt., lbs	488	488
Final wt., lbs	918	908
Gain, lbs	430	420
Days fed	195	195
Average daily gain	2.21	2.16
Feed efficiency	9.38	10.06
Feed cost/hd., $	171.36	179.17
Cost/hd/day, $	.88	.92
Cost/cwt gain, $	39.81	42.61
Hot carcass wt., lbs	543	540
Dressing %	59.1	59.4
U.S.D.A grade	8 Cho @ $60.75	8 Cho @ $60.75
	4 Gd @ $56.25	4 Gd @ $56.25
Carcass value, $	321.28	319.56
Net Return, $ 1/	149.91	140.40

1/ Carcass value less feed cost.

FEEDING TRIALS WITH RUMENSIN

Rumensin (R), (monensin sodium), is a new feed additive for beef cattle that is reported to improve feed efficiency by increasing the energy available from a given amount of ration. This is accomplished by altering rumen fermentation to increase the proportionate amounts of useable volatile fatty acids with less loss of carbon dioxide and methane gas.

In this trial, two pens of straightbred Hereford steer calves of similar background were randomly allotted on February 10, 2976. Both groups were started on a ration of four pounds of ground oats per head per day and self-fed a chopped mixed hay consisting of approximately 20% alfalfa and 80% tame grass. Both lots were also self-fed a mineral mixture of two parts dicalcium phosphate and one part trace mineral salt.

The lot receiving Rumensin was fed 150 mg per head per day in the ground oats until May 22, at which time the level of Rumensin was increased to 200 mg per head per day. The Rumensin fed steers averaged about 610 pounds at this time. On October 13, ground barley was added to the ration at the level of three pounds per steer per day. On December 8, the oats was increased to six pounds and the the level of Rumensin to 300 mg per head per day.

Both lots of steers remained on feed until February 14, 1977 at which time they were sold on a grade and yield basis.

Results of this trial are shown in the following tables.

Summary:

Although the problem corrected itself, the calves were somewhat reluctant to accept the ration containing Rumensin for the first three or four days.

The Rumensin fed steers in this trial gained 0.23 pounds per head per day faster than the control steers. The carcass data shows that because of a longer feeding period, the control steers were somewhat fatter, having a higher dressing percentage and deeper backfat measurement. Although the Rumensin fed steers consumed about one pound per head per day more hay, their costs were $18.15 less per steer than the controls. This savings in feed amounted to an eight and six tenths percent advantage for the steers receiving Rumensin.

A second trial is currently in progress.

Table 19. Feed record, Rumensin feeding trial, 1976-1977.

Average feed per day	Control	Rumensin
Oats, lbs	4.47	4.37
Barley, lbs	2.97	2.96
Chopped mixed hay, lbs	12.1	13.1
Mineral, lbs	0.2	0.2
Average lbs feed/lb gain	11.12	10.16
Feed savings, $	-	8.6
Feed cost:		
Total per head, $	252.15	237.79
Avg/hd/day, $	0.62	0.64
Avg/cwt gain, $	38.71	35.12
Calculated return:		
Carcass value ($58 Cho-$55 gd)	348.28	350.31
Less feed cost, $	252.15	237.79
Difference, $	96.13	112.52
Added value/hd, $	-	16.39

Average feed costs: Oats $1.55, barley $2.42, hay $40.00/ton, salt $4.20/cwt, Di-cal $14.40/cwt, processing $10.00/ton, Rumensin at .05¢/gram.

Table 20. Weights and gains-Rumensin feeding trial, 1976-1977.

Data on:	Control	Rumensin
Initial wt., lbs, Feb 10, 1976	405.7	411.4
Final wt., lbs, Feb 14, 1977	-	1088.6
March 21, 1977	1057.1	-
Feedlot gain/hd/lbs	651.4	677.1
Actual days on feed	405	370
Average daily gain	1.60	1.83

Table 21. Carcass data-Rumensin feeding trial, 1976-1977.

Data on:	Control	Rumensin
Hot carcass wt., lbs	605.3	617.3
Avg. dressing percent	57.25	56.70
Grade & price	5 Cho @ $58	3 Cho @ $57
	2 Gd @ $55	4 Gd @ $54
Actual carcass value, avg., $	348.29	341.28
Calculated value based on equal price, $	348.29	350.31
Inches backfat cover, avg.	0.60	0.44
Est. kidney knob, lbs	21	19
Loin eye-sq. in. avg.	11.2	11.9
Calculated yield grade	2.7	2.2
Calculated percent cutout	50.5	51.8

FEEDING TRIALS WITH RUMENSIN, RALGRO, AND RUMENSIN-RALGRO COMBINATION

Feeding trials with steers, comparing Rumensin (R), (monensin sodium), Rolgro (zeranol), Rumensin and Ralgro combined, and an untreated control were begun in November, 1976.

In this study 24 Angus X Hereford crossbred steer calves were randomly allotted into four lots of six steers each. All lots were fed for 333 days on as high roughage growing-fattening ration of oats, barley and chopped tame hay. The grain portion of the ration was hand fed on a daily basis and the roughage was self-fed. Levels of grain were increased periodically throughout the feeding period as follows: from December 1, 1976-May 20, 1977 the ration fed all lots was sour pounds oats and tame hay self-fed; from May 20-August 9, four pounds oats, three pounds barley and tame hay self-fed; from August 9-August 24, five pounds oats, four pounds barley and tam ehay self-fed; and from August 24-October 18, 6 pounds oats, four pounds barley and tame hay self-fed.

Steers in the Ralgro and Combination lots received a 36 mg zeranol implant in the ear at the beginning of the trial and again 151 days later. Cost of the implant was 60 cents per steer per implant, or a total of $1.20 for the feeding period. This does not include labor cost of implanting.

Steers in the Rumensin and Combination lots received monensin sodium daily in their grain ration at the following levels.

Warm-up period-12 days, no Rumensin
Next 170 days, 150 mg/hd/day
Next 81 days, 200 mg/hd/day
Next 15 days, 250 mg/hd/day
Next 55 days, 300 mg/hd/day

The control lot received only the basic grain and chopped hay ration. All lost received a trace mineral salt and di-calcium phosphate mineral mixture free choice.

All steers were weighed on a 28 day schedule throughout the trial. They were slaughtered at Flavorland Dressed Beef in West Fargo, North Dakota.

Table 22. Weights and gains-Rumensin, Ralgro, Combination trial,1976-1977.

Data on:	Control	Rumensin	Combination	Ralgro
Initial wt., lbs	412	412	412	414
Final wt., lbs	1020	1035	1025	1052
Feedlot gain, lbs	608	623	613	638
Days fed	333	333	333	333
Avg. daily gain, lbs	1.82	1.87	1.84	1.91

Table 23. Carcass data-Rumensin, Ralgro, Combination Trial, 1976-1977.

Data on:	Control	Rumensin	Combination	Ralgro
Hot carcass wt., lbs	574	588	573	580
Avg. dressing percent	56	57	56	55
USDA grade 1/	6 Cho	3 Cho	3 Cho	5 Cho
		3 Gd	3 Gd	1 Gd
Actual carcass value, $	364.17	357.82	347.96	362.89
Calculated value, $ based on choice grade	364.17	373.67	363.85	368.30

1/ Choice @ $63.50/cwt, good @ $58.00/cwt.

Table 24. Feed consumption-Rumensinm Ralgro, Combination Trial, 1976-1977.

Data on:	Control	Rumensin	Combination	Ralgro
Oats, lbs	8,490	8,490	8,490	8,490
Barley, lbs	3,138	3,138	3,138	3,138
Tame hay, lbs	27,565	23,850	25,420	27,505
Total	39,193	35,478	37,048	39,133
Kcal/Kg gain	22.3	19.1	21.0	21.3
& Feed saving	-	10.8	5.8	4.5

Table 24. Feed cost and returns-Rumensinm Ralgro, Combination Trial, 1976-1977.

Data on:	Control	Rumensin	Combination	Ralgro
Oats @ $1.55/bu	411.23	411.23	411.23	411.23
Barley @ $2.42/bu	158.21	158.21	158.21	158.21
Hay @ $40/ton 1/	551.30	477.00	508.40	550.10
Processing @ $10/ton	137.82	119.25	127.10	137.52
Rumensin @ 5¢/gram	-	18.60	18.60	-
Ralgro @ 60¢/implant	-	-	7.20	7.20
Total cost/lot, $	1258.56	1184.29	1230.74	1264.26
Return/lot, $	2158.02	2146.97	2087.77	2177.34
Net return less feed, $	926.46	962.68	857.03	913.08
Net return per head, $	154.41	160.45	142.84	152.18
Calculated net based on equal grade-choice, $	154.41	176.28	158.72	157.59

1/ Lower hay consumption in the treatment lots resulted in a feed saving of 10.8% in the Rumensin lot; 5.8% in the Combination lot; and, 4.5% in the Ralgro lot.

Summary:

The use of Rumensin in high roughage feedlot rations resulted in feed savings of from 5.8% to 10.8% when compared to the control ration. The use of Ralgro implants appeared to improve feed efficiency about 4.5%.

Considering only the feed cost and actual market value, the Rumensin lot returned $6.04 per steer more than the control. The Ralgro lot returned $2.00 less and the Combination lot $11.57 less than the control. This difference was primarily because of a $5.30/cwt price differential between USDA choice and USDA good grade. If all of the several steers in the treatment lots graded good, as did the control steers, the dollar advantage over the control woyld have been $21.00 for the Rumensin treatment, $3.18 for the Ralgro treatment and $4.31 for the Combination treatment.

The trial is being repeated in the 1977-1978 feeding period.

WINTERING REPLACEMENT HEIFERS FOR BREEDING SUCCESS

Winter feeding replacement heifer calves is an important phase of the cow-cal industry. Unless heifer calves are well grown and have adequate condition or weight, they may not cycle and conceive early in the breeding season. Because of normal variation in weights at weaning, the livestock producer has an important management decision to make. If he feeds all his replacement heifer calves so the lighter ones will be heavy enough by bressing season, he will more than likely be over-feeding the larger, growthier heifers. Or, if he feeds so the larger heifers are not over conditioning, the smaller heifers will not be large enough to breed early in the season. However, if it were possible to divide his replacement heifers into uniform weight groups, he could then feed each group so they would reach puberty prior to breed and conceive early in the breeding season. Also, each heifer would have been wintered as economically as possible consistent with reproductive success. Results at this Station show that a heifer that calves early as a two year old, will continue to calve early as a producing cow. Conversely a late calving heifer will more likely continue to calve late as a producing cow. A missed cycle with a late calving female produces a very late calf-with the likelihood that she will continue to calve later than desired.

With these thoughts in mind, a trial was started to evaluate the economics, performance and reproductive efficiency of heifers managed as previously outlined.

In this trial, a group of 40 Hereford heifer calves, some from the Station herd and some purchased, were divided by weight into four equal lots. A target weight of 650 pounds by the beginning of the breeding season, May 1, was established.

Starting on February 9th, 1977, 84 days before breeding was to begin, all lots were fed chopped mixed tame hay consisting of brome, crested, and alfalfa. In addition, depending on initial weight and rate of gain required, one lot received two pounds, one lot four pounds and one lot six pounds of a grain mixture consisting of 50% oats and 50% wheat. One lot was not fed any grain.

Following the winter phase all lots were recombined into two breeding herds. They were turned on pasture, exposed to bulls from May 3rd to June 20th, a period of 48 days, and continued on grass for the rest of the summer.

On August 10th, all heifers were weighed individually. On August 19th all heifers were palpated for pregnancy with estimated made for age of fetus.

Results of the first years' trial are shown in tables 26, 27, and 28.

Table 26. Results of the winter phase of the wintering heifer trial.

	Group 1 all hay	Group 2 hay + 2 #grain	Group 3 hay + 4 #grain	Group 4 hay + 6#grain
February 9, 1977 wt., lbs	586	548	524	493
May 3, 1977 wt., lbs	670	673	656	645
84 day winer gain, lbs	84	125	132	152
ADG, lbs	1.00	1.48	1.56	1.81

Table 27. Feed consumed pr heifer for 84 days.

	Group 1 all hay	Group 2 hay + 2 #grain	Group 3 hay + 4 #grain	Group 4 hay + 6#grain
50% oats, - 50% wheat mix, lbs	-	170	333	483
Chopped tame hay, lbs	1183	977	947	609
Minerals- (2 salt, 1 dical), lbs	16.8	16.8	16.8	16.8
Winter feed cost/hd, $	27.78	30.70	37.28	36.35
Feed cost/day, ¢	33.1	36.5	44.4	43.3
Feed cost/cwt gain, $	33.07	24.56	28.24	23.91
Avg. lbs feed/cwt- Gain, lbs	14.3	9.31	9.82	7.29

Table 28. Gain on grass and pregnancy status.

	Group 1 all hay	Group 2 hay + 2 #grain	Group 3 hay + 4 #grain	Group 4 hay + 6#grain
August 10th wt., lbs	819	795	762	769
99 day summer gain, lbs	149	122	106	110
ADG on grass, lbs	1.50	1.23	1.07	1.11
% of heifers pregnant 1/	66	70	70	90
Estimated age of fetus-days	84	69	93	91

1/ Percent pregnany low due to a sub fertile bull.

Discussion:

With the type and weight of heifers used in this trial, adding grain at levels of two, four or six pounds per head per day did allow heifers to reach the target weight by May 3, 1977.

We found at the close of the trial that one bull used was sub fertile, with a number of heifers exposed to him showing open.

Summary:

Dividing heifers into uniform weight groups did allow all of them to reach the target weight of 650 pounds without any of them getting overly conditioned. Cost of feed per day was almost 11 cents cheaper for the heavier heifers than for the lightest group.

The pregnancy test did not show any marked differences between any of the four groups.

The trial will be repeated in 1977-1978.

HEIFER MANAGEMENT STUDY

North Dakota stockmen can't afford the luxury of keeping a heifer, until she is three years old before she has her first calf. However, heifers bred to calve at two years must n=be properly managed if the calving season is to be successful. They should be fed so they will be well grown but not fat at calving. They should be bred to calve about three weeks earlier than the cow herd; and, should be bred to bulls known to sire small framed calves having low birth weights.

Identification of "easy-calving" bulls under natural breeding conditions presents a real problem. One breed of cattle, the Texas Longhorn, is reported to minimize calving difficulties when crossed with Hereford or Angus heifers. However, very little research data is available to confirm or disprove these claims. Several area ranchers have used Longhorn bulls on first calf heifers with apparent success. However, these crossbred calves are often discounted at market time, due to their type, although little or no performance or carcass data are available to justify these discounts. Other area producers report good success by using small framed Angus bulls on Hereford heifers to reduce calving difficulties.

With these ideas in mind, a trial was designed to compare calving difficulty with first calf Herreford heifers bred to either Angus or Longhorn bulls.

In May, 1975, 40 straightbred Hereford heifers weighing approximately 680 pounds were assigned at random to one of two breeding groups. One group of 20 heifers was exposed to two year old Longhorn bull while the other group was exposed to a two year old registered Angus bull. Bth bulls remained with the heifers from may 7th to July 8th, a period of 62 days. During this period the heifers grazed on fertilized tame grass pasture. Upon removal of the Longhorn and Angus bulls, Polled Hereford bulls were run with the heifers. The heifers grazed on native range until October 16th when they were pregnancy checked. This check revealed one heifer not bred because of an infantile reproductive tract, and two suspected late calves.

In 1976, the trial was repeated with another forty Hereford heifers. The Longhorn and Angus bulls were turned I with the heifers on May 3rd and remained with them until July 1st, a period of 59 days. After July 1st, Polled Hereford bulls were with the heifers until the first of August. All heifers were pregnancy tested on September 14, 1976 by a local veterinarian.

The heifers ran together and were wintered as a group until they were moved into calving lots in early February. The heifers were wintered on a full feed of tame hay plus salt and minerals free choice. After calving, each heifer received approximately two pounds of ground oats in addition to chopped hay free choice.

A close watch and record was kept of each birth including birth date, weight, sex and ease of delivery. Type of delivery was scored from 1 to 5 as follows: 1 no help, 2 slight pull, 3 hard pull, 4 Caesarian, 5 born dead.

Weaning weights were recorded at approximately 205 days of age.

Table 29. Calving difficulty score-heifer management trial, 1975-1977.

	Angus		Longhorn	
	1976	1977	1976	1977
Calving with:				
(1) No difficulty	16	16	19	16
(2) Light pull	-	1	-	1
(3) Hard pull	1	2	-	-
(4) Caesarian section	-	-	-	-
(5) Born dead	-	1	-	-
Possible live calves	18	19	19	17
% Born without difficulty	89	84	100	94

Summary:

The two calving seasons represented in this data indicate that Longhorn bulls mated to Hereford heifers will reduce calving loses and problems to a very minimum.

The economics of this practice appear to favor the Angus X Hereford matings due to heavier weaning weights of 34 pounds for steer calves and 36 pounds for heifer calves. These heavier weaning weights plus no discount at market time seem to favor the standard beef breeds if the operator can spend time with his first calf heifers at calving.

It is also much harder to select an eacy calving Angus bull than it is a Longhorn bull.

Table 30. Two years calving data-heifer management trial, 1975-1977.

	1975-1976	1976-1977	Total
	Number of heifers bred		
Angus	20	20	40
Longhorn	20	20	40
	Number of heifers calving		
Angus	18 1/	20	38
Longhorn	19 2/	17 3/	36

1/ One cow removed because of abnormal reproductive tract.
2/ One cow not included, late calving with a Hereford calf.
3/ Three cows not included, late calving with straight Hereford calves.

	1976	1977	Avg.
	Average birth weights of bull calves		
Angus	7 hd = 70#	8 hd = 73#	15 hd = 72+
Longhorn	13 hd = 66#	8 hd = 63#	21 hd = 65#
	Average birth weights of heifer calves		
	10 hd = 68#	12 hd = 65#	22 hd = 66#
	6 hd = 58#	9 hd = 59#	15 hd = 59#

		Averaging weaning weights of steers		
Angus	-actual	5 hd = 454#	7 hd = 440#	12 hd = 446#
	-adjusted	5 hd = 462#	7 hd = 486#	12 hd = 476#
Longhorn	-actual	13 hd = 407#	8 hd = 424#	21 hd = 413#
	-adjusted	13 hd = 426#	8 hd = 468#	21 hd = 442#
		Average weaning weights of heifers		
Angus	-actual	10 hd = 400#	12 hd = 425#	22 hd = 414#
	-adjusted	10 hd = 401#	12 hd = 480#	22 hd = 444#
Longhorn	-actual	5 hd = 369#	7 hd = 358#	12 hd = 364#
	-adjusted	5 hd = 369#	7 hd = 436#	12 hd = 408#

1/ Two heifers not included, one calf sick at weaning, one calf died in September of unknown causes.

Table 30. Two years calving data-heifer management trial, 1975-1977 continued.

	Estimated calf value at weaning		
	Steer calves		
Angus	5 hd @ $177.06	7 hd @ $215.60	12 hd = 199.54
Longhorn	13 hd @ $146.68	8 hd @ $195.04	21 hd = 165.10
	Heifer calves		
Angus	10 hd @ $131.93	12 hd @ $182.75	22 hd = 159.65
Longhorn	5 hd @ $110.70	7 hd @ $143.20	12 hd = 129.66

1/ Price estimates based on actual weaning weight time price. BWF steers at $49, BWF heifers @43, Longhorn X Hereford steers at $46, LXH heiders at $40 in 1977. 1976 prices were 10¢ per pound less.

	Return per heifer bred	
	1976	1977
Angus	$122.48	$186.93
Longhorn	$129.49	$170.85

PROSTAGLANDINS FOR SYNCHRONIZATION OF ESTRUS IN BEEF CATTLE

A cooperative trial to evaluate Prostin F2 Alpha (dinoprost tromethamine) for the control of estrus in beef cows was started in June, 1976.

Prostin F2 Alpha is a registered prostaglandin analog produced and developed by the Upjohn Company, Kalamazoo, Michigan. To date, it is available in the United States for experimental use only.

Basically, the drug acts to interrupt the estrus cycle of a normally cycling cow, starting the cycle over in a normal manner. Thus, cows treated as a group will re-cycle as a group and can be bred or artificially inseminated as a group.

The trial involved 72 commercial Hereford and Angus X Hereford cows three years old and older, belonging to the Osteroos Ranch of Des Lacs, North Dakota.

The Upjohn Company provided the Prostin F2 Alpha used in the trial. Dr. Edward Moody, a reproductive physiologist with the Upjohn Company, palpated all cows for evidence of pregnancy and estimated age of fetus on September 25, 1976.

Dickinson station personnel assisted in allotting the cattle into treatment groups, made the two required injections of Prostin F2 Alpha, and analyzed the results of the trial.

All care and handling, artificial insemination and field insemination and field record keeping of the cows in this trial was done by Mr. Loren Osteroos.

Group one, designed as the control group, was handled in a normal A.I. breeding program. They were detected for estrus and artificially inseminated 12 to 14 hours following visual detection of standing heat. Heat detection began on July 10th, with first insemination made on July 12th. The cows were bred A.I. as they were detected over a 24 hour period. After a minimum of 10 days following A.I., the cows were moved into a cleanup pasture where they were exposed to a functional bull equipped with a chin ball marker. Cows not detected during the 24 day A.I period were also moved into the cleanup pasture. Records were kept of cows bred in the cleanup pasture. All cows in the control group were worked through the chutes the same as treatments two and three although they did not receive any injections.

Group two, designed as the group inseminated at 80 hours following Prostin F2 Alpha injection, was maintained separately from groups one and three because no heat detection was required. Cows were injected beginning at 9:00 A.M., on June 28, 1976. The second injection was given at 8:00 A.M., on July 10th, 1976. Eighty hours following the second injection, starting at 4:00 P.M., on July 13th, all cows were inseminated. Twelve days following insemination the cows were moved into the cleanup pasture.

Group three, synchronized and inseminated as detected was maintained with group one in the detection pasture. They received the same injections as group two. Following the second injection a “gomer” bull wearing a chin ball marker was turned in and cows were inseminated approximately 12 hours after the first indications of standing heat. All cows were maintained at least ten days after insemination before they were turned into the cleanup pasture. Any cows not detected during the 24 day detection period were moved into the cleanup pasture.

Actual calving started about the middle of April in 1977.

Results of the trial are shown in the following table.

Table 31. Results of estrus synchronization using Prostin F2 Alpha.

	Group 1 normal A.I.	Group 2 A.I. At 80 hrs	Group 3 A.I. Of estrus
Number of cows allotted	21 [1/]	25	26
Number of cows bred-			
First 21 days	16	25	23
Not detected	3	-	3
Bred in 21 days	84%	100%	88%
Pregnancy test Sept. 25, 1976-			
Cows pregnant	12 of 19	16 of 25	17 of 26
the first 21 days	63%	64%	65%
Cows pregnant	14 of 19	21 of 25	21 of 26
the first 24 days	74%	84%	81%
Number cows diagnosed	19 of 19	25 of 25	26 of 26
pregnant	100%	100%	100%
Actual calving data-			
Cows calving first 21 days	12 of 19	16 of 25	16 of 26
	63.2%	64%	61.5%
Cows calving first 24 days	14 of 19	20 of 25	20 of 26
	73.6%	80%	76.9%
Cows calving later than	5 of 19	5 of 25	6 of 26
24 days	26.4%	20%	23.1%

1/ Two cows removed from study. One died, one was bred early.

Summary:

The results of this, and similar trials conducted across the country by the Upjohn Company are typical, and show that normal, cycling cows can be treated with Prostin F2 Alpha, and successfully inseminated on a synchronized schedule.

Concern has been expressed over the possibility that synchronization would result in having a concentrated calving period of one or two days, with the possibility of this occurring during a period of severe weather. Cows bred on a synchronized estrus in this trial calved over a 10 to 12 day period indicating that natural variation in the brood cow herd prevented a concentrated calving period from occurring.

USING STRAW IN COW WINTERING RATIONS

Straw feeding at various levels to replace part of the hay in wintering rations for pregnant beef cows has been recommended by this station and others in the United States and Canada. Past research at this station indicated that two-thirds of the hay in wintering rations can be replaced with straw, provided sufficient protein is available. Wintering rations of half hay and half oat straw and no supplemental protein have reduced wintering costs without affecting calving performance.

More efficient hay making equipment and portable tub grinders make possible the production of palatable, high quality rations containing various levels of hay and straw that can be blended and fed with little waste.

This cow wintering trial, started during the 1975-1976 wintering season, is designed to evaluate the nutritional as well as the economic aspects of processing hay and straw, as compared to feeding these roughages in their long form.

Only mature cows that were at least four years old or older were used, and were fed a period of 70 days in 1976 and 84 days in 1977. Two experimental groups were selected randomly according to age and fed a wintering ration of four parts mixed hay (crested wheatgrass and bromegrass + alfalfa) and three parts oat straw. Daily consumption of approximately 23 pounds of forage as fed was desired. Utilizing a fenceline feeder, group 1 received this ration after it had been processed in a tub grinder through a two inch screen. Group 2, which was fed in a conventional manner on the ground, received the same ratio of hay and straw in the long form on alternate days; hay being fed on Tuesday, Thursday, Saturday and Sunday, and oat or barley straw fed on Monday, Wednesday and Friday of each week. Both lots received minerals free choice. On February 1st, approximately 30 days before calving, each cow received an enterotoxemia booster shot and one-million units of vitamin A, intramuscularly.

Results of the trial are summarized in tables 32 through 34.

Summary:

Results on this trial show that chopping a ration of four parts mixed hay and three parts oat straw through a tub grinder produced an economical, highly palatable wintering ration for mature cows that readily consumed, regardless of weather conditions, up to the start of calving. Costs for chopping amounted to $2.10/ton.

Cows receiving the unprocessed hay and straw consumed an average 2.0 pounds less total feed per day, and wasted substantially more straw, especially on mild winter days, as compared to a very minimal amount of waste, and continued voluntary intake among the cows fed chopped forage.

The greatest amount of weight loss was experienced among the cows being fed unprocessed forage. Although weight loss was experienced by all age groups of cows calf birth weights and livability was unaffected by either method of feeding. The cows fed chopped blended hay and straw consumed the ration readily and some of their increase in weight is certainly to be considered as fill, which is very difficult to measure.

Table 32. Feed consumption, chopping costs and wintering economics-winters, 1975-1977.

	Group 1 Chopped hay + straw		Group 2 Long form hay + straw	
	1976	1977	1976	1977
Days fed	70	84	70	84
Number of head	32	36 1/	42	37
Mixed hay, lbs	32919	39533 2/	40959	41075
Straw, lbs	24690	29262	23300	27876
Feed/hd/day, lbs	25.7	22.7	21.7	22.2
Total feed cost, $ 3/	853.51	1088.99	1022.48	1042.40
Daily feed cost/hd, $	0.381	0.366	0.348	0.335
Chopping cost/cow, $ 4/	1.89	1.84	-	-
Total feed cost/hd, $	28.56	32.58	24.34	28.14

1/ One cow removed January 3.
2/ 2700 pounds long hay fed during severe storms.
3/ Mixed hay @ $40/ton, oat straw @ $10/ton, salt-mineral mixture fed free choice @ $104/ton. Mineral used is 17% phosphorus, 25% calcium, mixed at the rate of one part mineral mix to two parts white salt.
4/ Chopping sots, $2.10/ton.

Table 33. Weight changes, 1976-1977.

	Group 1 chopped hay + straw			Group 2 long form hay + straw		
Age of cow	4	5,6,7	8,9,10	4	5,6,7	8,9,10
Weight change, lbs						
1976	+67	+56	+62	-10	+5	+1
1977	+62	+43	+47	-7	-27	-38

Table 34. Two year average calf birth weights.

	Group 1 chopped hay + straw			Group 2 long form hay + straw		
Age of cow	4	5,6,7	8,9,10	4	5,6,7	8,9,10
Heifers:						
Avg. birth wt., lbs	73	72	70	65	73	73
Steers:						
Avg. birth wt., lbs	73	73	71	80	73	74

A COMPARISON OF BEEF CATTLE BREEDING METHODS TO IMPROVE PERFORMANCE

Artificial insemination is a management method that is available to livestock producers through various artificial breeding organizations. Superior sires can be selected from a large number of animals on the basis of their weaning and yearling performance as well as progeny records. Crossbreeding has also been shown to be an effective method of increasing the total pounds of calf weaned through the effects of hybrid vigor and the resulting improved performance. At a time when stockmen are faced with an every increasing price-cost squeeze they must use every management tool at their disposal to produce more pounds of beef at the lowest possible cost. The purpose of this long range study, is to evaluate crossbreeding and purebreeding management using natural service and artificial insemination followed by clean-up bulls.

In this trial, Hereford cows from the main Dickinson Station herd were randomly divided by age and date of calving into three breeding groups. Approximately 60 cows were assigned to the artificial breeding system and about 30 cows were assigned to the natural service purebred and crossbred breeding groups. Purebred horned and polled Hereford bulls were used in the straightbred treatment (HxH) and purebred Angus bulls were used in the crossbreeding treatment (AxH).

Cows selected for A.I. breeding in 1976 received two pounds dry rolled oats per head per day during the 25 day breeding season. Since no breeding facility was available in the pastures grazed, the A.I. cows were trailed one-half mile each morning to a holding area where the supplemental grain was fed and those cows that had been detected in standing heat were sorted out. Breeding was done on a twice a day basis and when cows were no longer in standing heat they were turned I with an Angus clean-up bull. To facilitate heat detection a detector bull equipped with a chin ball marker was used, breeding among all treatment groups was started on May 27th and ran for 60 days, when the bulls were removed. Fall pregnancy testing identified open cows, and any old cows or poor producers were culled.

the following changes were made in 1977. Prior to the beginning of the breeding season a handling facility and holding area for grain feeding was constructed adjacent to the water supply in the crested wheatgrass pasture used as the breeding pasture. Eight pounds of a mixture of equal parts of grain and chopped hay was fed per head per day. This, and the provision for adequate bunk space eliminated competition for grain between older and younger cows. Twice a day breeding was discontinued in favor of once a day early morning breeding. All breeding groups were grazed on separate crested wheatgrass pastures until approximately July of each year, depending on pasture condition, and were moved to native pasture. Minerals were fed free choice in a 2:1 salt-di-calcium phosphate mixture to insure adequate phosphorous intake. Also, during the early spring on crested pasture a level of 15% magnesium oxide was added to the mineral mixture as a grass tetany preventative.

A summary of the results to date are shown in tables 36, 36, and 37.

Summary:

Although a breeding study of this type has been hidden factors at work, the results to-date favor the natural service crossbreeding management system in which a return of $10 more per cow calved was experienced. The average pounds of calf weaned is not appreciably different between the A.I. and crossbred systems, however breeding costs and labor inputs were much higher for the A.I. system. The small number of A.I. calves born resulted in high breeding cost per cow, as well as, a loss in pounds of calf weaned among cows that didn't settle on the first service. In addition to the loss in pounds of calf, cows didn't settle on the first service were set back at least one heat cycle and possibly more if they didn't conceive early when exposed to the natural service clean-up bull. Setbacks such as this, in the reproductive cycle of a cow are difficult to regain.

Table 35. Breeding management systems summary-1976-1977 calving combined.

	A.I. system		Natural service		
	A.I. (HxH)	Angus clean-up (AxH)	Hereford (HxH)	Crossbred (AxH)	(HxH)
Total No. cows	131		57	56	
Total No. cows inseminated	131		-	-	
No. sold for management reasons	29		21	12	
No. having A.I. calves	38		-	-	
1st service conception rate of cows calved, %	37		-	63	
No. cows having (AxH) calves from Angus clean-up bull	-	62	-	-	
No. dead calves	3	3	7	5	
No. and sex of calf obtained					
Steers	16	36	14	16	3
Heifers	19	26	15	18	4

Table 36. Weaning data and adjusted calf weights-1976-1977 calving combined.

	A.I. system		Natural Service	Natural Service
	(HxH)	(AxH)	Hereford (HxH)	crossbred (AxH) (HxH)
Steers-actual	454	411	417	448 420
-adjusted	472	473	450	475 458
Heifers-actual	391	383	366	424 347
-adjusted	445	465	437	465 482

Table 37. Net return per cow-breeding management systems trial.

	A.I. System (HxH)			(AxH)	Natural Service Hereford			Natural Service Crossbred		
	No. head	Avg. wt.	$ value	$ value	No. head	Avg. wt.	$ value	No. head	Avg. wt.	$ value
Steers	16	454	3,269		14	417	2,627	16	448	3,226
@ 45¢	36	411		6,658				3	420	576
Heifers	19	391	3,046		15	366	2,251	18	424	3,129
@41¢	26	383		4,083				4	247	569
Gross return, $			17,056.00				4,878.00			7,500.00
Avg. return/cow calved			165.59 1/				135.50 2/			170.45 3/
Less breeding expense			-17.19				-11.50			-11.00
Net return, $			148.40				124.00			158.95

1/ Includes 6 dead calves.
2/ Includes 7 dead calves.
3/ Includes 3 dead calves.

COMMERCIAL WEANING RATIONS AND HOME FEEDS COMPARED FOR PRE-CONDITIONING CALVES

North Dakota cattlemen have asked this station to evaluate the performance of calves fed commercial weaning rations. Their interest has been in regard to expected daily feed consumption, resistance to stress related health problems, and overall economics of using the commercial program.

Past experience from numerous trials conducted at this station has shown that self-fed rations composed of home grown mixed hay and oats will promote good, steady, economical gains in calves following weaning.

This trial, then, is designed to compare the "Home Grown, ration and the commercial ration with respect to animal response and cost.

On November 2, 1977 Hereford and Hereford X Longhorn crossbred calves from the station herd were weighed, weaned and sorted within breed and sex into six equal feeding groups. Three groups were assigned to be fed the commercial ration, and three groups served as controls and were fed the "Home Grown" ration. Based on the recommendations of the commercial feed distributor the trial was designed to run for not less than 21 days, and preferably for 28 days. The trial as actually completed this year was for the 28 day period.

All calves in the trial were vaccinated with Electroid Seven on October 17th and were given a booster at the begginning of the trial. Careful daily observations for any health problems were made throughout the trial with treatment made were necessary.

The Home Grown ration consisted of 20% oats and 80% mixed hay at the beginning of the trial. It was changed by gradually increasing the percentage of oats so that by the end of the 28 day period the calves were eating a ration of 40% oats and 60% hay by weight. This ration also contained 20 pounds of salt and 10 pounds di-calcium phosphate per ton. The commercial ration used this year was Purina Pre conditioning/Receiving Chow. Both rations were self-fed in straight sided self-feeders designed for feeding high roughage rations. All feed was weighed in during the trail and feed left at the end of the trial was weighed back to give an accurate record of the amount of feed used. Feed waste was monitored throughout the trial, and was very minimal for both rations.

At the end of the trial period the crossbred calves were sold through a local auction market to evaluate any differences in "buyer" appeal. The straighbreds will be carried through to finish.

Results of the first years' trial are hsown in the following table.

Table 38. Calf pre-conditioning trial results, 1977.

	Home-Grown	Commercial	Home-Grown	Commercial	Home-Grown	Commercial
	Hereford	Steers	Longhorn X	Hereford	Hereford	Heifers
No. head	6*	7	10	10	10	10
Nov. Erd wt. lbs	428	424	401	393	431	428
Dec. 1st wt. lbs	478	486	453	446	480	478
28 day gain, lbs	50	62	52	53	49	50
ADG, lbs	1.78	2.21	1.86	1.89	1.75	1.78
Total gain/lot, lbs	300	434	520	530	490	500
Pounds feed fed	1959 2/	2750 1/	2896 2/	4200 1/	3121 2/	3940 1/
Feed/lb. gain	6.53	6.32	5.57	8.0	6.24	7.9
Feed/hd/day, lbs	11.7	14.0	10.3	15.0	11.2	14.1
Cost feed/hd, $	12.25	22.56	10.89	24.12	11.81	22.63
Cost feed/cwt gain, $	24.50	36.31	20.93	45.95	23.62	45.26
Actual selling value	-	-	$148.47	$148.02	-	-

* One steer died of bloat on November 16, 1977.
1/ Commercial-Purina Pre-conditioning Chow Sm-AB (G) medicated-chlortetracycline and sulfamethazine.
2/ Homegrown rations: 29% rolled oats, 70% chopped hay, 0.5% di-calcium phosphate, 1% salt.

Summary:

One calf was lost to bloat on the homegrown ration. No other calves required any medication or treatment.

Homegrown feeds used were of excellent quality, with hay averaging 10.7% protein and oats at 12%.

Gains on both rations were very satisfactory averaging 1.75 pouns or more per day.

Final weight was made after calves were off water for 16 hours. Feed was available up to the time of weighing.

DRIED SWEET WHEY IN GROWING-FINISHING RATIONS FOR SWINE

This feeding trial is designed to determine the substitution value of dried sweet whey compared with barley in swine-growing-finishing rations; and, to determine the optimum amount of whey that can be fed without causing undesirable side effects such as scours and blindness.

Whey, a by product of North Dakota cheese plants, can be used successfully as livestock feed. Feeding trials at the Dickinson Experimental Station, show liquid whey to be a practical and economical feed in rations for growing-finishing pigs. Dried sweet whey has a protein and energy analysis similar to barley, possesses a well balanced amino acid and vitamin B complex level, and is superior to barley in lysine. Drying liquid whey eliminates problems associated with handling a bulky liquid, and results in a product that can be stored, handled and mixed as a dry feed.

Research conducted at the Illinois Agricultural Experiment Station indicates that when rations containing 60% dried whey were fed to growing-finishing pigs a depression in rate of gain and daily feed intake was experienced as well as a tendency toward scours. In addition to the 60% level, rations containing 0, 5, 10, and 40% dried whey were fed and performed satisfactory.

Crossbred and straightbred pigs, produced at the Dickinson Experiment Station, averaging 37 pounds, were randomly allotted into eight groups. To provide for pen replication two feeding units of four pens each were used. The rations fed, as shown in tables 1 and 2, consisted of a basic barley and oat control ration and three experimental rations in which barley was replaced with either 15, 30, and 45% dried sweet whey. The crude protein level was maintained at 15.5% until the pen averaged 120 pounds, at which time the protein was lowered to 12%. A portable mixer-grinder was used to produce the rations which were self-fed in meal form.

The experiment was duplicated under fall/winter feeding conditions with pigs having an average starting weight of 57 pounds.

Summer housing consisted of exposed solid concrete floored pens equipped with opn front shelters and automatic waterers. Winter housing consisted of drylot arrangement equipped with automatic waterers, self-feeders, and closed front lean-to-shelters that are bedded with straw on a routine basis. The pigs were weighted at two week intervals with records maintained on condition of health, with particular attention to the incidence of scours and blindnes. Prior to the start of the trial the pigs were routinely vaccinated for eyesipelas and wormed with Atgard.

Dried whey product, which was used in these feeding experiments at no cost, was donated by Mr. Joel Johnson, Whey-To-Go Plant, Mandan, North Dakota. Calculations for ration costs were made using the current agricultural market price of six and one-half cents per round.

The rations as they were fed are shown in tables 1 and 2.

Weights, gains, and feeding economics for the summer and fall/winter trials have been summarized in tables 3 and 4.

At the close of each trial one half of the pigs were randomly selected to be slaughtered at Hormel's grade and yield plant at Mitchel, South Dakota. A summary of the carcass data is shown on table 5.

Summary:

The results of this trial indicate that dried sweet whey product can very successfully replace up to 45% of the barley in swine growing and finishing rations. Problems such as scours and blindness that were reported by researchers in Illinois were not detected at the 45% level, which was the highest level fed in this study.

Al rations containing dried sweet whey, when compared with the basic barley and oats control ration, were more palatable and had a lower fiber content, which resulted in faster grains and better efficiency. Feed efficiency, as shown in tables 3 and 4, ranged from no difference to approximately 15% less feed per pound of gain.

Although net returns from all levels of dried whey feeding were higher than those received from pigs fed control ration, the highest returns were attained at the 15% level of dried whey, and ranged from $3.60 more per head under summer feeding conditions to $6.41 more per head under the fall/winter feeding conditions.

Table 1. Rations as fed to 120 pound.

Ingredients in pounds	#1 0% Whey	#2 15% Whey	#3 30% Whey	#4 45% Whey
Dried sweet whey	-	150	300	450
Oats	285	285	285	285
Barley	572	425	278	131
SBOM	120	120	120	120
Di-cal	6	5	4	3
Limestone	11	9	7	5
Vitamins & minerals 1/	6	6	6	6
Total	1,000	1,000	1,000	1,000
Cost/lb of feed, Whey: 6.5¢		.0604	.0626	.0648
Gross energy (Kcal/lb)	1,832	1,791	1,755	1,716
% protein	15.5	15.6	15.7	15.8
% calcium	0.617	0.621	0.602	0.628
% phosphorus	0.528	0.537	0.549	0.559

1/ Includes trace mineral salt, 5 lbs; vitamin B complex, 1 lb; vitamin A, 30 grams; vitamin D, 14 grams; and zinc sulfate, 180 grams.

Table 2. Rations as fed from 120 pounds to market.

Ingredients in pounds	#1 0% Whey	#2 15% Whey	#3 30% Whey	#4 45% Whey
Dried sweet whey	-	150	300	450
Oats	285	285	285	285
Barley	673	525	378	231
SBOM	20	20	20	20
Di-cal	6	5	4	3
Limestone	10	9	7	5
Vitamins & minerals 1/	6	6	6	6
Total	1,000	1,000	1,000	1,000
Cost/lb of feed, Whey: 6.5¢	0.533	0.554	0.576	0.598
Gross energy (Kcal/lb)	1,832	1,791	1,755	1,716
% protein	15.5	15.6	15.7	15.8
% calcium	0.560	0.597	0.600	0.570
% phosphorus	0.503	0.513	0.524	0.534

1/ Includes trace mineral salt, 5 lbs; vitamin B complex, 1 lb; vitamin A, 30 grams; vitamin D, 14 grams; and zinc sulfate, 180 grams.

Table 3. Weights, gains and feeding economics-summer 1976.

	No Whey	15%	30%	45%
No. head	14	14	14	14
No. days on feed	118	118	118	118
Initial wt., lbs	37	37	37	37
Final wt., lbs	197	217	229	223
Total gain, lbs	160	180	192	187
ADG, lbs	1.36	1.53	1.63	1.58
Feed/hd/day, lbs	5.00	5.32	5.96	5.48
Feed/lb gain, lbs	3.68	3.48	3.66	3.47
Cost/lb feed , $	.0555	.0576	.0612	.062
Cost/cwt gain, $	20.42	20.04	22.40	21.51
Feeding economics:				
Return/hd @ $35/cwt	68.95	75.95	80.15	78.05
Feed cost/hd, $	-32.67	-36.07	-43.01	-40.22
Feeder pig cost/hd, $	-30.00	-30.00	-30.00	-30.00
Net return, $ 1/	6.28	9.88	7.14	7.83

Table 4. Weights, gains and feeding economics-fall/winter 1976-1977.

	No Whey	15%	30%	45%
No. head	14	13 2/	14	14
No. days on feed	102	102	102	102
Initial wt., lbs	57	58	56	57
Final wt., lbs	218	237	236	234
Total gain, lbs	161	178	180	176
ADG, lbs	161	178	180	176
Feed/hd/day, lbs	6.70	6.64	6.34	6.27
Feed/lb gain, lbs	4.24	3.79	3.60	3.62
Cost/lb feed , $	.0555	.0576	.0612	.062
Cost/cwt gain, $	23.53	21.83	22.03	22.37
Feeding economics:				
Return/hd @ $35/cwt	84.58	91.96	91.57	90.79
Feed cost/hd, $	-37.88	-38.85	-39.65	-39.37
Feeder pig cost/hd, $	-23.33	-23.33	-23.33	-23.33
Net return, $ 1/	23.37	29.78	28.59	28.09

1/ Net return figure is market value less cost of feeder pig and feed cost, and does not include costs for veterinary supplies, equipment, housing, depreciation, taxes, insurance etc.
2/ One pig removed from trial due to pneumonia.

Table 5. Carcass summary.

	No Whey	15%	30%	45%
Summer 1976				
Live wt., lbs	211	226	230	225
Carcass wt., lbs	150	160	164	163
Carcass dressing %	71	71	71	72
Carcass length, in	31	31	31.5	31.4
10^{th} rib backfat, in	.9	1.2	1.2	1.1
Loin eye muscle, in	2.6	2.6	2.7	2.7
Quality score:				
Loin eye area, sq. in	4.5	4.0	4.2	4.1
Percent lean	54.6	50.3	51.0	51.4
Fall/winter 1976-1977				
Live wt., lbs	225	232	245	233
Carcass wt., lbs	165	170	182	173
Carcass dressing %	73	73	74	74
Carcass length, in	31.7	31.8	31.6	31.8
10^{th} rib backfat, in	.72	.82	.81	.69
Loin eye muscle, in	2.8	2.9	2.0	2.4
Quality score:				
Loin eye area, sq. in	5.1	4.3	5.6	5.5
Percent lean	57.0	55.3	57.0	58.0

DRIED SWEET WHEY AND WHEAT COMBINATION FOR GROWING-FINISHING SWINE

Recent changes in grain values have again made feeding an economic practice. In addition, work just completed at this station and summarized on page eight of this progress report indicates that when dried sweet whey replaced 15, 30, or 45% of the barley in growing-finishing rations palatability and total digestible nutrients were increased. The result was a greater net return among all three levels of dried whey feeding when compared to the control ration which contained no whey. The purpose of the most recent trial was to further evaluate dried sweet whey when fed in combination with wheat to growing-finishing swine.

Feeder pigs used in the study averaged 53 pounds when the trial was started on June 7th, 1977, and average market weights were reached in 107 days. Housing for the pigs consisted of open front sheds on concrete floors, automatic waterers and self-feeders. The pigs were wormed with Atgard swine wormer at the start of the trial and again they averaged approximately 150 pounds.

Rations used contained the following energy feedstuffs: dried sweet whey, wheat and barley or oats, but not both. Dried whey was included at either 15 or 30% of the ration, and wheat was held at 40% in all cases. The barley or oats portions varied with respect to the amount of dried whey that was included in each of the experimental rations. The rations as they were fed are shown in tables 6 and 7.

At the completion of the trial three barrows from each treatment were shipped to Hormel and Company's plant at Mitchell, South Dakota for carcass measurement and evaluation. A summary of that carcass data is shown in table 8.
Weights, gains, feed efficiency and net returns have been tabulated and are shown in table 9.

Summary:

Pigs consuming the lower levels of whey were the most efficient in this first feeding trial in which wheat and dried sweet whey were combined. The 15% whey-wheat combination was the most economical followed by the 15% whey-wheat-oats ration in which an eight and eight tenths percent lower fed efficiency was experienced. Carcass data favored the 30% whey-wheat-barley combination which was the least efficient ration. Future trials are planned using these ration combinations.

Table 6. Rations as fed from start to 120 pounds.

Ingredients in pounds	15% whey wheat + barley	30% whey wheat + barley	15% whey wheat + oats	30% whey wheat + oats
Dried sweet whey	150	300	150	300
Oats	330	183	-	-
Barley	-	-	330	182.5
Winter wheat	400	400	400	400
SBOM	100	100	100	100
Di-cal	5	4	4	4
Limestone	9	7	10	7.5
Trace mineral salt	5	5	5	5
Vitamin B complex	1	1	1	1
Vitamin A, gms	30	30	30	30
Vitamin D, gms	14	14	14	14
Zinc sulfate, gms	180	180	180	180
Total	1,000	1,000	1,000	1,000
Gross energy (Kcal/lb)	1,923	1,872	1,908	1,864
% protein	16.0	15.9	16.3	16.3
% calcium	0.666	0.653	0.673	0.669
% phosphorous	0.522	0.542	0.529	0.555

Table 7. Rations as fed from 120 pounds to finish.

Ingredients in pounds	15% whey wheat + barley	30% whey wheat + barley	15% whey wheat + oats	30% whey wheat + oats
Dried sweet whey	150	300	150	300
Oats	409	263	-	-
Barley	-	-	411	263
Winter wheat	400	400	400	400
SBOM	20	20	20	20
Di-cal	6	4	4	4
Limestone	9	7	9	7
Trace mineral salt	5	5	5	5
Vitamin B complex	1	1	1	1
Vitamin A, gms	30	30	30	30
Vitamin D, gms	14	14	14	14
Zinc sulfate, gms	180	180	180	180
Total	1,000	1,000	1,000	1,000
Gross energy (Kcal/lb)	1,923	1,877	1,904	1,865
% protein	13.6	13.5	13.8	13.6
% calcium	0.623	0.610	0.615	0.629
% phosphorous	0.513	0.515	0.505	0.535

Table 8. Carcass summary

Carcass Measurement	15% whey wheat + barley	30% whey wheat + barley	15% whey wheat + oats	30% whey wheat + oats
Length	31.50	32.36	31.28	31.63
10^{th} rib backfat, in	1.42	1.25	1.16	1.43
Loin eye, sq. in	3.62	4.29	3.48	3.85
Loin eye quality	2.5	2.6	3.0	2.66
% Lean meat	47.61	50.48	49.27	48.24

Table 9. Weights, gains and feed efficiency and net return.

	15% whey wheat + barley	30% whey wheat + barley	15% whey wheat + oats	30% whey wheat + oats
No. head	11 1/	12	6 2/	12
Days fed	107	107	107	107
Starting wt., lbs	53	53	46	52
Final wt., lbs	210	217	207	227
Gain, lbs	157	164	161	175
ADG, lbs	1.46	1.53	1.50	1.63
Feed/hd/day, lbs	5.56	6.12	5.09	6.82
Feed/lb gain, lbs	3.81	4.00	3.37	4.18
Cost/cwt gain, $	21.21	23.20	18.76	24.15
Gross Return @ $40/cwt	84.00	86.80	82.80	90.80
Feeder pig cost/hd, $	-27.00	-27.00	-25.50	-27.00
Feed cost/hd, $	-33.30	-38.05	-30.20	-42.26
Net return, $ 1/	23.70	21.75	27.10	21.54

1/ One pig removed because of lameness.
2/One replicated lot removed because of disease problems unrelated to ration comparison.

SWINE ARTIFICIAL INSEMINATION PILOT TRIAL

Artificial insemination of swine is not new. Until boar semen could be successfully frozen and stored, and the optimum time of insemination became better understood, it was not very practical for the commercial pork producer and was used only to a limited extent by purebred breeders. Recently, USDA-ARS scientists at Beltsville, Maryland perfected the technique that is now being used to freeze and thaw boar semen. These freezing and thawing techniques, and improved semen extenders in which fresh collected semen can be successfully held for as long as 72 hours, have made AI for swine a practical possibility, creating considerable interest among commercial pork producers as well as purebred breeders. In response to this new interest, a pilot breeding trial was conducted at the Dickinson Experiment Station to lay the ground work for future trials.

Throughout this study mature sows were used. To reduce labor involved in heat detection and to evaluate the use of heat synchronization hormones, sows were synchronized using the hormones pregnant mare serum (PMS), and human chorionic gonadotrophin (HCG) following lactaiton. PMS was administered subcutaneously 56 hours following the PMS injection. Insemination was done 24 hours after the HCG injections without regard o standing heat.

At the outset, natural service was compared with a single artificial service following heat synchronization as described above. It should be pointed out that only those sows selected to be bred artificially were synchronized. A 58% conception rate was attained from breeding AI, which left amply room for improvement. In an attempt to improve conception rate, and litter size as well, the natural seervice comparison was set aside, since sow numbers were limited, so that subsequent to heat synchronization one insemination could be compared with two inseminations separated by eight hours.

Breeding data obtained from the two investigations has been summarized in tables 10 and 11.

Frozen semen used was purchased at a cost of four to eight dollars per ample from United Suppliers, Inc. Box 538 Eldora, Iowa; the only commercial supplier of frozen boar semen in the United States at this time. Shipping and handling charges amounted to approximately two dollars per ampule.

Discussion:

A lot of information has been gleaned from this preliminary investigation. The first and foremost point to be made is that we have only scratched the surface of swine AI; and the other is that, although varied, the results obtained are promising enough to warrant further investigation. Swine AI is not going to be a panacea for the pork producer. However it does provide an opportunity for both the purebred breeder as well as the commercial producer to make herd improvement through the use of proven sires. AI is not intended to supplant the purebred breeders. Instead, it makes it possible for large and small purebred and commercial producers alike to have available to them some very good bloodlines that they would not otherwise have access to. It can be used very well by the purebred producer to create herd improvements that could result in a greater demand for his purebred stock. It can be put to good use in herd health management since a closed herd can be maintained. In view of potentially dangerous herd health problems such as pseudorabies, which is on the increase, swine AI may provide an avenue of prevention that swine producers may not have already considered.

Offspring produced from AI matings at this station have been very desirable showing good balance, length and above average muscling and carcass quality.

Significantly lower conception rates were experienced in two out of three artificial breedings in this preliminary study. Probable cause for this, in one of two instances points out a major weakness of swine AI today, that is, the wide variation in semen freezing quality. The problem doesn't seen to be specific, but appears to be a problem of certain individuals with any breed. Amount the small number of boars used in the breeding, semen of Yorkshire origin had a 20% settling rate as compared to an 86% settling rate for semen of Hampshire origin.

In the fall of 1976 an especially how conception rate and litter size prevailed. Although boar variability is certainly a potential cause, it is felt that heat stress was the major contributing factor. Research conducted by Edward (1968) and Teague (1970) clearly illustrate that high air temperatures reduce an incidence of estrus, decrease ovulation rate, decrease embryo survival, and increase the number of stillborn pigs. However, when air temperatures were kept below 85% ovulation rate and embryo survival were highest.

The average daytime high in August was 86° F and September averaged 77° F. Seventeen days during August were 85° H or above with seven of those days having temperatures between 91 to 100° F. As expected, September had a cooler average temperature; however one week near the time of breeding was very warm with a record 103° F recorded on September 7th.

Summary:

The results of this preliminary breeding trial indicate that when using superior sires, typical of those available through artificial insemination, excellent quality offspring can be produced.

Conception rate was variable and ranged from a high of 87.5% where two inseminations separated by eight hours were used down to 50% when the influence of heat stress prevailed. Although a double insemination resulted in a significant increase in conception rate, no measurable increase in litter size was experienced.

When a single insemination was used conception rates ranged from a high of 58% to a low of 33%.

Pigs treated with the synchronization hormones PMS/HCG were satisfactorily synchronized. Additional research is necessary however, to pinpoint the optimum time of insemination when using them.

Table 10. Sow performance, AI pilot breeding trial.

	Artificially inseminated	Naturally inseminated
Winter 1975:		
No. sows exposed	12	10
No. sows settled	7	8
Conception, %	58	80
Avg. pigs born/sow	6.0	9.8
Avg. pigs weaned/sow	5.7	9.3

Table 11. Sow performance, AI pilot breeding trial, one insemination vs. two inseminations.

	One insemination	Two inseminations separated by 8 hours
Spring 1976:		
No. sows exposed	7	8
No. sows settled	5	7
Conception, %	71.9	87.5
Avg. no. pigs born alive	6.8	6.8
Avg. no pigs weaned	6.0	4.9
Fall 1976:		
No. sows exposed	6	6
No. sows settled	2	3
Conception, %	33	50
Avg. no. pigs born alive	3.5	4.3
Avg. no pigs weaned	3.5	4.3

BREEDING GILTS ARTIFICIALLY USING FROZEN SEMEN

This trial was designed to further investigate conception rate and litter size, as well as semen handling, timing and insemination techniques according to current recommendations using non-synchronized gilts under typical farm conditions.

Twenty-two non-synchronized virgin gilts that averaged approximately 280 pounds were randomly assigned to either a natural, or AI breeding treatment. The naturally bred gilts were pen mated to two fertile Yorkshire boars which were rotated every other day until breeding was completed. The gilts were checked twice daily to record breeding information.

Gilts in the AI treatment were checked for standing heat twice daily using an intact detector boar. Twelve hours following detection of standing heat the gilts were inseminated with extended thawed semen, using procedures outlined by International Boar Semen, a division of United Suppliers, Inc., of Eldora, Iowa. If the gilts were still in standing heat 12 hours following the first insemination, they were re-inseminated. During the coarse of breeding a detector boar was used across the fence as a breeding stimulus. The frozen semen used was a composite of three breeds, Duroc, Landrance, and Chester White, to reduce the probability of sire effect with the frozen semen. Following insemination, the gilts were checked for return to estrus using the detector boar.

The gilts were housed in dirt lots equipped with portable houses, automatic waterers and self-feeders.

Breeding and farrowing results have been summarized in table 12.

Summary:

Satisfactory conception rate and litter size were obtained when non-synchronized gilts were artificially inseminated using frozen boar semen. Success is attributed to the three-way semen composite that represented the Duroc, Landrance, and Chester White breeds, as well as the use of a detecror boar and strict adherence to procedures as outlined by International Boar Semen for semen thawing, extending and inseminating. By using the three-way semen, boar variability which has been a problem in other AI bredding trials conducted at this Station, was reduced.

Conception rate in the natural service treatment was 100% as compared to 90% among the gilts inseminated artificially.

There was no difference between treatments in the number of pigs born alive; however, survival rate among artificially sired pigs was significantly lower.

Time required for inseminating averaged approximately 15 minutes per gilt.

The results of this trial represent a limited number of individuals and therefore future trials are planned.

Table 12. Breeding summary AI vs natural service of non-synchronized gilts.

	AI	Natural Service
Number of gilts	11 [1/]	11
Number of gilts settled	9	11
Percent conception	90	100
Pigs born alive	8.8	8.9
Pigs weaned	7.8	6.5

1/ One gilt removed after being bred by herd boar.

USING ALFALFA IN RATIONS FOR GESTATING GILTS AND SOWS

How much alfalfa can be used in self-fed gestation rations for gilts and sows?

This study, started at the request of North Dakota pork producers, was designed to evaluate moderate and high levels of alfalfa in self-fed gilt and sow gestation rations under North Dakota winter conditions.

Research conducted in Nebraska indicated that lower cost gestation rations can be formulated using high levels of alfalfa, without affecting gilt development, litter size, birth weights, number of pigs weaned or weaning weights.

Purebred Yorkshire gilts were randomly allotted into two groups. Each group was fed 15% protein gestation ration containing either 40% or 70% alfalfa, and balanced according to NRC requirements.

Both groups were sheltered in portable houses under drylot conditions, and had free access to automatic waterers and self-feeders equipped with openings large enough to handle the bulky rations satisfactorily.

The two rations as fed are shown in table 13. During the feeding period the gilts were weighted bi-monthly. Their weights, gains and feed costs are summarized in table 14. Litter production data are shown in table 15.

Table 13. Gestation ration composition.

	40% alfalfa	70% alfalfa
Alfalfa, lbs	400.0	700.0
Oats, lbs	526.5	179.0
Soybean oilmeal, lbs	63.0	107.5
Tripoly phosphate, lbs	4.0	7.0
Vitamins and minerals, lbs 1/	6.5	6.5
Total, lbs	1000.0	1000.0
Protein %	15.0	15.0
Cal. dig. energy, Kcal/lb	988	826
Cost/lb, $	.04132	.03814

1/ Includes trace mineral salt, 5 lbs; B-complex vitamins, 1 lb; Vitamin A, 75 gms; Vitamin D, 5 gm.; and zinc sulfate, 180 gms.

Table 14. Gestation weights, gains and feed costs, 2-year average

	40% alfalfa		70% alfalfa	
	Gilts	2nd litter sows	Gilts	2nd litter sows
Weights and gains:				
No. head	12	10	11	10
Initial wt., lbs	324	455	323	438
Pre-farrowing wt., lbs	426	577	373	508
Gain, lbs	102	122	50	71
Days on test	75	66	75	66
Avg. daily gain, lbs	1.36	1.84	.66	1.08
Feed and costs:				
Feed/hd/day, lbs	9.7	14.2	9.0	12
Ration cost/day, $	.39	.59	.34	.46
Feeding period cost, $	29.25	36.47	25.50	29.49

Table 15. Litter production data, 2-year average

	40% alfalfa		70% alfalfa	
	Gilts	2nd litter sows	Gilts	2nd litter sows
Birth data:				
No. of litters	11	10	10	9.5
Litter size	9.8	8.7	8.8	9.2
Litter wt., lbs	30.6	32.0	24.3	27.4
Avg. individual pig wt., lbs	3.1	3.7	2.7	3.0
Weaning data:				
No. of litters	11	10	10	9
Litter size	8.7	7.8	7.9	8
Litter wt., lbs	282	225	226	210
Avg. weaning wt./pig, lbs	33	32	29	28
Percent survival	88	91	88	87

Summary:

Gestation diets containing either 40% or 70% alfalfa were self-fed to gilts and second litter sows during the last two-thirds of gestation. Gilts fed the two rations performed most favorably with 40% level of alfalfa. Those gilts fed the 70% alfalfa ration consumed approximately one pound less feed per day at a savings of $3.75 for the feeding period. Although a savings was realized, the amount was not nearly enough to offset the significant loss in litter production. Feeding the higher energy 40% ration, which was more suitable for gilt development and litter production, resulted in one additional pig being farrowed per sow, heavier pigs at birth, and more and heavier pigs at weaning. Total litter production at weaning among those gilts fed 40% alfalfa was an average 57 pounds heavier then litters from the 70% group.

Second litter sows in phase II of this trial, which is designed to evaluate the long-term effect of feeding moderate versus high levels of alfalfa in gestation rations, performed satisfactorily under both levels of alfalfa. Although no problems were experienced, daily feed consumption was high for both levels of alfalfa and resulted in a 2-year average daily feed cost of $.59 among those pigs fed 40% alfalfa and %.46 among the pigs receiving 70% alfalfa, which resulted in a savings of $6.97.

Results of this study indicate that even when high levels of roughage are used in sow rations some kind of restriction is necessary to avoid expensive over consumption.

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Hog Marketing Alternatives Selling Packer Grade and Yield vs. Selling Locally

Douglas G. Landblom and James L. Nelson

What is your best hog marketing alternative? Hogmen attending the 1976 Southwest Area Pork Producers annual meeting were encouraged by a Hormel and Company representative to consider selling on a grade and yield basis as one of their marketing alternatives.

Since the job of raising pork isn't finished until marketing has been completed, a study was initiated in 1976 and completed in 1977 at the Dickinson Experiment Station to evaluate the economics of selling market hogs at a local buying station, compared to selling on a grade-and-yield basis from the Dickinson, North Dakota, area. In this economic study, above average quality crossbred York X Hamp and straightbred Yorkshire market barrows raised at the Dickinson Station were randomly assigned to be marketed at either the Hormel and Company plant, Mitchell, South Dakota, or Western Livestock Company, Dickinson, North Dakota.

Three separate comparative marketings were made for each selling method. The hogs selected for slaughter at Mitchell, 450 miles from Dickinson, were weighed and shipped directly via a commercial livestock hauling firm. Storm-related problems were encountered during one of the two winter marketings. Those hogs that were marketed on March 12, 1976 had originally been scheduled for shipment one week earlier. However, a severe winter storm interrupted normal livestock movements and arrangements had to be made for a later shipping date. As a result, several of the hogs became heavier than desirable.

The hogs marketed locally were to be hauled directly to the Western buying station according to the project's original design. However, no measurable shrinkage was recorded after the first group of hogs were sold locally, since the Dickinson Station is located within two miles of Western. Thus, the original design was modified and in an effort to typify a regular farm marketing, the second group of hogs sold locally were weighed and transported 30 miles before being delivered to the buying station.

Compared to no measurable weight loss in the first group (Table 1), an average live weight loss of 4.7 pounds per head occurred in the second group sold locally, which amounted to an average shrinkage of 2 per cent. The third group assigned to be sold locally were marketed but not actually sold, since most of them were kept for replacement purposes.

Origin, destination weight and shrinkage, as well as the market value per hundred weight, have been summarized for both marketing types in Table 1.

Landblom is assistant animal husbandman and Nelson is animal husbandman, Dickinson Branch Experiment Station.

Discussion

Selling grade-and-yield carcasses differs substantially from selling live hogs at a local buying station. Buying stations purchase hogs in groups, sort out the obvious individuals that are either light or heavy and pay a lower price. In grade and yield marketing, however, each pig is sold on an individual basis. Those that are either under- or over-finished are bought on a calculated meat price that is determined by dividing the liveweight market value per hundred weight by a standard yield factor that is predetermined by the packer. Hormel's standard yield factor was derived from the actual yields taken from a large number of hogs that were slaughtered in each liveweight category.

In Table 2, the meat price has been calculated using the standard yield conversion factor for those hogs shipped to Mitchell. Also in Table 2, it can be seen that improper sorting of hogs to be sold on a grade-and-yield basis can result in a substantial loss. This is not to say that sorting losses can be eliminated completely. However, they can be reduced considerably, especially when a scale is employed.

Grade-and-yield premiums are paid for those carcasses which possess above average quality. Carcass quality is graded on a scale from 1 to 4, and those carcasses that are considered to be of high enough quality to be given a number 1 or 2 grade are paid a premium per hundred pounds of carcass according to the schedule shown in Table 3. Any carcass graded as number three in quality is said to be standard and no premium is paid. Quality grade number 4 is reserved for over-finished hogs and a dockage of $2.00 per hundred weight is levied. Each of the three grade-and-yield marketings have been summarized in Table 4.

Compared to Hormel's standard yield, pigs sold from the Dickinson Station were above average in quality and also yielded 2.5 per cent, 1.9 per cent and 1.7 per cent higher in groups I, II and III, respectively. In all cases the gross return per hundredweight was higher for hogs marketed grade-and-yield; however, net return was less in two of the three shipments after trucking and shrinkage expenses were deducted.

When compared on an equal weight basis of 220 pounds (Table 5), a slight net return of $.85 per head was received for the first group marketed grade-and-yield. The net return for groups 2 and 3 favored local marketing and amounted to $.61 and $1.41 more per head, respectively. Average shipping cost from the Dickinson area amounted to $3.04 per head. Shrinkage expense above that encountered with local selling amounted to an average $1.21 per head.

Summary

Results of this trial, after three marketings, indicate that there is no advantage for selling on a grade-and-yield basis from the Dickinson area. Grade-and-yield premiums contributed to a higher gross return than that received from local selling, but on the average the premiums were not enough higher to substantially offset the high cost of trucking and liveweight shrinkage. Although no economic advantage was obtained by selling grade-and-yield from the Dickinson area, producers situated within a reasonable hauling distance of 130-175 miles may want to consider selling grade-and-yield if they are able to sort and market 30-40 butcher hogs at a time that are above average in quality and will weigh within the desirable weight range of 200-230 pounds on arrival at the packer.

For those producers situated within a reasonable hauling distance and considering grade-and-yield marketing, the following guidelines should be adhered to: market price information should be obtained from the packer and the local buyer prior to shipment to determine which marketing method has the potential to yield the most return. In an attempt to avoid sorting losses when selling grade-and-yield, it is essential that each hog be weighed before shipment, and those that are too heavy should be sold locally, and those hogs that are lighter than desirable, should be continued on feed.

Winter weather should be watched closely when hogs are approaching optimum market weight because severe winter storms can interfere with normal transportation movement, and hogs can easily become heavier than 200-230 pounds. When small or part semi-loads are being shipped commercially, trucking arrangements should be made in advance to allow the trucker ample time to arrange for livestock to fill out the remainder of his load.

Table 1. Weight summary and market value of pigs sold grade and yield vs. local marketing.

	Grade and Yield			Local marketing		
Date marketed	Mar 12	Oct 1	Jan 7	Mar 12	Oct 1	Jan 7
No. head	36	28	29	19	7	24
Base market value/cwt, $	45.00	33.24	37.36	43.75	33.75	37.25
Dickinson wt., lbs.	8729	6247	7075	4459	1653	5161
Avg. wt./pig, lbs.	242.5	223.1	243.9	234.7	236.1	215
Destination wt., lbs.	8555	6025	6770	4459	1620	[1]
Shrink, lbs.	174	222	305	—	33	—
Shring/pig, lbs.	4.9	7.9	10.5	—	4.7	—
Per cent shrink	2.02	3.5	4.3	—	2.0	—

[1]*Pigs in this group were not actually marketed locally since they were retained for replacement purposes.*

Table 2. Live market price, standard yield + meat price/cwt of carcass sold grade + yield

	Live market price						Extended meat price $/cwt.		
Live wt.	Mar 12 1976	Oct 1 1976	Jan 7 1977	÷	Standard yield conv. factor	=	Mar 12 1976	Oct 1 1976	Jan 7 1977
170-180	43.50	31.75	35.50		.704		61.79	45.10	50.43
181-190	43.50	32.00	36.50		.709		61.35	45.13	51.48
191-200	44.50	33.00	37.50		.713		62.40	46.28	52.59
201-230	45.00	33.50	38.00		.720		62.50	46.52	52.77
231-240	44.75	33.25	37.75		.725		61.72	45.86	52.06
241-250	44.25	33.00	37.25		.727		60.86	45.39	51.23
251-260	43.75	32.50	36.75		.729		60.01	44.58	50.41
261-270	43.25	32.00	36.25		.730		59.24	43.83	49.67
271-280	42.25	31.00	35.25		.732		57.71	42.35	48.16
281-290	41.25	30.00	34.25		.733		56.27	40.92	46.73

Table 3. Weight categories and premiums paid for number 1 and 2 hogs.

Live wt. range	Carcass wt. range	Premium $/carcass cwt. Mar 12 and Oct 1	Jan 7
No. 1 grade			
180-240	128-176	+$1.75/cwt	+$2.00/cwt
240-270	177-199	+$1.25/cwt	+$1.50/cwt
270-330	200-245	+$1.00/cwt	+$1.25/cwt
No. 2 grade:			
180-240	128-176	+$1.00/cwt	+$1.25/cwt
240-270	177-199	+$0.75/cwt	+$1.00/cwt
270-330	200-245	+$0.50/cwt	+$0.75/cwt

Table 4. Grade and yield summary.

Group I, marketed March 12th, 36 head.

Actual yield 6417 ÷ 8555=	75.0%
Hormel's average standard yield=	72.5%
Yield increase	2.5%
Market value excluding grade + yield	$45.00/cwt
Market value increase for yield	+$ 0.41/cwt
Market value increase for grade	+$ 0.73/cwt
	$46.14/cwt
Local market value	$43.75/cwt

Group II, marketed October 1, 1976, 28 head.

Actual yield 4456 ÷ 6025=	73.96%
Hormel's average standard yield=	72.08%
Yield increase	+ 1.88%
Market value excluding grade + yield	$33.24/cwt
Market value increase for yield	+$ 0.87/cwt
Market value increase for grade	+$ 1.00/cwt
	$35.11/cwt
Local market value	$33.75/cwt

Group III, marketed January 7, 1977, 29 head.

Actual yield	73.8%
Hormel's average standard yield	72.1%
Yield increase	1.7%
Market value excluding grade + yield	$37.36/cwt
Market value increase for yield	+$ 0.70/cwt
Market value increase for grade	+$ 0.76/cwt
	$38.82/cwt
Local market value	$37.25/cwt

Table 5. Comparison of grade and yield marketing vs. local marketing based on equal weight.

	Grade and yield			Local selling		
Marketing group	I	II	III	I	II	III
Date	Mar 12	Oct 1	Jan 7	Mar 12	Oct 1	Jan 7
Live wt. value/cwt, $	46.14	35.11	38.82	43.75	33.75	37.25
Gross return, 220 lb. hog, $	101.51	77.24	85.40	96.25	74.25	81.95
Expenses: trucking, $	−2.77	−3.03	−3.33	−0.50	−0.50	−0.50
shrinkage, $	−2.14	−2.66	−3.67	—	−1.59	−1.64
Net return/head, $	96.60	71.55	78.40	95.75	72.16	79.81
Difference, $	+0.85				+0.61	+1.41

REPORT OF

RANGE AND PASTURE MANAGEMENT

AND OTHER

GRASS & LEGUME INVESTIGATIONS

AT THE

DICKINSON EXPERIMENT STATION

DICKINSON, NORTH DAKOTA

by

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GRAZING UTILIZATION OF INTERSEEDED MIXED GRASS PRAIRIE

A study to evaluate the grazing value of interseeded native range was begun in the spring of 1976. The pastures were seeded to Travois alfalfa and Russian wildrye in the first week of May. Glyphosate, a non-selective systemic herbicide was sprayed in 12 inch bands over the interseeded rows to control the competition. Because of the poor growing conditions due to the lack of moisture the herbicide had little effect. Since conditions in the spring of 1977 were similar to those in 1976 an alternative method was sought which would control the native vegetation.

Many commercial no-till drills were evaluated and the Melroe 701 was chosen because of its availability, its design facilitated making the modifications necessary to control established vegetation by mechanical means. The 701 drill is equipped with straight rolling coulters followed by double disk furrow openers, and it designed so that the entire weight of the drill can be placed in the coulters, causing them to penetrate even frozen ground.

The first modification consisted of moving the rolling coulter forward and placing a 12 inch cultivator sweep mounted on a heavy shank of the double disk furrow openers. The double disk openers followed in the cut left by the coulter and sweep which were run at a depth of one and one half to two inches. At this depth the roots of existing vegetation were cut, without disturbing the surface of the soil.

Twenty five acres were interseeded with the 701 drill at the Dickinson Station the second week of May. Vegetation control obtained from using the weeps was very good throughout. Seventy five to 90 percent of the vegetation was killed within two to three days following treatment. Fifteen of the 25 acres were seeded to Russian wildrye at a rate of 15 pounds per acre. The remaining ten acres were seeded at the rate of four pounds per acre with Travois alfalfa. Because of the small size of the seed being used the furrow openers were run at a depth of about one-half to three fourths inch. At this depth the double disk openers failed to rotate evenly because of lack of contact with the sides of the furrows left by the sweep and shank, which caused the seed to be distributed unevenly. The wet weather in June resulted in good germination, and good but uneven stands resulted. Both pastures were grazed during the month of July with little sign of damage tot he seedlings. Visual inspection of the alfalfa showed the taller plants had been grazed but no permanent damage had been done.

1972 NEW ALFALFA TRIAL

The new alfalfa trial was seeded at the Dickinson Experiment Station in the spring of 1972. The trial consisted of twelve varieties of alfalfa seeded in 6 by 30 foot plots replicated four times. Included in the trial were newer released varieties of spreading type alfalfas as well as some of the older more established alfalfa varieties.

In 1973, 1974, and 1975 two cuttings were made on the alfalfa as adequate regrowth was present. However, in 1976 and 1977 only one cutting was made sue to the lack of sufficient regrowth (see table 1).

Production for all varieties in 1977 were below those of the previous years. This is caused by a combination of factors; extremely dry early spring conditions, low effective precipitation during the growing season, and the fact that alfalfa stands are growing old and losing their productivity.

The highest producing variety in 1977 was Vernal (1102 lbs) an older more established variety. The next highest producing variety was Drylander with 1032 lbs, Dorminar, and Scout had yields very close to Drylander, all between 1000 lbs and the 1032 lbs produced by Drylander. The remaining varieties produced under 100 lbs, ranging from a low of 787 lbs (Weevlchek) to 985 lbs (Ladak-65). All varieties were close with only 315 lbs separating the highest and lowest producing varieties (see table 1).

Three year averages for second cutting yields show Glacier to have the largest amount of regrowth with 1489 lbs per acre. ATN-224 (Titan) was a close second with 1417 lbs. Again all varieties performed similarly with Ladak-65 being the only second cutting. No second cutting was taken in 1976 and 1977 due to lack of regrowth.

Table 1. Production of varieties in the 1972 new alfalfa trial.

Variety	1977	1976	5-Yr. avg. 1st cutting	3-Yr. avg. 2nd cutting
	Dry weight yields in lbs/acre			
ATN-224 (Titan)	900	1404	2969	1417
Ladak	1021	1220	2803	1249
Drylander	1032	1254	2963	1044
Weevlchek	787	1083	2640	1163
Vernal	1102	1268	2918	1253
Spredor	839	1273	2627	1305
Ladak-65	985	1227	2719	825
Glacier	809	1196	2609	1489
Dorminar	1018	1121	2650	1230
Thor	774	1144	2608	1314
Scout	1013	1163	2755	1237
Saranoc	947	1336	2808	1314
Average	935	1224	2756	1237

1975 NEW ALFALFA TRIAL

The second alfalfa trial was established at the Dickinson Experiment Station in the spring of 1975 to test new varieties not included in the 1972 study. Ten varieties were included in the trial. Thor was included twice, once with the standard inoculant and once with a commercial seed treatment called inoculime. The plots were 12 by 27 feet and replicated four times.

Only one cutting was made in 1977 due to lack of regrowth. The 1977 production was considerably reduced, this being mainly due to an extremely dry early spring and low effective precipitation during the growing season (see table 2). Again Kane was the highest producing variety with 2208 lbs per acre. All other varieties were under one ton per acre yield. Next highest producing variety was SX-10 with 1620 lbs per acre. The lowest was Thor (noculimed) with 1055 lbs. Other varieties were intermediate ranging from 1173 lbs (G-777) to 1460 lbs (WL-310). Variability between highest and lowest producers was 1153 lbs.

A second cutting was made only in 1976 and again Kane was the highest producing of the varieties. G-777 and Thor (Inoculimed) were second and third respectively, with a production of 1641 and 1606 lbs per acre. The lowest was Spredor yielding 1031 lbs per acre.

When considering the two year average of the first cutting there appears to be little difference between the two inoculants used on Thor. Thor (noculized) yielder 134 lbs more than the noculimed plots, an amount not significantly different.

Table 2. Production of varieties in the 1975 new alfalfa trial.

Variety	1977	1976 1st	1976 2nd	2-Yr. avg. 1st cutting
	Dry weight yields in lbs/acre			
Enbro A-57	1411	2441	1347	1926
SX-10	1620	2573	1561	2096
Polar	1397	1764	1601	1580
Spredor	1389	2529	1031	1959
Thor (N. Liz.)	1354	2455	1353	1904
Kane	2208	3176	1772	2692
WL-310	1460	2750	1586	2105
Gladiator	1425	2647	1443	2036
G-777	1173	2426	1641	1799
Thor (N. Lim)	1055	2485	1606	1770
Valor	1182	3000	1538	2091
Average	1425	2568	1498	1996

PASTURE TYPE ALFALFA TRIAL

In the spring of 1972 twelve varieties of alfalfa, Emerald crownvetch, birdsfoot trefoil, and Latana civer milkvetch were seeded in 12 by 30 foot plots replicated four times.

Yields from plots in 1976 and 1277 were below 1975 and generally reflected the low spring precipitation (see table 3). In 1977 only four varieties produced over 1000 lbs per acre. The highest yielding variety was Semi-Palatinsk with 1175 lbs per acre; Travois was next highest with 1138 lbs production. Teton and Swift Current, synthetic variety Sc-Syn 3703L ranked 3rd and 4th with productions of 1068 and 1041 lbs per acre respectively. All other varieties produced under 1000 lbs per acre with production varying from 830 to 998 lbs per acre. Variability between the lowest and highest producing varieties was low (345 lbs). No second cutting was made in 1976 or 1977 because lack of regrowth.

In the 5-year average of the first cutting Swift Current synthetic variety Sc-Syn 37025 was the highest with 2715 lbs per acre. All other varieties were above 2000 lbs per acre for the 5-year average. In a 3-year average of the second cutting Roamer was highest (1656 lbs per acre) with all other varieties being very close in production (see table 3).

As of yet none of the varieties in the trial demonstrated a creeping habit. It is felt this will be unlikely to develop as long as the plots are clipped rather than grazed. To date both vigor and stand maintenance have been good considering the low spring moisture conditions that have prevailed for the last two years.

As in precious years the other legume species (Emerald crownvetch, birdsfoot treefoil, and Latana cicer milkvetch) did not produce enough forage to warrant harvesting.

Table 3. 1972 pasture type alfalfa production.

			1975		1974		1973		Average	
Variety	1977	1976	1st	2nd	1st	2nd	1st	2nd	5-yr 1st	3-yr 2nd
Drylander	830	1439	3292	2483	3569	446	3395	1596	2505	1508
Sc-Syn 3701L	878	1490	3001	2687	2912	483	3398	1532	2336	1567
Semi-Palat.	1175	1442	3435	2844	3204	514	2709	1545	2393	1634
Travois	1138	1378	3700	2796	2898	533	3474	1309	2517	1546
Sc-Syn 37045	870	1373	3727	2701	3042	593	3526	1440	2507	1578
Roamer	848	1390	3657	2702	3292	696	3685	1569	2575	1656
Sc-Syn 37025	920	1822	4037	2195	3348	728	3449	1737	2715	1553
Ladak	916	1774	3563	3088	2890	637	3418	1466	1512	1730
SCMF 3713	910	1369	3281	2235	3731	371	2620	1404	1382	1337
Teton	1068	1629	3692	2883	3018	589	3302	1398	2542	1623
Rambler	998	1505	3492	2671	3331	600	4156	1461	2696	1577
Sc-Syn 3703L	1041	1489	3670	2478	3180	671	3850	1541	2646	1563
Average	966	1508	3545	2647	3201	572	3415	1500	2527	1563
			6192		3773		4915			1572

GRASS ADAPTATION TRIAL

The grass adaptation trial seeded in 1972 was harvested for the fifth year in 1977. All varieties again showed a decrease in production when compared to the previous years yields. Mandan ricegrass and Indian ricegrass because of very poor stand establishment were not harvested during any years of the trial. In 1977 effects of two years of dry early spring weather showed up in stand vigor as some of the varieties in the 4 replications were not harvested because of very poor production (see table 2).

In 1977 alfalfa wildrye (SCS) was the highest producing variety with 2346 lbs per acre. However, in this particular variety only 1 out of 4 reps was considered worth harvesting. The second highest producer was Turkey brome with 2299 lbs per acre. Sodar wheatgrass was third highest with 1708 lbs per acre. Only two varieties (Altai wilrdrye-SCS and Turkey brome) produced over 1 ton er acre yield. Mandan wildrye, Topar Pubescent wheatgrass, Mandan 404 brome, and Vinall Russian wildrye produced under 1000 lbs per acre with respective yields of 797, 930, 987, and 998 lbs per acre. Variability between the lowest and highest producers was 1549 lbs. Montana wheatgrass was the only variety that did not show a decrease when compared to the 1976 yields. Sodar wheatgrass, Topar Pubescent wheatgrass, Dunar Hard fescue, and Sheep fescue showed smaller declines between 1976 and 1977 than other varieties. This may have been partially due to their extensive root system which may have been able to extract more moisture from the soil during this dry year, and to other drought resistant characteristics of the grasses.

Of those varieties that have been harvested for 5 years Pubescent wheatgrass #759 has the highest average of 3249 lbs per acre. Second is Lincoln brome with 2725 lbs -per acre. Turkey brome has the highest average production of any of the grasses (4128 lbs per acre). This is only a four year average since the stand was considered too poor the first year to harvest. In spite of this slow start this variety has shown excellent production for the last four years.

Both varieties of Basin wildrye and Altai wildrye appear to be declining in stand vigor and in most cases the plot is not worth harvesting.

Table 1. Production of grass varieties in the Grass Adaptation Trial seeded in 1972.

	Dry weight yield-lbs per acre									
					Averages					
	Rep 1	Rep 2	Rep 3	Rep 4	1977	1976	1975	1974	1973	5-yr avg
Turkey brome	1719	1869	3050	2557	2299	3181	5679	5355	N.H.	4128
Pubescent wheatgrass 759	1320	894	2421	1763	1599	2056	4999	4042	3551	3249
Lincoln brome	1001	1007	2051	1311	1342	1489	4280	5001	1512	2725
Topar Pubescent wheatgrass	661	1177	647	1236	930	1684	4237	3629	1646	2425
Mandan 404 brome	625	1184	855	1283	987	1384	3587	3772	1630	2272
Nordan crested	1333	823	795	1195	1036	1805	4176	2484	2199	2340
Lodorm green stipa	1082	1516	781	2047	1356	1781	3309	2418	N.H.	2216
Sodar wheatgrass	1140	1375	2315	2001	1708	1991	3692	3804	829	2405
Mandan wildrye	1071	625	N.H.	696	797	1384	2872	3927	1427	2081
Durar Hard fescue	1629	1509	1707	1929	1693	1983	2302	3794	1136	2182
Western wheatgrass 456	1098	873	1113	1524	1152	1352	3081	2689	1381	1931
Vinall Russian wildrye	689	1146	1064	1092	998	1449	2766	3891	471	1915
Montana wheatgrass	926	803	2216	1926	1468	1443	2724	3679	711	2003
Green stipa (SCS)	1154	N.H.	1120	1332	1202	1756	2700	1850	N.H.	1877
Sheep fescue	1628	1085	880	1735	1332	1756	2270	2246	N.H.	1901
Basin wildrye (SCS)	2099	1191	1240	N.H.	1510	3416	5286	N.H.	N.H.	3404
Basin wildrye (Pull.)	1619	N.H.	1608	N.H.	1613	3003	3706	N.H.	N.H.	2774
Altai wildrye (SCS)	2346	N.H.	N.H.	N.H.	2346	4258	N.H.	N.H.	2614	3302
Altai wildrye (Sask.)	N.H.	N.H.	N.H.	N.H.	N.H.	4412	N.H.	N.H.	1933	3172
Mandan ricegrass	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.
Indian ricegrass	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.	N.H.

N.H.-not harvested because of: (1) Lack of vegetation, (2) infestation of invading plants.

INTERSEEDING OF NATIVE MIXED PRAIRIE IN WESTERN NORTH DAKOTA

In the fall of 1969 a small plot interseeding trial was seeded at the Dickinson Experiment Station in southwestern North Dakota. The area used for the study was native mixed grass prairie dominated by western wheatgrass and green needlegrass on Morton fine sandy loam soils. Five species of grasses and five legumes were seeded in rows on 50 x 150 foot plots replicated three times. Species used in the trial were western wheatgrass, Russian wildrye, smooth bromegrass, Ladak, Vernal, Travois alfalfa, Eski sainfoin and Emerald crownvetch. In addition to the above species a check-plowed treatment was also included where the plots were treated with the machine but not seeded.

The plots were seeded with a two row machine which mounted on a standard farm tractor three point hitch. This machine used a lister blade to open and remove the sod from a 14 inch strip. The blade was followed by stationary seed tubes which deposited the seed. The seed was then covered and the seedbed firmed by a metal pack wheel. The seed boxes utilized a fluted seed metering wheel which handled all species satisfactorily. The rate of seedling, however, was difficult to control on the legumes with a heavier than normal rate being applied. The grasses were seeded at a rate of 15 pounds per acre and the legumes at eight pounds per acre.

All interseeded species germinated well in the spring of 1970 but a week of hot weather caused high mortality among some of the species. Western wheatgrass, Russian wildrye, Eski sainfoin, and Emerald crownvetch never recovered sufficiently to warrant further study.

Forage yields were taken by clipping nine frames 12 by 80 inches in each plot. The samples clipped from each frame were separated into grasses, forbs, and interseeded species. Percent composition of the individual species was estimated and the height of both the seed stalks and leaves of the grasses were measured. Total height measurements were taken for the forbs. Following harvest the samples were dried at 150° F and oven dried weights recorded.

The dry spring in 1977 had its effect on the interseeded native range as elsewhere. All plots in the trial produced less total production than the seven year average (1971-1977) (see table 1). The three grasses and the check plowed treatments also declined in production over the 1976 yields while the check and three alfalfa varieties increased. Production of the interseeded species in the crested wheatgrass, smooth brome, Ladak and Vernal alfalfa plots increased over the 1976 yields but declined on the green needlegrass, and Travois alfalfa. Table 2 shows the average forage yields for the seven years of the trial from 1971 to 197. The highest producing treatment, Travois alfalfa yielded 2975 pounds per acre,. All three of the alfalfa varieties produced significantly more total forage than any of the grasses. Smooth brome was the highest producing grass with 2394 pounds per acre. The crested wheatgrass as well as the check plowed treatments produced less than the untreated check.

Interseeding smooth brome stimulated the production of the mid grasses as much as Vernal and Ladak alfalfa and more than Travois. All interseeding treatments increased the production of mid grasses except crested wheatgrass.

The production of short grasses was significantly decreased by all the interseeding treatments including the check plowed.

Smooth brome, Travois, and Vernal alfalfa all had less potential forbs than did the check plots. Green stipa, crested wheatgrass, Travois, and the check plowed plots had significantly greater production from annual forbs than the other treatments or the check plots.

Table 3 gives the percent of yield increase or decrease compared to the check plowed plots. Travois alfalfa, the highest producing treatment, showed a 35% increase over the control plots. Vernal 31%, Lodak 28%, and smooth brome 9% were also significantly higher producers than the check.

Table 1. 1977 Range interseeding trial.

Treatment	Mid-grasses	Short grasses	Total grasses	Per. forbs	Ann. forbs	Total forbs	Inter-seeded spp.	Total yield
	Dry weight yields in lbs/acre							
Check	1107	481	1588	201	2	203	0	1791
Check plowed	1015	255	1270	167	51	218	210	1698
Crested wheatgrass	743	256	999	254	30	284	313	1596
Smooth brome	1281	126	1407	193	10	203	173	1783
Green needlegrass	1053	277	1330	284	71	355	102	1787
Travois alfalfa	1259	88	1347	156	55	211	967	2525
Vernal alfalfa	1259	167	1426	220	44	264	885	2575
Ladak alfalfa	1572	127	1699	137	34	171	701	2571

Table 2. 1971-1977 Range interseeding trial.

Treatment	Mid-grasses	Short grasses	Total grasses	Per. forbs	Ann. forbs	Total forbs	Inter-seeded spp.	Total yield
	Dry weight yields in lbs/acre							
Check	1120	802	1922	298	23	321	N.A.	2243
Check plowed	1228	425	1653	313	41	354	191	2198
Crested wheatgrass	1048	501	1549	344	54	398	231	2178
Smooth brome	1500	382	1882	244	24	268	244	2394
Green needlegrass	1279	468	1747	376	61	437	80	2264
Travois alfalfa	1338	207	1545	212	53	265	1165	2975
Vernal alfalfa	1438	403	1841	215	33	248	796	2885
Ladak alfalfa	1493	400	1893	274	31	305	609	2807

Table 3. 1971-1977 Range interseeding trial (% increase (+) or decrease (-) in yield in ralation to check-plowed).

Treatment	Mid-grasses	Short grasses	Total grasses	Per. forbs	Ann. forbs	Total forbs	Inter-seeded spp.	Total yield
	Dry weight yields in lbs/acre							
Check	-8.8	+88.7	-16.3	-4.8	-43.9	-9.3	N.A.	+2.0
Check plowed	1228	425	1653	313	41	354		2198
Crested wheatgrass	-14.6	+17.9	-6.3	+9.9	+31.7	+12.4	+20.9	-0.9
Smooth brome	+22.1	-10.1	+13.8	-22.0	-41.4	-24.3	+27.7	+8.9
Green needlegrass	+4.1	+10.1	+5.7	+20.1	+48.8	+23.4	-58.1	+3.0
Travois alfalfa	+8.9	-51.3	-6.5	-32.2	+29.2	-25.1	+509.9	+35.3
Vernal alfalfa	+17.1	-5.1	+11.4	-31.3	-19.5	-29.9	+316.7	+31.2
Ladak alfalfa	+21.9	-5.9	+14.5	-12.4	-24.4	-13.8	+218.6	+27.7

TECHNIQUES FOR INTERSEEDING NATIVE RANGE

Control of competition and seedbed preparation are the two most important factors in successfully interseeding native range. In 1977 a study undertaken to look at the methods and equipment which asre needed to accomplish these objectives.

A small plot study was set up in the spring of 1977 to evaluate the effectiveness of two non-selective herbicides on controlling competition on three interseeded species. Glyphosate and Paraquat were applied in bands over row-intersseded to Travois alfalfa, green needlegrass and Russian wildrye. Three band widths were used; 8, 12.5 and 14 inches over the Travois alfalfa in 42 inch rows, and 6, 8, and 12 inches over the grass species in 21 inch row spacing.

Glyphosate was applied at 2 lbs active ingredient (AI) per acre and paraquat at 0.5 lb AI per acre actual coverage on the bands sprayed.

Results of the treatment were poor with no significant difference between the untreated check and either herbicide treatment in any width. None of the three species seeded germinated until the fall. Seedling counts done in October did show some significant differences between the herbicide treatments. However, because of the late germination, the results of the data collected on the degree of control it is unlikely that there is any correlation between the number of seedlings and the herbicide applications.

Because of the unreliability and high cost of herbicide application an alternative method was sought which would give adequate sod control without the problems associated with old lister type interseeders.

Several new minimum tillage drill were reviewed for this portion of the study but none seemed to fill all our requirements. Since no commercial drill was available for this purpose we set out to modify an existing drill. The Melroe 701 drill was chosen for this modification work because its design facilitated the work we wanted to do and because it was available at the university. The 701 drill is designed so each row is seeded with a separate “seeding unit”. Each of these seeding units is mounted independently under the drill and can be easily removed. Each unit consists of a single straight coulter followed by a double disk furrow opener. These are mounted on a length of 2½ inch square steel tubing by means of U-bolts. When these bolts are removed the coulter and double disks can be removed or their position changed without interfering with any others on the drill.

Our first modification effort (unit 1) consisted of moving the coulter forward and mounting a support shank and 12 inch cultivator sweep in front of the double disks. The drill was set so the sweep would run 1½ to 2 inches below the soil surface severing the roots without disturbing the soil surface. Two pastures were seeded with unit 1 in the spring. One 10 acre pasture to Travois alfalfa and one 15 acre pasture to Russian wildrye. Sod control on both pastures was very good with 75 to 90 percent kill.

Uneven seed distribution resulted from the fact that double disk furrow openers ran in the furrow made by the sweep support shank and because of the lack of ground contact failed to turn evenly. This uneven rotation caused the seed to catch between the double disks resulting in the uneven seed distribution. In addition to this some of the seed fell to the bottom of the cut made by the sweep and was unable to emerge when it germinated.

In order to correct the problems of uneven seed distribution three more units were constructed in the fall. On the first of these (unit 2) the support shank was removed and placed on the unit on either side. Half sweeps were then mounted on each side so the sod control was achieved without the soil disturbance in the seeded row. The double disk assembly was also removed and a new one constructed using a seedling shoe from an old planet Jr. Grass feeder. This shoe formed a wider furrow and a firmer seedbed in which to place a the seed. The seedbed was firmed with an adjustable packwheel mounted behind the seeding assembly. On unit 3 the coulter was removed and replaced by a shank with two coulters attached 2½ inches apart. This was followed, as in unit 1, with a sweep and support shank. Following this was a seeding assembly similar to unit 2. The double coulters actually cut and removed a strip of sod 2¼ inches wide and 1 to 2 inches deep.

Unit 4 was constructed by moving the double disk assembly forward and placing the support shank and sweep behind it. A seeding assembly similar to the one on unit 2 was used except the shoe was modified by placing two pieces of 3 by 8 inch flat iron on each side. These “fins” were bent to help spread the sod to each side making a wider furrow.

A late fall seedling was done with each of the modified units plus the stock unit supplied with the drill. These evaluation plots were replicated four times and space was allowed for another test plots beside them for a spring seeding.

MINE SPOIL RECLAMATION PROJECT

The Dickinson Branch Station is cooperating with Dr. Warren C. Whitman and REAP in a project involving the selection and increase of perennial forbs for mine spoil reclamation in the Northern Great Plains. Because the field plantings are being made on spoil bank beds constructed on the Dickinson station a compete copy of the study plant written by Dr. Whitman is being included in this report, along with the planting plans for the 1977 plantings, to provide a permanent record of this project.

STUDY PLAN

Cooperative Agreement 16-608-CA

SELECTION AND INCREASE OF PERENNIAL FORBS FOR MINE SPOIL RECLAMATION IN THE NORTHERN GREAT PLAINS

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Date: November 8, 1976

STUDY PLAN

Cooperative Agreement 16-608-CA

SELECTION AND INCREASE OF PERENNIAL FORBS FOR MINE SPOIL RECLAMATION IN THE NORTHERN GREAT PLAINS

Problem Reference:

Plans for reclamation of strip-mined land may require that the native vegetation be restored for purposes of controlling erosion, enhancing wildlife values, increasing recreational opportunities or for fulfilling the needs of proposed land use plans. Some attention is being given in North Dakota to the restoration of mined land to a cover of native grasses, but little or no concern has been given to the restoration of the forb component of the ecosystem. Forbs are an integral part of the climax grassland of the northern Great Plains, usually making up over 10 percent of the total foliage production on vegetation types subjected to normal grazing usage. The grassland forbs are particularly important in terms of furnishing cover and food for game species, small mammals, game birds, and the non-game birds that rely on small seeds for an appreciable part of their diet.

Sources of forb seeds or forb plant material for use on mine spoils is very limited or even non-existent. The problems of the development of planting methods and site conditions conducive to the establishment of forbs on mine spoils have not been investigated in this area. The immediate and specific aspects of the problem with which this study is concerned are thus the collection of seeds of native forbs which may have usefulness in the reclamation of mined lands, the determination of

forb seeds from a wide variety of geographical sources in eastern United States and studied their germination requirements with respect to cold treatments. Many species were found to show better seed germination with cold treatment (stored outside during winter months), while a large number of species showed little or no stimulation from the cold treatment. Germination of a few species was definitely decreased as the result of the cold effects.

Blake (1935) collected seed of 27 forbs from native tall grass prairie in the vicinity of Lincoln, Nebraska. In germination trials with seed of these species she found that seeds of most prairie plants are subject to deep dormancy during the greater part of the year. The germination of seeds of most forbs kept in dry storage was below 15%, but stratification of seeds through the winter months resulted in marked improvement in germination for many of the forbs. Griswold (1936) working with the seed of 26 range forbs collected on the Wasatch Plateau in Utah concentrated on the effects of alternate wetting and drying on germination of seeds. She found the effects of wetting and drying treatments to vary with individual species. The time at which drying begins in relation to stage of development of the germinating seed was critical. Germination of only a few forb species was improved by the wetting-drying treatment.

Tolstead (1941) collected seed of native Nebraska sand hill plants. As the result of germination trials he found that some species would not germinate without low-temperature treatments. Another group of species germinated without this treatment, but germination was usually accelerated when the seeds were previously subjected to winter temperatures. Some

forbs were included in each of these groups. Wright (1967) from her studies with native plant seeds concluded that a 5 C treatment breaks the dormancy of most forb seeds.

Plummer, Christensen, and Monsen (1968) reported on their experience in seeding a variety of forbs for the restoration of big game ranges in Utah. They also suggested transplanting root sections, where satisfactory seed supplies could not be obtained. Mixtures including seeds of shrubs, forbs, and grasses were recommended for game range seeding. McDonough (1969) collected seeds of 9 perennial and one biennial forb from forb-grass and aspen types at elevations of 2300-3600 m in the Uinta and Dixie National Forests and grew seedlings under controlled alternating temperatures. Day temperatures were 20 C, but nighttime temperatures were alternated. Only two species showed significantly greater growth at the 15 C night temperature than at other temperatures. The other species showed no single optimum night temperature.

In another trial McDonough (1970) attempted to determine whether there are trends in germination adaptations, such as dormancy mechanisms or specialized temperature requirements for germination in forb and grass species from high-elevation ranges in Utah. Fifteen species of forbs were included in his trials, and he concluded that his germination tests showed that the severe climatic conditions of the high altitude ranges did not result in a greater incidence of seed dormancy nor in specialized temperature requirements for germination, as compared to the germination responses of species from lower elevations. Florez and McDonough (1974) in a detailed study of a single forb species, Rudbeckia occidentalis, found alternating temperature ranges with an 8-hour photoperiod to favor germination, as did cold temperature stratification for two months.

Hull (1973) seeded 37 species on mountain rangelands in Utah. While most of these were grasses and legumes, six species were range forbs. Seeding was by hand on terraced slopes with spring, early fall, and late fall seedings being made. Stand ratings were made on these seedings from three to five years after the seeding and again about 30 years later. Five of the six forbs showed fairly good stands at 3-5 years after seeding, but 30 years later both the forbs and the legumes were nearly gone from the seeded plots. In another trial on mountain rangelands, Hull (1973a) found that seedling emergence was generally good for grasses and forbs, but high seedling mortality resulted from summer drought, frost heaving in spring and fall, from other plant competition and from pocket gopher action. The legumes and forbs that showed promise were birdsfoot trefoil, crownvetch, birdvetch, alfalfa, and horsemint.

Hull (1974) found that range forb seeds stored for relatively long periods of time (23-41 years) lost their germinability. Of 21 lots of forb seeds stored for this period only Erodium cicutarium produced seedlings.

McDonough (1974) tested seed of trees, grasses, and 18 forb species collected from mountain ranges in 1928-31 at the Great Basin Experiment Station, Ephraim Canyon, Utah. Tests were made in 1972. Four forb species showed viability with the tetrazolium test, and low to intermediate germination percentages. Survival of seedling transplanted to the greenhouse was generally good.

Sorensen and Holden (1974) collected native forb seed from Sioux Prairie near Brookings, S. Dak. Of the 23 species tested, 69.5% germinated under normal conditions, 21.7% required moist-cold treatment,

4.4% required scarification, and 4.4% did not show germination. They found chemical induction of germination with gibberellic acid to be beneficial to only one species, downy gentian. Seed of prairie coneflower (Ratibida columnifera) required puncture of the membrane around the embryo before viability or germination would be exhibited.

This examination of the literature with respect to native forb seeds shows in general that most of the native grassland forbs can be expected to produce viable seed, although seed set may not always be satisfactory. Germination of the seed of most forbs will be benefitted by cold treatment. Most viable forb seeds can be expected to retain some of their viability for at least four to five years, although storage for longer periods of time does ot seem to be desirable. Special treatments to stimulate germination will be needed for only a few species, with scarification for the native legume seeds probably being the major required treatment. The survival of planted forb seedlings in the field apparently has been tested in only a few cases.

The use of containerized seedlings for transplants has been largely a development in forestry. Techniques used, problems, and relative degree of success with the practice have been extensively documented by Tinus, Stein, and Balmer (1974) in "Proceedings of the North American Containerized Forest Tree Seedling Symposium," Great Plains Agr. Coun. Publ. No. 68. Most of the work has been concerned with the use of containers for growing and transplanting tree seedlings. However, a limited amount of work has been done using containerzied seedlings of shrubs, forbs, and grasses for transplants in revegetation work on difficult soil areas.

Aldon (1970) has grown fourwing saltbush in containers for transplanting to mine spoils. He has also grown containerized seedlings of western wheatgrass for transplanting in similar disturbed situations (Aldon, Knipe, and Garcia, 1973). Ferguson and Monsen (1974) have used containerized seedlings of shrubs and forbs in attempts to revegetate deer winter range in Idaho. These authors believe that the use of containerized seedlings for revegetation of disturbed areas offers considerable promise, but the technique probably cannot overcome the influence of extremely adverse climatic or soil factors. In their field plantings fair success was obtained with the shrub species, and with one species of penstemon (Penstemon deustus). Only a few forb species were tried.

Davidson and Sowa (1974) used containerized tree seedlings for transplants on bituminous coal mine spoils in Pennsylvania. Spoil material here was acid sandstone. The principal trouble experienced was from frost heaving in the first winter following planting. No doubt other trials have been made with containerized seedlings on mine spoils, but the results have not yet appeared in readily available literature.

Techniques of growing containerized seedlings for use in the Northern Plains have been discussed by George (1974), Hite (1974), Tinus (1974), and the discussion of techniques by Ferguson and Monsen (1974) seems to have particular value relative to this study. The leaflet, "Native plants from greenhouse to mine spoils," SEAM (April 1975) illustrates the procedures used in growing containerized shrub seedlings. The techniques shown should be readily applicable to

growing forb seedlings in containers. The "book" type containers should be especially useful with forbs. Davidson and Sowa (1974) suggest that containers made from compressed peat have some advantages on mine spoils. The Walters bullet container appears to have some limitations for potential use with forbs (Ferguson and Monsen, 1974).

Objectives:

The immediate and specific objectives of this study are:

1. To prepare a list of perennial native forb species which can be reasonably expected to show some promise for use in the revegation of mined spoils.
2. To collect seed from these species during the summers of 1976 and 1977.
3. To determine the germinability, viability, storage, and pre-planting treatment needs of the forb seeds collected.
4. To determine the adaptability of the various forb species to establishment on mine spoil material using both greenhouse grown containerized seedlings and straight seeding procedures.
5. To record observations of growth rates and survival of seedlings as well as general condition and seed production of forb species established on mine spoils.

Methods:

Seed will be collected from about 25 perennial forb species growing in the native mixed grass prairie region of southwestern North Dakota. The species from which seed will be collected will be those which on the basis of past experience have shown reasonably good possibilities

for successful establishment on mine spoils. The species which seem most promising are those which are commonly found on rough broken slopes in the prairie area. A list of the species initially proposed for collection in the 1976 season is given in Table 1. The forb species from which seed actually will be collected, however, will depend on the type of growing season, seed production by the species, and relative abundance of the species in the vegetation of the area. Additional seed collections will be made in the 1977 season, and other species may be included in the selected list at that time.

Seed collections will be made by hand picking, since even under the best conditions the forb species generally occur more or less as single, scattered individuals. The collected seed will be threshed, cleaned by hand-screening and winnowing, and stored at room temperature until the beginning of the winter season.

Viability Tests: With native seeds of the kinds to be collected usually a portion of the seeds are not filled. In order to make sure that germination and viability tests are made on filled seeds the weed will be tested for fill by physically pinching the seeds by hand with a forceps or similar type of apparatus. Only seeds which have been checked for fill will be used in the viability and subsequent germination tests. Lots of 25 seeds of each species will be tested for viability using the tetrazolium test (8 hours soaking in 0.1% triphenyl tetrazolium chloride followed by scanning for development of carmine red staining of the embryo). Viability tests will be made at the beginning of the germination trials and every 3 months thereafter. At the present time very little is known as to how long the seeds of specific native forbs can be expected to remain viable.

Table 1. List of species to be collected in the 1976 season.

Common name	Scientific name
Yarrow	Achillea lanulosa
Butte marigold	Actinella acaulis
_____ _____	Artemisia caudata
White upland aster	Aster ptarmicoides
Long-leaved milkvetch	Astragalus ceramicus
Ground plum	Astragalus caryocarpus
Green milkvetch	Astragalus striatus
Bluebells	Campanula rotundifolia
Bastard toad-flax	Commandra pallida
Golden aster	Chrysopsis villosa
Purple coneflower	Echinacea angustifolia
Yellow wild buckwheat	Eriogonum flavum
Wild buckwheat	Eriogonum multiceps
Gaillardia	Gaillardia aristata
Wild licorice	Glycyrrhiza lepidota
Stiff sunflower	Helianthus rigidus
Blazing star	Liatris punctata
Lewis' wild flax	Linum lewisii
Evening star	Mentzelia decapetala
Narrow-leaved beardtongue	Penstemon angustifolius
White prairie clover	Petalostemum candidum
Purple prairie clover	Petalostemum purpureum
Indian breadroot	Psoralea esculenta
Prairie coneflower	Ratibida columnifera
Early goldenrod	Solidago missouriensis
Stiff goldenrod	Solidago rigida
Sea blite	Suaeda fruticosa
Golden pea	Thermopsis rhombifolia

Germination Tests: Germination tests of all species will be made monthly on triplicate lots of 50 seeds each in a seed germinator kept at a temperature of 21 C. The period for these germination trials will be from Dec. 1 to May 1. The forb seeds will be stored and treated in the following three ways: (a) Seeds stored in the dark at room temperature and moved directly to the germinator for testing; (b) Seeds stored in moist-cold conditions in the refrigerator at a temperature of 4 C. Seeds will be counted out, placed in moist filter paper in Petri dishes, and placed in the refrigerator for the entire storage period. Seed lots will be removed from the refrigerator to the germinator at 21 C at the scheduled intervals; (c) Seeds will be stored outside in dry cold under normal winter freezing conditions. The storage system now proposed is in glass bottles covered with sand or soil to maintain dark, cold conditions. Seed will be removed for the germination trials as needed.

Tests of germination of each lot of seeds will continue for 60 days. Seed will be considered to have germinated when the radicle has penetrated the seed coat. At the beginning of the germination period the seeds will be treated with a fungicide (Arasan). Legume seeds will be lightly scarified by rubbing with sandpaper. Seeds of species which do not germinate under the conditions of the trials will be given special attention with utilization of other methods of breaking seed dormancy.

Greenhouse Planting: Seeds of the different forb species will be planted in containers in the greenhouse beginning in early February. The seed used for these plantings will be the outdoor chilled seed. Four to five seeds will be placed in each container and after germination thinned

to two seedlings per container. The containers to be used will probably be of the "book" type or the compressed peat type such as Jiffy pots, or other containers fabricated from paper products. A mixture of peat moss and vermiculite moistened with nutrient solution will be used as the planting medium in the containers. Plantings will be made in sufficient quantity to secure at least 100 seedlings of each species.

Field Plantings: A mine spoil bank will be constructed at the Dickinson Experiment Station in southwestern North Dakota. Climatic conditions at the Dickinson Station are essentially similar to those found in the mined areas of the general region. For the construction of the spoil bank materials will be hauled in from the spoil piles at the American Indianhead Mine at Zap, North Dakota, about 60 miles from the Dickinson Station. A spoil pile about 1 - 1½ ft. deep will be constructed with these materials. Spoil materials that have been exposed for about one year will be used. The spoil pile will be of a size to accommodate the field plantings for the first year of the 2-year period outlined in the project. An additional pile will be constructed for the second year of the trial.

Field plantings of containerized forb seedlings will be made on the spoil piles in 3 replications. Plants will be placed 1 ft apart in rows 1 ft apart. Time of planting will be early to mid-May. Direct seedings of the forb species will be made on small plots in 3 replications. The proposed plot size is 5 ft x 5 ft; the proposed seeding rate about 3 lbs/acre. Plot sizes and seeding rates will be determined to some extent by the amount of seed available of the different species.

The principal data recorded for all field plantings will be success of establishment, growth rates of plants, survival of seedlings and established plants, and any disease or other special problems that may develop.

Presentation of Expected Results:

The expected results will be presented as informal progress reports from time-to-time, an annual progress report by June 30, 1977 and a final report by December 31, 1978. It is anticipated that a graduate thesis will be developed using the data obtained in the trials. Data which lend themselves to tabular records will be presented in both detailed and summary tables. This treatment would involve particularly the trials of seed germination, viability, and seedling survival and growth in the field from both the containerized plantings and the direct-seeding plots. Where applicable, normal statistical procedures will be used in interpreting and presenting the data. Greenhouse and field growth rates will be presented in graphical form in the final report.

Personnel Assignment, Time of Completion and Cost:

The personnel assignments and costs are indicated in the budget attached to the original project proposal. The major personnel requirements are for a graduate research assistant and for time-slip labor to work on the project during the summer months. The research assistant is budgeted for approximately 18 months for a total of $7,000, and time-slip labor (Technical assistants) is budgeted at $2,650 for the approximate 2½-year duration of the project. An allowance of $1,000 has been

made for clerical and typing assistance on the project. The University will contribute $1,500 for technical assistance, $950 for clerical assistance, $500 toward direct project expenses, and additional funds as salary of the principal investigator and indirect costs. A copy of the budget as agreed upon is attached to this study plan.

It is expected that the work outlined in the project can be completed in the time period designated in the proposal. It will not, however, be possible to determine the ultimate survival of the forb species planted on the spoil materials during the prescribed time limits of the project. Plants established in the summer of 1977 will have only two growing seasons, while plants established in the summer of 1978 will have only one growing season. It is now planned that observations of growth and survival of the planted forbs on the mine spoils will be observed for a period of two growing seasons beyond 1978. This additional period of observation should make possible a more adequate assessment of the survival potential of the selected forb species.

BUDGET

	Forest Service Costs	University contribution
A. Salaries and benefits		
Principal Investigator	—	$ 8,600
Research Assistants	$ 7,000	—
Technical Assistants	2,650	1,500
Clerical Assistants	1,000	950
Fringe Benefits (not included above)	640	1,658
B. Expendable Supplies, materials, etc.	1,600	500
C. Travel	2,100	—
D. Indirect Costs (Contribution of the University - 41.0% of salaries and wages)		8,897
TOTAL	$14,990	$22,105

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REAP STUDY - PLANTING WITH SEED 1977

1	Ratibida columnifera	2	Astragalus striatus
4	Echinacea angustifolia	3	Penstemon angustifolia (Vanvig)
5	Artemesia caudata	6	Glycyrriza lepidota
8	Gaillardia aristata	7	Petalostemum purpureum
9	Petalostemum candidum	10	Chrysopsis villosa
12	Erigonum multiceps	11	Liatris punctata
13	Gaillardia aristata	14	Penstemon angustifolius
16	Mentzelia decapetala	15	Liatris punctata
17	Astragalus striatus	18	Solidago rigidus
20	Campanula rotundifolia	19	Thermopsis rhombifolia
21	Solidago rigidus	22	Solidago missouriensis
24	Suaeda fruticosa	23	Petalostemum purpureum
25	Astragalus ceramicus	26	Petalostemum candidum
28	Aster ptarmicoides	27	Helianthus rigidus
29	Penstemon angustifolius	30	Mentzelia decapetala
32	Blank	31	Campanula rotundifolia
33	Echinacea angustifolia	34	Linum lewisii
36	Ratibida columnifera	35	Suaeda fruticosa
37	Petalostemum purpureum	38	Petalostemum purpureum
40	Astragalus ceramicus	39	Artemesia caudata
41	Blank	42	Penstemon angustifolius
44	Erigonum multiceps	43	Solidago missouriensis
45	Aster ptarmicoides	46	Helianthus rigidus
48	Glycyrrhiza lepidota	47	Thermopsis rhombifolia

Planting order: North to south. Plot 1 on northeast, plot 2 on northwest corners of west planting bed.

REAP STUDY - TRANSPLANTS 1977

1	See footnote 1/	2	See footnote 2/
4	Thermopsis rhombifolia	3	Petalostemum candidum
5	Campanula rotundifolia	6	Helianthus rigidus
8	Aster ptarmicoides	7	Glycyrriza lepidota
9	Ratibida columnifera	10	Solidago rigidus
12	Thermopsis rhombifolia	11	Liatris punctata
13	Helianthus rigidus	14	Ratibida columnifera
16	Liatris punctata	15	Aster ptarmicoides
17	Solidago rigidus	18	Ratibida columnifera
20	Aster ptarmicoides	19	Liatris punctata
21	Thermopsis rhombifolia	22	Blank

1/ Plot 1 - Row 1 Mentzelia decapetala, 12 seedlings
Row 2 Pentstemon angustifolius, 9 seedlings
Row 3 Petalostemam purpureum, 3 seedlings
Row 4 Erigonum multiceps, 2 seedlings

2/ Plot 2 - North half - Echinacea angustifolia, 17 seedlings
South half - Astragalus striatus, 7 seedlings

Planting order: North to south. Plot 1 on northeast, plot 2 on northwest corners of east planting bed.